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Kashkin, K. P.*

Ob izmenchivosti kul'tur fekal[?]go shchelo-
chsobrazovatelia pod vliianiem[?]tibiotikov.

[Variation in cultures of Alcaligenes faecalis
under the influence of antibiotics].

Akademiia Nauk Latviiskoi SSR. Institut Mikro-
biologii. Trudy, no. 5, p.47-[?] 1956. 448.39 R44

(In Russian)

The frequency and the regularities with which Alcaligenes variants "biochemically inert" in media of variegated [biochemical test] series [fermentation of various sugars, testing for reduction of methylene blue, effect on litmus milk, formation of indole and formation of H_2S] have been obtained in the process of experimental variation in microbes of the enteric-typhoid-dysenteric group (Kudlai, Pers, Lebedev, Kalina, Kondrat'eva, Proskuriakova, Rosenfel'd and others) have prompted us to undertake a study of the microbiology of the Alcaligenes faecalis bacillus.

The problem of the pathogenicity and toxicity of Bact. faecalis alcaligenes [Alcaligenes faecalis] is not by far fully investigated, regardless of the length of time that has elapsed since its discovery (Petrushki, 1889). Thus, Morozova seeded the culture of the indicated microbe taken from several patients with a clinical picture of typhoid; Petrushki succeeded in isolating Bacterium faecalis alcaligenes from a seeding of the contents of roseola typhosa [eruptions [?]]. A. A. Smorodintsev points out a considerable number of cases in which Bact. faecalis alcaligenes was seeded from the urine

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of pregnant pyelitis [patients]. In experiments in directed variation, D. G. Kudlai, F. F. Lebedev and others have often succeeded in obtaining variants identical with Bact. faecalis alcaligenes with respect to properties.

It appeared to us that a study of the characteristics that determine the fecal alkali producing bacillus, the establishment of similarity traits and, especially, of the differences between the alkali-producing variants and the typical representatives of Bact. faecalis alcaligenes were particularly interesting and necessary.

Considering the ever expanding use of various antibiotics in the therapy of enteric infections and the impairment of conditionally pathogenic and pathogenic microorganisms by antibiotics, we undertook a special investigation of the study of adaptive variation of the fecal alkali-producing bacillus [Alcaligenes] under the influence of antibiotic preparations.

Of the large amount of Bact. faecalis alcaligenes cultures at our disposal, typical museum strains obtained from the largest institutes of microbiology in the Soviet Union were specially selected for experimental purposes. The newly isolated, biochemically inert strains [Begin p.48] of Bact. faecalis alcaligenes we did not use in experiments because they could have been alkali-producing variants of other inhabitants of the intestines.

Our experiments were conducted with four strains of Bact. faecalis alcaligenes. Microscopically the strains no. 415 obtained from the Control Institute im. Tarasevich, and no. 4 obtained from the Kiev Microbiological Institute, UAN [Ukrainian Academy of Sciences], represented short, rough, actively motile, gram-negative bacilli.

Strain M obtained from the Moscow Medical Institute and strain K, from the museum of the Faculty of Microbiology, Leningrad GIDUV [State Postgraduate

Institute for Physicians] also proved to be gram-negative, small, adequately motile bacilli.

With respect to their cultural properties all of them, with the exception of strain no. 415, grew on a thick culture medium in the form of evenly convex, moist, smooth, mildly fluorescent, transparent colonies. Strain no. 415 produced a colony with a creeping growth and an uneven surface.

On liquid culture media experimental strains grew in the form of a surface film, frequently with a simultaneous formation of a clot at the bottom.

Biochemically they were studied in differential media of a variegated series composed of glucose, maltose, lactose, saccharose, levulose, arabinose, galactose, raffinose, xylose, mannite, sorbite, glycerin, esculin and salicin. The variegated [biochemical test] series included test tubes with methylene blue in milk, with peptone water for the detection of the formation of indole and hydrogen sulfide and litmus milk.

With the exception of no. 415 which produced a reduction of methylene blue in milk after 48 hours, all strains studied in a variegated series were inert and failed to produce any visible changes.

Serologically experimental strains were agglutinated with specific sera; non-specific reactions with other sera to microbes of the enteric-typhoid and dysenteric group we were unable to establish.

Data on the sensitivity of original strains to antibiotics and on their resistance to some antiseptics are presented below (see table 2).

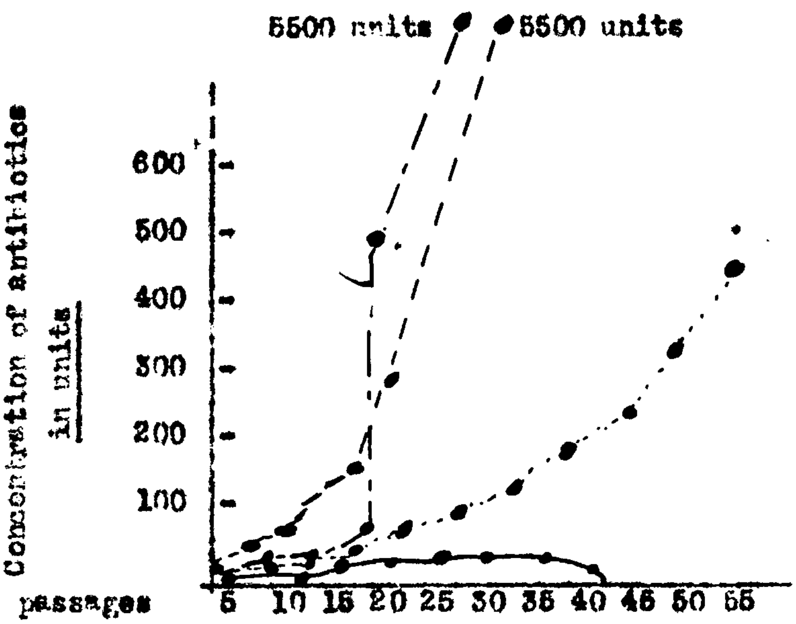
The antibiotics we dwelled on were streptomycin and syntomycin which are used widely in the therapy of enteric infections.

Special orientation experiments which we conducted have demonstrated that of all the methods used in a study of variation for adaptation to antibiotics, the most convenient one is the method employed at the Faculty of Microbiology, GIDUV [State Postgraduate Institut for Physicians], involving replating on solid culture media containing the corresponding antibiotics. This method enabled us to determine the exact dosage of antibiotics in the culture medium, to observe changes occurring in the dynamics of strains being adapted, and to isolate and study the developing variants. [Begin p.49].

The streptomycin used in the experiment was diluted in sterile, distilled water, and syntomycin by the indicated Khanen [or Hahnen (?)] method.

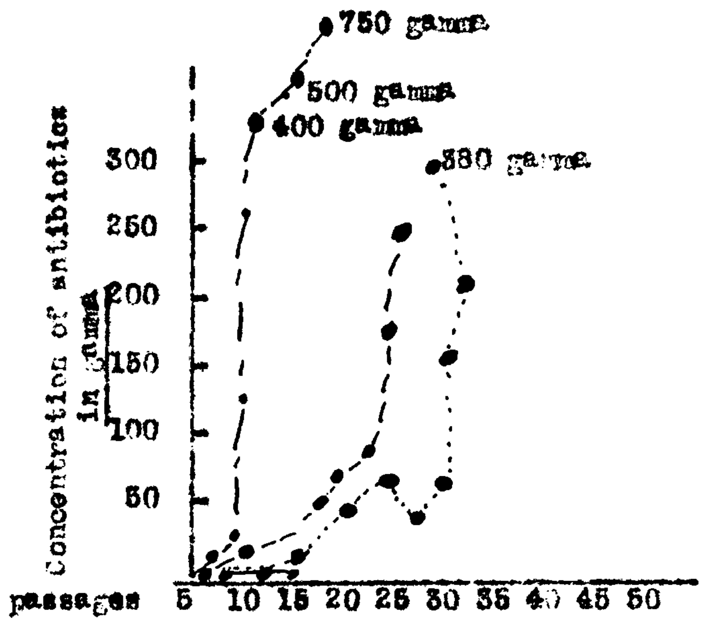
Within a year the experimental strains were led through 40-50 passages on media containing antibiotics, and were cultivated in an incubator for 72-96 hours.

The absence of growth after 24 hours of incubation was to some degree or other characteristic of all adapted strains.



Legend ..•.. = No. K; -•- = No. M; -.o-. = No.415; -•- = No. 4;

Fig. 1. Curves of adaptation to streptomycin on a solid culture medium.



Legend ..•.. = No. K; -•- = No. M; -.•-. = No.415; -•- = No.4;

Fig. 2. Curves of adaptation to syntomycin on a solid culture medium.

Adaptation to streptomycin proceeded considerably more rapidly than to syntomycin (fig. 1). Strains no. 415 and M adapted themselves more readily and more rapidly. Strain no. 4 was entirely unadaptable. After numerous replication attempts at adaptation, it died even from a continuous, low streptomycin concentration in the culture medium.

Adaptation to syntomycin (fig. 2) proceeded slowly; here we increased the concentration of the antibiotic in the culture medium slowly and gradually. Despite the care which we exercised in the process of adaptation, we often had to return to the original antibiotic concentration, or to begin adaptation anew.

Strain no. 415 was adapted to syntomycin more readily than other strains. The adaptation curve of strain K to syntomycin was the most interesting one, because it showed in the course of adaptation [Begin p.50] a sharp drop in resistance to the adaptive antibiotic, and then a rapid upward rise. This drop corresponds to the biological reconstruction of strain K which has expressed itself in the capacity of the strain adapted to syntomycin to produce a yellow pigment.

The viability of this pigmented variant with respect to antibiotics and antiseptics surpasses sharply the viability in the original [strain].

Comparative data on the sensitivity of original and adapted strains (fig. 3) to antibiotics permits noting that the highest resistance indicators are found in the strains adapted to streptomycin (a maximum of 10,000 ic in strain M); the degree of indicators produced by adaptation to syntomycin is less (the maximum in the pigment-producing K strain is 1250).

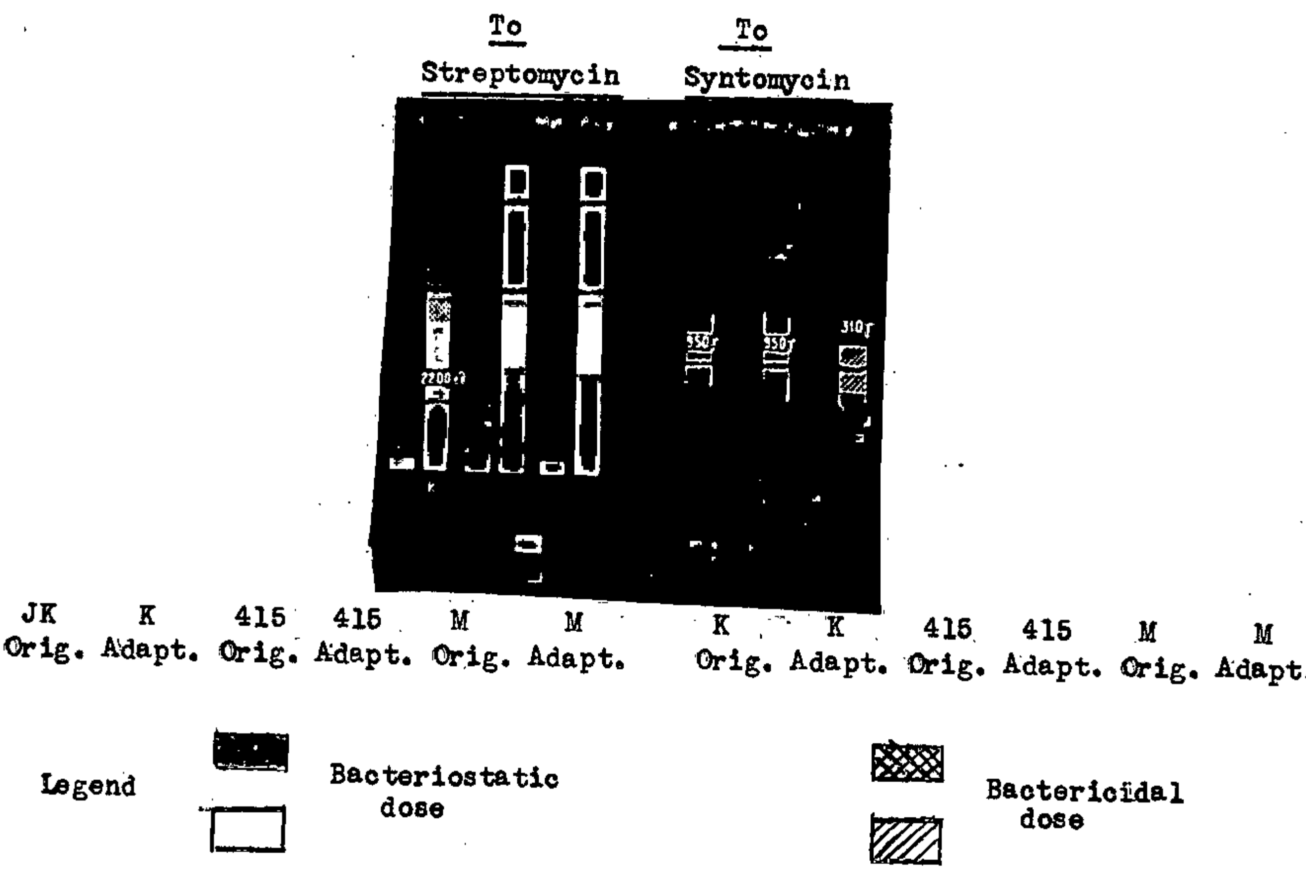


Fig. 3. Sensitivity of original and adapted strains.

In the process of adaptation of experimental strains changes occurred in their cultural and microscopic characteristics, biochemical activity, viability and serological properties. [Begin p.51].

The variants which we obtained with different properties can be subdivided into several groups.

1. Small, rough colonies, firmly grown together with the culture medium.

2. Small, entirely transparent dwarf colonies with a uniformly convex surface.

3. Two-zone, uneven colonies, bulging at the center and with a rampart-shaped periphery.

4. Round, slimy, viscous colonies.

5. Yellow colored, moist and slimy colonies.

At various stages of adaptation the formation of daughter colonies appeared to be a regularity. The variants listed were obtained also from strain no. 415 the initial culture of which produces colonies with a creeping growth.

The earliest changes noted in the course of adaptation were microscopic characteristics. They were expressed in the appearance of winding, drawn-out, giant, granular, spirally twisted and other forms of cells. Changes occurring in the form of the microbe cell are more characteristic of all strains adapted to streptomycin. Cells in preparations stained with Gram's stain appeared to be pale, mildly rose-colored, with violet granules arranged at the ends.

In the process of further adaptation the preponderant form, and later the only form of microbe cells became the coccobacterial one with a polar, violet granularity with Gram's stain.

In the course of adaptation to syntomycin a capsular variant was obtained from strain K that grew on a solid culture media in the form of round, ductile, slimy colonies. Such changes occurring in the form of a microbe cell, heretofore considered as degenerative, are now explained as a process of variation occurring under the influence of an unfavorable habitat (Kirkhenshtein [or Kirchenstein] and others).

The biochemical properties of experimental strains were tested in the course of adaptation after every 5 passages in an analytical variegated series [v rasvernutom pestrom riadu] the ingredients of which are listed above. The changes that occurred in the variegated series were extremely insignificant; thus in all strains adapted to syntomycin was detected a capacity to reduce methylene blue in milk after 48 hours. This uniformity of growth in different variants on media of a variegated series induced us to initiate special quantitative investigations of the assimilation of sugars. A quantitative characterization carried out by Bertran's method of the assimilation of carbohydrates in original strains and in strains adapted to antibiotics, and also in some alkali-producing strains of other microorganisms, has demonstrated that these cultures do not assimilate carbohydrates and that their quantity remains unchanged in the medium. [Begin p.52].

A special series of experiments was conducted with original and adapted strains for the purpose of making a study of their assimilation of the different aminoacids: valine, alanine, lysine, beta-phenylalanine, leucine, glycine, cystine, a-aminobutyric acid, glutaminic acid and asparagine.

The assimilation of aminoacids was tested on a special synthetic medium in which some or other of the indicated aminoacids were included as the only source of nitrogenous nutrition.

Our investigations have demonstrated that the fecal alkali-producing bacillus does not assimilate glycine or leucine; glutaminic acid is assimilated only by strains adapted to streptomycin.

Of all experimental strains, strain K which produces growth only on media with a-aminobutyric acid and cystine assimilates the smallest quantity of aminoacids. On a medium containing cystine the variant of strain K adapted to syntomycin produces one and a half times more intensive growth than the original [strain].

Apart from the general non-assimilable aminoacids, strain M does not grow on a medium with valine and beta-phenylalanine. Strains adapted to antibiotics grow more intensively on a medium with asparagine: a strain adapted to streptomycin grows 1.25 times [more intensively] and to syntomycin 1.5 times. The largest amount of aminoacids is assimilated by strain no. 415. Its variant adapted to streptomycin produces 2.2 times more intensive growth and the one adapted to syntomycin 1.5 times more intensive growth on a medium with beta-phenylalanine.

Investigation of the assimilation of aminoacids by alkali-producing variants has shown that some of them are characterized by a capacity to assimilate the same aminoacids as Bact. faecalis alcaligenes.

As regards their nitrogen metabolism some alkali-producing variants, obtained experimentally in variation of microbes of the enteric-typhoid group, come close to the typical representatives of Bact. faecalis alcaligenes.

A study of dehydrase and catalase activity and of desoxyribonucleic acid of original and adapted strains was made in collaboration with A. M. Bezborodov and V. P. Ismshchikov. It proved that the amount of desoxyribonucleic acid increases in strains adapted to syntomycin and decreases in strains adapted to streptomycin.

Regularities as to the fact concerning catalase and dehydrase activity we were unable to obtain.

Serological properties of experimental strains and variants were studied in cross reaction in agglutination (Table 1). Syntomycin brings about more thorough changes in the antigenic apparatus. Strains adapted to this antibiotic have lost the capacity to produce agglutination reaction with a serum to the original strain. The original strains in turn did not agglutinate with sera against strains adapted to syntomycin. Changes in the antigenic structure less sharp were discovered in strains adapted to streptomycin. These strains acquired the capacity [Begin p.55] to produce non-specific agglutination reactions in low dilutions with some dysenteric and paratyphoid antisera. In these variants has been noted a marked decrease in the titer in agglutination reaction with sera against original strains.

A study was made of the viability of original and adapted strains with respect to some antibiotics and antiseptics (tables 2 and 3).

Table 1.

Agglutination reaction of original and adapted strains

Serum	Strains								
	K orig.	K strep.	K synt.	415 Orig.	415 strep.	415 synt.	M Orig.	M strep.	M synt.
No. K orig.	1:6400	1:100	-	-	-	-	-	1:50	-
K synt.	-	-	1:1600	-	?	1:100	-	-	1:100
No.415 orig.	-	-	-	1:6400	1:800	-	-	-	-
" strep.	-	-	-	1:800	1:1600	1:1600	1:50	1:50	1:50
No. M orig.	-	-	-	-	-	1:100	1:3200	1:400	1:50
" strep.	1:100	-	-	1:50	1:50	-	1:800	1:6400	1:3200
" synt.	-	-	-	1:100	-	-	1:100	1:800	1:6400
Bfa No. 4	-	-	1:200	-	-	1:400	-	-	-
Paratyphoid B	-	-	-	-	1:100	-	-	-	-
Schmitz-Shtutser [or Stutzer]	-	-	1:100	-	-	-	-	-	-
Grigor'ev-Shiga	-	-	-	-	1:200	-	-	-	-

Note. Agglutination reaction with typhoid, paratyphoid B, and dysenteric (Kruse-Sonne, Newcastle, Flexner) sera is negative.

Table 2.

Sensitivity of original and adapted cultures to antibiotics

Strains	Streptomycin (in units)		Syntomycin (in gamma)		Levomycetin (in gamma)		Biomycin (in gamma)		Ecmoline	
	BST*	BCD**	BST	BCD	BST	BCD	BST	BCD	BST	BCD
K orig.	3.0	6.0	0.5	1.0	0.35	0.7	12.5	25.0	1:800	1:320
K adapt. to synt.	62.5	125.0	950	1250	125	250	40.0	50.0	1:40 T.	1:20 T.
K adapt. to strept.	2200	3125	0.5	1.0	0.35	0.7	12.5	25.0	1:20 T.	1:10 T.
415 orig.	15.0	30.0	15.0	30.0	6.0	12.0	50.0	100.0	1:40	-
415 adapt. to synt.	62.5	125.0	950	1250	250	500	100.0	200.0	1:160	1:80
415 adapt. to strept.	> 50 T.	> 50 T.	3.1	6.2	1.5	3.0	12.5	25.0	1:160	1:80
M orig.	4.0	8.0	7.5	15.0	3.5	7.0	25.0	50.0	1:200	1:100
M adapt. to synt.	15.6	31.2	250	310	15.0	30.0	50.0	100.0	1:2500	1:1250
M adapt. to strept.	> 50 T.	> 50 T	3.1	6.2	1.5	3.0	12.5	25.0	1:2500	1:1250

[*Bacteriostatic. **Bactericidal].

Strains adapted to syntomycin, as compared to original strains, possess considerably more resistance to many non-specific antibiotics. [Begin p.54]. The pigment-forming variant of strain K adapted to syntomycin increased resistance to streptomycin 20.7 times, to biomycin 3.2 times and to levomycetin 355 times. Conversely, strains adapted to streptomycin display either a decreased resistance to some antibiotics, or remain unchanged. Thus, strain no. 415 adapted to streptomycin decreased its resistance to syntomycin 5 times, to levomycetin 4 times, and to biomycin 4 times.

Table 3.

Resistance of original and adapted cultures to antiseptics

Strains	Chloramine 0.125%	Phenol 0.125%	$CuSO_4$ 0.25%	Rivanol 0.1%	HCl 0.25%	Formalin 0.25%	KOH 0.25%	$KMnO_4$ 0.05%
K orig.	5'	30'	5'	20'	60'	5'	5'	20'
K strept.	5'	20'	5'	5'	10'	5'	5'	5'
K synt.	10'	60'	60'	60'	60'	60'	30'	60' yellow variant
415 orig.	5'	30'	10'	20'	20'	10'	5'	10'
415 strept.	5'	60'	20'	60'	10'	60'	20'	20'
415 synt.	10'	60'	20'	60'	10'	20'	5'	20'
M orig.	5'	20'	5'	10'	10'	5'	10'	5'
M strept.	3'	60'	5'	10'	3'	5'	5'	5'
M synt.	3'	60'	5'	20'	3'	5'	5'	5'

In testing sensitivity to antiseptics, the concentration of the antiseptic and the time in which its action was exerted were taken into account. Our investigations have demonstrated that strains adapted to syntomycin tolerate a more prolonged action exerted by ordinary antiseptics, or a short-term action exerted by more concentrated solutions of a whole series of antiseptics.

The pigment-forming variant of strain K resistant to syntomycin survives the action exerted by potassium hydroxide (0.25%), copper sulfate (0.125%), formalin (0.25%) one hour, while the original strain is killed by it after 5 minutes. We were unable to establish such clearly pronounced changes in strains adapted to streptomycin.

CONCLUSIONS

On the basis of investigations conducted on adaptive variation of Bact. faecalis alcaligenes occurring under the influence of antibiotics it is possible to draw the following conclusions.

1. The fecal alkali-producing bacillus [Alcaligenes], its variants adapted to antibiotics and the alkali-producing variants of some other intestinal microorganism do not, according to quantitative investigations conducted by the Bertran method, assimilate carbohydrates in media of a variegated [Biochemical test] series.

2. The cultural and microscopic characteristics, biochemical activity, viability and serological properties change in Bact. faecalis alcaligenes under the influence of antibiotics.

3. Adaptation to syntomycin proceeds more slowly than to streptomycin; changes brought about by this antibiotic are more thoroughgoing.

4. The yellow variant obtained in the course of adaptation to syntomycin is distinguished from the original strain by its increased resistance to antibiotics and antiseptics.

Trans. A-967
(In full)
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Kosikov, K. V.

Otdalennaia gibridizatsiia drozhzhei. III. Poluchenie gibridov mezhdu Saccharomyces Cerevisiae (XII rasa) i Schizosaccharomyces Pombe putem kopuliatsii prorastaiushchikh spor.

[Distant hybridization of yeasts. III. The obtaining of hybrids between Saccharomyces cerevisiae (XII race) and Schizosaccharomyces pombe by means of copulation of the germinating spores]

Mikrobiologiia, vol. 25, no. 5. p.533-536.
Sept./Oct. 1956. 448.3 M582.

(In Russian)

In cases of hybridization of Sacch. cerevisiae and Schizosacch. Pombe, described by us, it was shown [1,2] that hybrid forms were obtained after deviations from the usual, natural to the given species, process of copulation of cells or spores; they were typical for one of the components of crossbreeding (in the given case Sacch. cerevisiae); yet in these forms at the same time, although irregularly, there appeared certain peculiarities characteristic also of the other component of crossbreeding. An assumption was expressed that in the above cited cases of hybridization no fusion of nuclei occurred. Nevertheless, this supposition could be considered more probable if one succeeded in obtaining a hybrid in which the features and characteristics of initial forms would combine to a greater degree and it would differ more considerably from the initial parent forms; this would then furnish the grounds for presuming the fusion of nuclei during its formation.

It is possible to assume that one could obtain such a hybrid only when: first, both initial forms would be in a haploid phase of development at the moment of crossbreeding, and, secondly, copulation would proceed with the formation of copulation offshoots, as it takes place during the usual sexual process of the given species.

During examination of old mixed cultures of Sacch. cerevisiae (XII race) and Schizosacch. Pombe, which were cultured on wort agar, a small number of asci with spores was detected. These asci, basically, were typical of the XII race, yet some of them deviated in their form from those characteristic for the XII race. With the aid of a micromanipulator eight asci with 2-3 spores were transferred to microdrops of nutrient medium. It was supposed that among these asci there might be some of a hybrid origin.

As long as hybrid cells in the mixed culture could have been formed only through the copulation of haploid cells of Schizosacch. Pombe with diploid cells of the XII race, one had to expect the formation of asci with spores from such cells without a preliminary fusion of nuclei. And this, in its turn, could lead to the fact that in spite of the remoteness of copulating cells, the spores in such ascus could be fully viable. At the same time, in so far as the fusion and interchange with plasma would take place, these spores, which contained the nuclei of Schizosacch. Pombe could acquire a capacity for copulating during germination in consequence of the influence of the plasma of the XII race. In such a case germination and copulation of spores of the hy rid ascus could lead to the formation of a hybrid diploid cell (zygote) with a following fusion of nuclei. Multiplication of such a hybrid zygote would lead to the formation of hybrid diploid cells.

The majority of spores, which were in the isolated asci, germinated, forming diploid and haploid cells, characteristic for the XII race. In one microdrop there was an ascus with two spores. These spores germinated simultaneously and copulated, having formed a zygote. From the zygote cells were formed, [Begin p.534] which in outer form were like cells of Schizosacch. Pombe, but they multiplied by budding, which is characteristic of XII race cells. In one of the original cells a clearly expressed wall was formed, characteristic of the dividing cells of Schizosacch. Pombe (figure 1) (1). In figure 2 are represented, for comparison, cells of the initial culture of Sacch. cerevisiae, in figure 3 - cells of the initial culture of Schizosacch. Pombe.

Further examinations of the culture, obtained from the specified cells (culture was denoted as 69), have shown that features, characteristic of it, were retained in the following generations. Cells of culture 69 are represented in figures 2-8. The form deviating from the initial species and dimensions of cells, in some cases clearly expressed side offshoots of micellar type, the presence of walls, together with budding; all this does not leave any doubts, that these cells are hybrid.

Title of figure 1. Sporulated spores have copulated, forming hybrid cells, which multiply by budding. In the first elongated cell a wall is seen.

Title of figure 2. Cells of the initial species Saccharomyces cerevisiae (multiply by budding).

(1) In figure 1, 4 and 5 walls are indicated by arrows.

Title of figure 3. Cells of the initial species *Schizosaccharomyces Pombe* (multiply by fission).

Title of figures 4-8. Hybrid cells; in some of them there is a side offshoot of a micellar type. Along with budding, some cells have walls.

It was interesting to find out, if spores would form in the culture of hybrid 69. Seeding of hybrid cells in an appropriate medium has shown that spores are formed, and the form of asci and the disposition in them of spores varies to a great degree (figures 9 and 10). Experiments were set up for the sporulation of hybrid spores. For this purpose, with the aid of a micromanipulator 65 asci with 108 spores were isolated to microdrops of culture medium (beer wort). Some of the spores germinated and began to form cells, but the growth stopped shortly and the cells died. As a result we did not succeed in obtaining a single viable culture.

The cause of the cessation of growth, as it was possible to judge from the outward appearance of the sporulating spores, consisted of the inability of the formed cells and of the micellar type of offshoots to bud off to the very end. These disturbances in development and multiplication must be explained by great physiological differences of the initial forms. In figures 11-14 are represented the sporulated spores respectively of one, two, three and four-spored asci. After sporulation of the two-spored ascus a clear segregation of the hybrid was uncovered. One spore formed cells of a round form, resembling haploid cells of the XII race, the other spore formed an elongated cell with a wall at the place of budding (figure 12). In all cases the sporulating spores of the hybrid formed atypical, and in some cases misshapen, cells. (Text is continued after description of figures).

Title of figures 9-10. Spores have formed in some of the cells (asci)

Title of figure 11. One-spored hybrid ascus sporulated, having formed branching cells of micellar type. Multiplication stopped there.

Title of figure 12. Two-spored hybrid ascus. Both spores germinated. One formed round, small spores, the other elongated. Multiplication stopped there.

Title of figure 13. Three-spored hybrid ascus. The spores germinated, having formed undivided cells. Multiplication then stopped.

Title of figure 14. Four-spored hybrid ascus. Spores germinated, forming round and elongated cells.

Title of figure 16. Colonies of hybrid on wort agar. They changed from smooth to rough.

It is necessary to point out, that under conditions of laboratory cultivation on wort agar the hybrid showed a variability in the form of colonies. And as a result rough colonies were formed from smooth ones (figure 16). Besides this, in old cultures on wort agar secondary colonies began to appear; their cells deviated from the initial by a greater capacity to use malt wort.

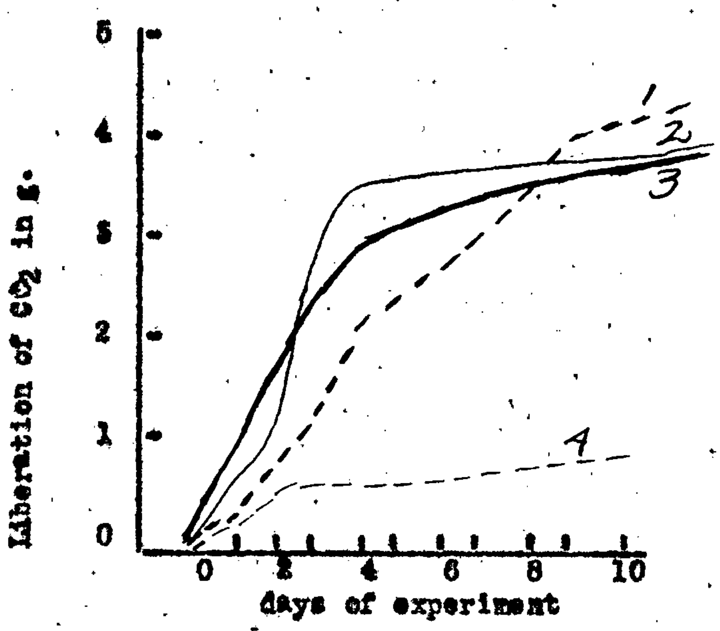
Interesting and somewhat unexpected data were obtained when testing the hybrid in its ability to ferment sugar. Both initial forms fermented glucose, saccharose, maltose and simple dextrins of beer wort; the XII race, besides this, fermented galactose. Hybrid 69 fermented glucose, galactose and saccharose, but it did not at all ferment maltose and simple dextrins of beer wort. Consequently, the capacity to ferment galactose, obtained from the XII race, dominated in the hybrid, but the unification of capacities in the hybrid to ferment maltose and the simple dextrins of beer wort, which were present in both initial forms, lead to a full suppression of this function. After reseeding to wort agar under usual conditions (at 20-26°) this property is stably inherited. The cultures of the hybrid, obtained from secondary colonies (of such cultures there were 14), also did not ferment maltose and simple dextrins of beer wort.

It was decided to influence the hybrid with high and low temperature [Begin p.535] in order to change its characteristics, to try and obtain forms which would be capable of fermenting maltose and simple dextrins of the beer wort. After cultivating the hybrid in the incubator at 40° (re-seeding every 10 days) during the course of six months a form was obtained which fermented both the maltose and the simple dextrins of beer wort. Cells of this form multiplied by budding and resembled the cells of the XII race very much in their morphological features.

It is quite possible, that here we have a case of segregation of the hybrid under the influence of high temperature, and this segregation occurred, apparently, after the somatic multiplication of cells. Cultivation of hybrid 69 at a lowered temperature (2-4°) during this same period did not change its fermentative properties.

In figure 16 are represented the curves of fermenting beer wort by initial forms, hybrid 69 and the new form 69 T, which was obtained under the influence of increased temperature.

Analysis of obtained experimental data, when studying hybrid 69, gave a reason to think, that at its formation, as it was supposed, occurred not only the uniting of plasma elements, but also the fusion of nuclei, which then led to deep and stable changes of both the morphological and physiological properties of hybrids. In particular, the suppression of functions in the hybrid to ferment maltose and simple dextrins of beer wort bear witness to the fact that the mechanism of formation of appropriate fermentative systems in the initial species was so different that mutual assimilation processes of the united components of the XII race and Schizosacch. Pombe led to a disturbance of both systems in the hybrid.



Title of figure 16. Curves of fermentation of beer wort by initial species of Sacch. cerevisiae (XII race) and Schizosacch. Pombe and hybrids 69 and 69 T. 1 - Schizosacch. Pombe; 2 - 69; 3 - XII race; 4 - 69.

Such a type of hybridisation, after distant crossbreedings, must be called a full hybridisation in distinction to the previously described by us [1, 2] partial or incomplete, when a joining of plasma elements occurred, but this union was not accompanied by the fusion of nuclei.

CONCLUSIONS

1. The two-spored ascus, isolated from a mixed culture of Saccharomyces cerevisiae (XII race) and Schizosaccharomyces Pombe, formed cells as a result of sporulation and copulation of spores; these cells, in their outward appearance, somewhat resembled those of Schizosacch. Pombe, but they multiplied by budding like Sacch. cerevisiae. In some of the cells appeared clearly expressed walls, as well as side branching of a micellar type. From the 108 isolated spores of the obtained culture not one formed viable cells. All this testified that in the given case a hybrid was formed between Sacch. cerevisiae and Schizosacch. Pombe.

A supposition was expressed that copulation of haploid cells of Schisosacch. Pombe with diploid cells of Sacch. cerevisiae preceded the formation of hybrid; it was not followed by fusion of nuclei of these cells. After this the spores were formed in the zygote, sporulation and copulation of which led then to the formation of the hybrid.

2. During testing of hybrid for its capacity to ferment carbohydrates it was [Begin p.536] detected that it did not ferment maltose and simple dextrins of the malt wort although both initial forms fermented these carbohydrates well. This attested to the essential difference of the existing fermentative systems of the initial species.

After prolonged cultivation of the hybrid under conditions of increased temperature (40°) a form was obtained which fermented maltose and simple dextrins of the malt wort approximately to the same degree as the Sacch. cerevisiae (XII race). The cells of this form did not essentially differ in morphological features from those of the XII race, which could be explained by the segregation of the hybrid during the process of vegetative multiplication of its cells.

3. The obtained experimental data and observations during studies of the hybrid gave reason to assume that during its formation occurred not only the joining of plasma, but also the fusion of nuclei, which then led to deep and stable changes, both of morphological and physiological features of the hybrid.

This type of hybridization, after distant crossbreedings, should be called full hybridization in contrast to the previously described by us partial, or incomplete, when a joining of the elements of plasma occurred, but this union was not accompanied by a fusion of nuclei.

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Kasatkina, I. D.

Ob izmenchivosti Bac. Mesentericus.

[On the variability of Bac. mesentericus].

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Mar./Apr. 1956. 448.3 M582.

(In Russian)

At the present time there is noted an increased interest in studies of the fermentative activity of various microorganisms. A great variety of enzymes in Bac. mesentericus makes it possible to utilize this organism for obtaining various enzymatic preparations. The amylolytic enzyme preparation "Rapidase", which was obtained with the aid of Bac. mesentericus cultures was utilized in beer brewing [7]. The variability of this organism in the process of its culturing was not usually taken into consideration during studies of fermentative properties of Bac. mesentericus (Popova and Pushkova [7] and Proskuriakov and Dobina [8]). Numerous literary data [4, 5, 6, 9, 10] show that Bac. mesentericus changed under laboratory conditions of culturing and formed colonies differing in morphology, while about the physiology of these variants very little is known yet. Only separate hints are met that variants of Bac. mesentericus are not identical in their biochemical properties. Vasilenko [1, 2] has observed that the wrinkled forms of Bac. mesentericus produced an antagonistic action on bacteria of the intestinal group, whereas the smooth variants, originating from them, did not depress, but stimulated development of these bacteria.

In a previously published work (Imshenetskii and Kasatkina [3]) comparative data were cited about the fermentative activity of Bac. mesenterious variants. The conducted research has shown that the amylolytic and proteolytic activity of the cultural liquid in wrinkled forms of Bac. mesenterious is considerably higher, than in smooth variants. This urged us to study, together with enzymatic properties of Bac. mesenterious variants, their morphological and cultural properties, as well as to find out the conditions which cause the variability of this organism.

The knowledge of these properties is important during selection of Bac. mesenterious variants which possess more active hydrolytic enzymes. Results of this research comprises the contents of the present article.

Methods.

Two cultures of Bac. mesenterious, isolated from the soil, and two smooth variants, which arose after the variability of the first ones during the process of their prolonged laboratory cultivation were experimented with. Culture no. 1 was isolated from sierozem (gray desert soil); from it, by means of repeated seedings and selection of the most typical colonies, was developed a wrinkled variant 2 b, which was characteristic for the wrinkled forms of Bac. mesenterious commonly met in nature, and variant 3 a, forming smooth slimy colonies. The second examined culture of Bac. mesenterious was isolated from a brown soil, and, as a result of numerous reseedings, a typical wrinkled variant was selected, designated further as 16/7, and a smooth variant, designated as 16/1. Besides the cited forms, one more variant of Bac. mesenterious was studied, which was obtained by us during reseedings of the old culture of the smooth variant

(3 a); owing to the uneven edge of its colonies it was named laciniate and designated as 2 a.

Variants of Bac. mesentericus were cultured and stored on MPA [meat-peptone agar]. Temperature of culturing was 37°. Gigantic colonies were grown for studies of morphology of variants. For this purpose the seeding was produced by an injection into the center of a dish with MPA, which was dried a little. For the rating of the gigantic colonies, their size and weight were determined. For the determination of weight, five colonies were washed off from agar and transferred with wash water to "biuksy" [cans?], where they were dried to a constant weight; after weighing , the dry weight of one colony was computed. In experiments of submerged culturing of Bac. mesentericus a liquid synthetic medium was utilized [Begin p.157] of the following composition in g/l [grams per liter]: K_2HPO_4-1; $(NH_4)HPO_4$-1; $MgSO_4$-0.5; NaCl-traces; $FeSO_4$-traces; Glucose-10.0, distilled water - 1L; pH of medium was 7.2-7.3. Culturing of variants was conducted in glass vessels; into the lower part of which glass filters were fused for a better atomization of air in the liquid. Culture medium, in the amount of 50 ml was placed in a vessel and was inoculated with the suspension of cells of one-day-old cultures, which were grown on MPA. Sterile air was blown through in the amount of 3 volumes per one volume of medium per minute. For the determination of relation of Bac. mesentericus variants to different sources of carbon, we utilized the above cited medium into which instead of glucose we added various carbohydrates and alcohols in the amount of 0.5%. Culture media were sterilized thrice in "Kokh" [Koch's] apparatus. Besides the usual media, used in laboratory practice, we also used a bread decoction in experiments on studying the variability of wrinkled forms; it was prepared in the following manner: 20 g of white bread were soaked in 100 ml tap water, the whole mass was boiled and strained through gauze and then it was poured into test tubes, 10 ml in each.

Morphology of colonies

Variants of Bac. mesentericus, cultured by us on MPA and designated as 2 b, 16/7,3 a and 16/1 differed sharply in morphology of their colonies. The basic forms (2b and 16/7) formed large, grayish-white, dry, plicated colonies with uneven edges, which coalesced tightly with agar. These colonies must be referred to the wrinkled type. The wrinkled type is, apparently, the basic one for Bac. mesentericus because colonies of this type form the majority of freshly isolated cultures of Bac. mesentericus. The smooth variants (3a and 16/1) which originated as a result of variability of wrinkled forms had a different morphology of colonies. Their colonies were small, of rounded form, raised, smooth, with a lustrous surface. The color of colonies was creamy, but became brown with age. Edges of the colony were even, sometimes finely serrated. Consistence was soft, viscous. Colonies were easily detached from agar. The variability of Bac. mesentericus is far from being determined by the formation of such colonies, which can be referred to the winkled or smooth type. A laciniate variant (2a) was isolated from an old broth culture of the smooth variant (3a). In the morphology of its colonies it noticeably differed both from the initial and the wrinkled forms. Its colonies were much larger than those of the initial form, with large serrated laciniate edges and with a dull surface. The peculiarities of colonies were stably retained after reseedings of culture. Apparently, the laciniate variant is not an intermediate form, but a new stable variant of Bac. mesentericus, originated in the culture of the smooth variant under definite conditions of its culturing.

Medvinskaia [4] observed the formation of variants different in morphology in cultures of Bac. mesentericus under the influence of the bacteriophage. The idea about morphology of colonies in variants of Bac. mesentericus can be obtained from figures 1, 2, 3 were 6-day-old gigantic colonies of bacteria, cultured on MPA, are represented. Specific measurements permitted forming an idea about weight and size of colonies. The obtained data are cited in figure 4. It is possible to see that the diameter of the six-day-old colony of the wrinkled form of Bac. mesentericus is three times larger than the diameter of colonies of the smooth variant, and 1.7 times larger than the diameter of the colony of the laciniate variant. Weight of colonies of the wrinkled variant of the same age, equal to 19.4 mg is, approximately, 1.8 times higher than the weight of the smooth variant (10.8 mg). Colony of the laciniate variant, with a comparatively large diameter has a small weight (12.3 mg), approximating in weight the colonies of the smooth variant. (Text is continued after description of figures).

Title of figure 1. Colony of the initial form of Bac. mesentericus (2b) (natural size).

Title of figure 2. Colony of the smooth variant of Bac. mesentericus (3a) (natural size).

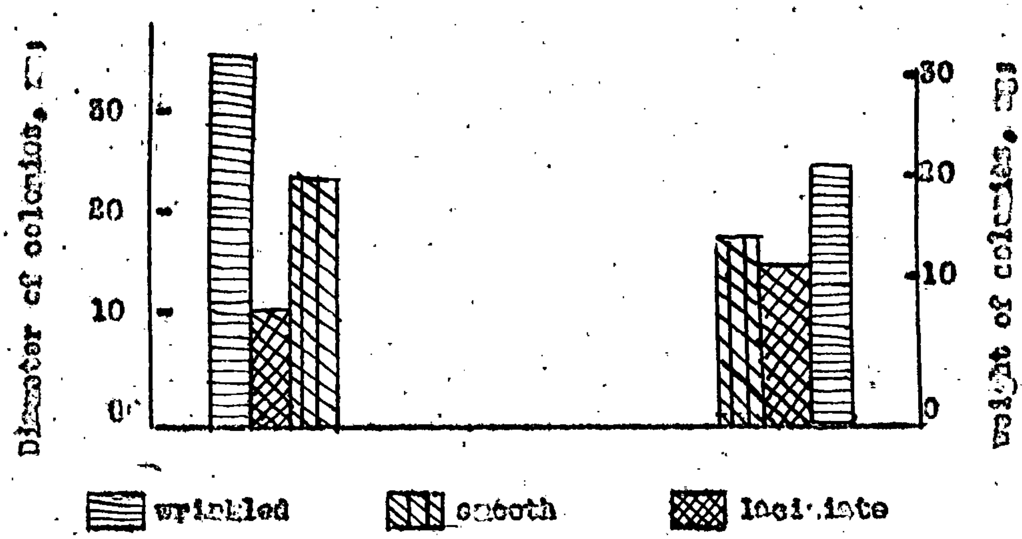
Title of figure 3. Colony of the laciniate variant of _Bac. mesentericus_ (2a) (natural size).

Title of figure 5: 1 - Cells of the initial form of Bac. mesentericus, grown under conditions of deep culturing (cells form chains, traces). Enlarged 1,300 times; 2 - Cells of the smooth variant of Bac. mesentericus (3a), grown under conditions of deep culturing (cells are situated either singly or in pairs). Enlarged 1,300 x; 3 - Cells of the laciniate variant of Bac. mesentericus,

[See title of figure 5 continued on next page].

[Continuation of figure 3: below]

grown under conditions of deep culturing (filar elements are seen). Enlarged 1,800 times; 4 - seeding on MPA of the wrinkled form of Bac. mesentericus, which was cultivated on a bread decoction (dark colonies of the smooth variant are seen, which sometimes form sectors in wrinkled colonies; 5 - seeding on MPA of the wrinkled form of Bac. mesentericus, which was kept on MPA (growth of only the wrinkled colonies).



Title of Figure 4. Dimensions and weight of colonies of variants of Bac. mesentericus, grown on MPA.

Morphology of cells

The form of a colony is determined by the whole complex of properties of bacteria; it depends on the morphology of cells, on their grouping in the colony, on the speed and method of multiplication of cells, on their physiological features, and so on. [Begin p.168] As one should have expected, the variants of Bac. mesentericus, which differ so sharply in the morphology of their colonies, have differences in the morphology of cells also. Microscopical study of preparations, made of one-day-old culture of Bac. mesentericus, has shown that these differences consist primarily of a peculiar grouping of cells in each variant. In the wrinkled variant (3b) the cells in most cases form chains, varying in their length. The chains often are closely drawn together, forming traces, bundles, and so on. The cells are stably connected into chains and it is not possible to upset their specific grouping even after a lengthy shaking of test tubes with water suspensions of cells. The roughness of colonies of the wrinkled form is, apparently, conditioned by the grouping of cells in the form of chains, traces, and so on.

Sizes of cells of the wrinkled form fluctuate in the following limits: 1.9-4.0 μ X 0.7-0.9 μ. Spores are found in great numbers along with vegetative cells. A different microscopic picture is in the smooth variant. Cells of the smooth variant are distributed singly or in pairs; chains, consisting of 3-4 elements, are found more rarely. [Begin p.159] Cells detach easily from each other and are evenly distributed. Sizes of cells of the smooth variant fluctuate, approximately, in the same limits as in the wrinkled form, they comprise 1.8-2.7 μ X 0.6-0.9 μ; yet, shorter cells predominate here than in the wrinkled form. Spores are present, but in much smaller numbers.

Laciniate variant (2a) presented an interesting microscopic picture. Here long filar formations, in which the cell walls are not seen are found together with single cells and short chains. Formation of such cells is possible as a result of the more slowed down multiplication of individual cells during a continuing growth of filaments. The latter attain a length of 20-51 μ. It is essential, that similar formations are not met in other variants of <u>Bac.</u> <u>mesentericus</u>. Dimensions of cells of the laciniate variant vary in the following limits: 2.1-3.5 μ X 0.5-0.7 μ. It is possible that the comparatively small weight of colonies of the laciniate variant, at their large diameter, is conditioned exactly by the fact that cells, which comprise the colony are thinner, than in other forms. The fact, that the character of multiplication and distribution of cells in variants of <u>Bac.</u> <u>mesentericus</u>

is a stable hereditary feature, which is retained under different conditions of culturing of these bacteria, deserves a special attention. Variants of Bac. mesentericus were grown submerged in a liquid synthetic medium with glucose (1.0%) with a constant blowing of sterile air through the medium.

It was possible to think that under such conditions of growing the air bubbles would disturb the specific grouping of cells in each variant and we should not have detected any differences in the distribution of their cells. Nevertheless, the conducted experiments have shown, that variants of Bac. mesentericus, multiplying intensively under conditions of submerged culturing retained the type of growth peculiar to each variant. In figure 5, pictures 1,2 and 3, cells of variants of Bac. mesentericus are represented which were grown in a liquid aerated medium (age of culture - 19 hours, cells were stained with erythrosine). When comparing the pictures, it is seen, that the microscopic picture was different in variants of Bac. mesentericus. Cells of the smooth variant (3a) were distributed singly or in pairs; in the laciniate variant (2a) are seen long filar formations; and the wrinkled form (2b) can be distinguished by chains and traces, which consist of interlaced chains, which are characteristic for it. Consequently, the peculiarities of multiplication and distribution of cells in variants of Bac. mesentericus are stably retained not only on a solid medium, but also under conditions of their submerged culturing. Microscopical picture of each variant, which was grown in a liquid aerated medium, is so characteristic, that according to it one can judge about the belonging of the given culture of Bac. mesentericus to one or another variant.

Growth on various media

Variants of Bac. mesenterious grow well on MPA, on wort agar and especially on the mixture, consisting of MPA and wort agar in a ratio 1:1. In such a case the wrinkled forms (2b and 16/7) form on the surface of the agar slant [Bogin p.160] a dry, grayish-white wrinkled coating, while the smooth variants make a moist coating of cream color.

The wrinkled and the smooth variants of Bac. mesenterious differ especially sharply in the character of their growth in liquid culture media. The wrinkled forms (2b and 16/7) develop on the surface of the liquid media forming compact films, which sometimes creep up the sides of test tubes and flasks, while the smooth variants grow down into the depth of the liquid, causing its uniform turbidity. Such a character of growth of varinats we observed on MPB [meat-peptone bouillon] and on liquid synthetic media with various sources carbon.

Relation of variants of Bac. mesenterious to different sources of carbon was studied on a mineral medium into which sources of carbon were added in the amount of 0.5%: glucose, mannose, saccharose, maltose, lactose; of polysaccharides - starch and inulin; of pentoses - xylose; of alcohols - mannite and sorbite. Results of this research are cited in table 1. From data of the table it is seen, that the wrinkled forms (2b and 16/7) form films on all media, without causing turbidity of the medium proper. Media with saccharose and xylose represent exceptions, as on them the wrinkled variants produce turbidity also. Smooth variants (3a, 16/1, as well as 2a), as a rule, cause a uniform turbidity of media.

We did not detect any basic differences among the variants of Bac. mesenterious in respect to their utilization of various sources of carbon.

All the variants of this species produce good development on glucose, saccharose, maltose, mannite, and mannose, causing acidification of media at the same time. The growth is almost absent on lactose, a slight development is noted on inuline, starch, sorbite.

On pieces of potatoes was noted a luxurious development of all the examined variants of Bac. mesentericus. On potatoes the wrinkled form produced a finely pliated, dry growth of cream color, while the smooth and laciniate variants formed a moist film of yellow color. On "MPZH" [meat-pepton bouillon with gelatin] (15%) the wrinkled forms formed thick films. All the variants of Bac. mesentericus liquify gelatin. Developing on milk, they cause its coagulation, peptonization and alkalization (pH of the medium is displaced from 6.5 to 6.8-7.2).

Conditions, which cause variability of Bac. mesentericus

The problem about variability of Bac. mesentericus has been thrown light upon in detail in the work of Morosova and Drobot'ko [5]. The authors observed the formation of smooth variants in cultures of wrinkled forms of Bac. mesentericus as a result of their prolonged laboratory culturing on the usual culture media. The seedings from old cultures of Bac. mesentericus, which were kept for a long time in the incubator or at room temperature, basically gave two types of colonies, which sharply differed from one another. There are indications that it is possible to obtain variability of Bac. mesentericus, with the formation of smooth variants, in a much shorter time if the given culture will be grown on certain nutrient media.

According to Morozova and Drobot'ko such a nutrient medium for Bac. mesentericus is MPB [meat-peptone bouillon] with the addition of white bread. After a three week culturing of the wrinkled form on such a medium an appearance of smooth colonies was noted on reseedings from it. Vasilenko [1,2] observed that Bac. mesentericus forms smooth variants when grown on a bread decoction. The use of bread media in this case was not accidental; the authors strived to create favorable conditions for the growth of Bac. mesentericus, as it is known that this organism develops well on bread, causing the so-called "ropy bread" disease.

[Text continues after table 1.).

Table 1.

Relation of variants of Bac. mesentericus to different sources of carbon

Form of Bac. mesentericus	Peculiarities of growth of variants, pH of medium (final)									
	Glucose	Mannose	Saccharose	Maltose	Lactose	Starch	Inulin	Xylose	Mannite	Sorbit
Wrinkled (2b)	Film, pH 6.15	Film	Film, pH 6.21	Film, pH 6.44	Weak development, pH 6.35	Film thin	Weak development	Film, Slime, pH 6.2	Film, pH 6.5	Film, pH 6.0[illegible]
Wrinkled (16/7)	Film, pH 5.97	Film, Slime	Film, Slime pH 6.44	Film, pH 6.37	Thin Film, pH 6.34	Thin Film	Weak development	Film, Slime, pH 6.71	Film, pH 6.40	Film, pH 5.6[illegible]
Smooth (3a)	Slime, pH 5.72	Slime	Slime, ring, pH 5.99	Slime, ring, pH 6.82	Slime almost absent, pH 7.10	Slight Slime	Slight Slime	Slime, pH 7.03	Weak development, pH 6.27	Weak developme[illegible] pH 6.51
Smooth (10/1)	Slime, pH 5.66	Slime	Slime, ring, pH 5.85	Slime, film, pH 6.66	Slight slime, pH 7.19	Slight Slime	Slight Slime	Slime, pH 7.08	Slime, pH 6.51	Slime, ring, pH 6.51
Laciniate variant (2a)	Slime pH 6.62	Slime Strong	Slime Strong, pH 5.77	Slime Slight, pH 6.63	Slight Slime, pH 7.31	Slight Slime	Slight Slime	Slime, pH 7.0	Slime, pH 6.47	Slime, pH 6.31

In order to experimentally cause a variability of our wrinkled forms of Bac. mesentericus (2b and 16/7) we began to cultivate them on bread [Begin p.162] decoction. We took MPA as a control medium. Cultures were grown at 37°, and then were stored (without reseedings) on the above cited media at room temperature. At different times, in three weeks and in a month seedings on MPA were made from the experimental and the control test tubes. Experiments were conducted with a double replication.

Data, obtained in these experiments, have shown, that in cultures of both wrinkled forms of Bac. mesentericus (2b and 16/7), which were grown and kept on bread decoction, two types of colonies appeared, when seeded on MPA, which differed one from the other. The first type - large, grayish-white, dry, wrinkled colonies, suggesting the initial form; and the second type - small colonies, round, shiny, almost transparent. When seeding was done from control test tubes we observed quite a different picture of growth. In this case all the colonies were monotypic and corresponded to the initial wrinkled form of Bac. mesentericus. Pictures 4 and 5 in figure 5 give an idea about different outer appearances of the experiment and the control seedings; in them are shown pictures of growth on MPA of the wrinkled form of Bac. mesentericus (16/7) after its cultivation on the bread decoction and on MPA during the course of one month.

Picture 4 of figure 5 shows that colonies of the smooth type lie either in groups, isolated from wrinkled colonies or protrude in the form of sectors, segments or protuberanse in colonies of wrinkled forms. One should mention that in picture 4 of figure 5 these sectors sometimes have a form of dark spots on white colonies of the wrinkled variant because the smooth colonies are almost transparent. After calculating the smooth colonies in experimental seedings it proved to be that they comprised about 40% of the whole number of colonies, while in the control seedings their number was equal to zero (table 2).

Table 2.

Variability of the wrinkled form of Bac. mesentericus 16/7 on bread decoction and on MPA

Preliminary cultivation (medium)	Total number of colonies grown on MPA*	Smooth colonies	Percentage of smooth colonies
Bread decoction	354	161	45.7
MPA	490	0	0

* Number of colonies represents the sum of colonies, which grew on three dishes with MPA.

The circumstance, that the wrinkled form of Bac. mesentericus after its preliminary cultivation on bread decoction produced smooth variants after its seeding on MPA, and did not produce them after their similar growing on MPA, points to the specific reaction of bread decoction on the variability of Bac. mesentericus.

Our data are in conflict with the theory of spontaneous microbe dissociation, which denies the influence of life conditions on the formation of new characteristics and features of microorganisms. The role of external conditions, according to this theory consists only in the selection from the population of individuals, which already have certain characteristics and features. If the rôle of outer conditions would come to only the selection of ready forms then in our experiments the smooth variants should have appeared after seeding of wrinkled forms in both cases: from bread decoctions and from MPA, because the selection was conducted on one and the same medium (MPA). Nevertheless, under the present conditions of experiment the formation of smooth variants was observed by us only in the case when the wrinkled form was preliminarily cultivated in bread decoction. Consequently, changeability of Bac. mesentericus occurred under the influence of the culture medium, on which the bacteria were grown. Conditions, which caused the variability of the wrinkled form, facilitated also the selection of smooth variants. What is the specific reaction of the bread medium on the variability of Bac. mesentericus is yet hard to say; is it the influence of individual components of the nutrient [Begin p.163] medium, or are these the products of metabolism, which form in this medium during the process of cultivation of bacteria; these are the questions which require further study.

But there is no doubt that the bread medium to a greater degree, than MPA, assisted the variability of Bac. mesentericus in the formation of smooth variants.

In conclusion, I want to express my deep gratitude to Professor A. A. Imshenetskii for his directions and advice in my work.

CONCLUSIONS

1. Studies of morphological and cultural properties of Bac. mesentericus have shown, that the smooth variants, which appeared after the variability of wrinkled forms differ from these last ones in the morphology of colonies, in their size and weight, as well as in the character of growth on solid and especially on liquid media.

2. Variability of Bac. mesentericus was expressed not only in the formation of colonies, which can be referred to the wrinkled and the smooth type. Besides the usual R and S-forms colonies of laciniate variant were also formed, which could not be referred to the above types, according to their properties. The laciniate variant must be regarded not as an intermediate

form, but as a new stable variant, which appeared in the culture Bac. mesenterious under the influence of conditions of cultivation.

3. Peculiarities of multiplication and distribution of cells, which are characteristic for each of the variants of Bac. mesenterious, are stable hereditary features under various conditions of their culturing (during the surface and the submerged with a blowing of air through the cultural liquid).

4. Culturing wrinkled forms of Bac. mesenterious on bread decoction helps a greater formation of smooth variants in their cultures, than when growing on MPA. The cause of the specific reaction of bread medium on the variability of Bac. mesenterious remains as yet unexplained.

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Kosikov, K. V.

Otdalennaia gibridizatsiia drozhzhei. II
Poluchenie gibridov mezhdu Saccharomyces
Cerevisiae (XII rasa) i Schizosaccharo-
myces Pombe putem kopuliatsii kletok.

[Distant hybridization of the yeasts. II.
Obtaining of hybrids between Saccharomyces
cerevisiae (XII race) and Schizosaccharomyces
pombe through copulation of cells].

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July/Aug. 1956. 448.3 M582.

(In Russian)

In our previous report about distant hybridization of yeasts [1] the possibility was shown of obtaining hybrids between Saccharomyces cerevisiae (XI race) and Schizosaccharomyces Pombe. During the process of research it was established, that hybridization can take place also without any clearly expressed process of copulation (formation of copulation offshoots), but by means of producing a small channel, connecting both cells, touching each other, through which then proceeds the infiltration of the contents of one spore or cell into the other. This deviation from the usual process of copulation for the given species gives a reason to suppose that in certain cases hybridization can occur in consequence of the active reaction of only one of the components of crossbreeding, as result of which the second component can be involved into the process during the stage of development which is unnatural to it.

Proceeding from this assumption, experiments were conducted on crossbreeding of cells of Schizosacch. Pombe with cells of Sacch. cerevisiae (XII race). The cells of Schizosacch. Pombe were considered in the given case as active components of crossbreeding, as it was known that in this species copulation occurs between the vegetative cells (they are haploid) in proportion to the consumption of the nutrient medium. Vegetative cells of the XII race are diploid and no copulation was noted among these cells. These cells were chosen as a second component for crossbreeding with the purpose to show (in case of a positive result) that copulation can be realized with the active role of only one component for crossbreeding.

A two-day old culture of Schizosacch. Pombe, grown on wort agar, was seeded into a test tube, containing beer wort without hops. The two-day old culture of the XII race in the same amount (one loop) was seeded into this same test tube one day (24 hrs) later. The cels were carefully mixed, and the test tube was left at room temperature. In 24 hours suspended drops were prepared on a cover glass from the mixture of cells, which were placed into a moist chamber and were also kept at room temperature. During the next 3-4 days the preparations with the suspended drops were examined for detecting the copulating cells.

The form of cells Schizosacch. Pombe differs considerably from the form of cells of the XII race, and this makes it possible to distinguish them in a mixed culture. Copulation of cells of Schizosacch. Pombe one with another occurs, under the cited conditions of the experiment, comparatively rarely, nevertheless, in one suspended drop it was possible to detect up to 6-10 and more of such cases. A typical case of copulation of cells of Schizosacch. Pombe is represented in figure 1. (Text is continued after description of titles).

Title of figure 1. Typical case of copulation of cells of Schizosacch. Pombe.

Title of figure 2. Copulation of a cell of Schizosacch. Pombe with a cell of the XII race of Sacch. cerevisiae.

[See the picture of figures at the end of translation].

Title of figure 3. Same as of figure 2.

Title of figure 4. A group of budding cells, two of them have walls.

Title of figure 5. A group of budding cells, one of them has a wall.

Title of figure 6. Same as of figure 5.

Title of figure 7. From among two split elongated cells one formed large cells and the other small ones.

Title of figure 8. Small cells formed from isolated cells.

There are deviations from this case, yet forms of zygotes (copulated cells) and forms of cells remained typical for the given genus.

Two cases were detected, as a result of examination of about 20 preparations, when copulation occurred between the cells of Schizosacch. Pombe and of the XII race, as it was possible to judge from the superficial picture of the copulating cells (figure 2 and 3). The form of zygote in figure 2 [Begin p.421] is typical for Schizosacch. Pombe, yet one of the copulating cells has an ellipsoid form, which is characteristic of the XII race. The zygote, represented in figure 3, in its form sharply differs from the typical for cells of Schizosacch. Pombe; at the same time one of the copulating cells here is characteristic for Sch. Pombe, the other for the XII race.

Zygotes represented in figures 2 and 3 were transferred to microdrops of fresh nutrient medium, nevertheless we did not succeed in obtaining offspring from them. They did not multiply and did not form any spores. This could have occurred either owing to unfavorable conditions in the suspended drop for the multiplication of the formed zygotes, which led to the cessation of their development or in consequence of certain traumatism, which could have occurred during the transfer of zygotes to microdrops of nutrient medium. In order to exclude these assumptions, it was decided to seed the mixed cells of Schizosacch. Pombe and of the XII race on wort agar, where the conditions for a further development of the formed zygotes should be more favourable.

The mixed cultures, thus obtained, were examined, during the course of one month and longer, for detecting the hybrid cells. The intention was to detect either the zygotes, which started to multiply, of the cells of Schizosacch. Pombe and of the XII race, that copulated between themselves, or the cells, which multiply simultaneously by budding and fission (the presence of walls). As a result of such examination in one of the test tubes, with mixed cultures, cells were detected which multiplied by budding with the presence in some of them of clearly expressed walls. With the aid of a micromanipulator we succeeded in isolating such cells into microdrops of beer wort; but together with them were also cells without walls, which were attached to them. In all, four groups of such cells were isolated. In the first group, at the moment of separation, there were 6 cells, among them two had walls (microdrop 4, figure 4); in the second group, at the moment of isolation, there were three drops, one of them had a wall (microdrop 5, figure 5); there were 6 cells in the third group; two of them had a wall (microdrop 6) and in the fourth group there were 3 cells, ne of them had a wall (microdrop, figure 6).

Cell groups were isolated into other microdrops also, yet no walls were found in these cells. An unusual group was isolated into microdrop 11. During the moment of isolation in the group there were two elongated cells which were attached to each other; at one end of these cells there were two large round cells. In 24 hours the large cells multiplied and on the other end of the elongated cells minute cells formed (figure 7). A group of large cells, which, probably, were polyploid, was transferred into another microdrop of a fresh nutrient medium. But later on minute cells started to bud off from the large ones and thus a mixed culture was formed (figure 8). An attempt to obtain a culture of large cells alone did not turn out well; in it always small cells formed and displaced the large.

Groups of cells, both with walls and without them, which were transferred to nutrient microdrops, multiplied in most cases, but the newly formed cells did not have walls and multiplied by budding only. After further examination of cultures, which were obtained from cells that formed in microdrops, no cells with walls were observed, although one cannot exclude a possibility of formation of such cells in those cultures, which were produced from cells with walls, when one takes into consideration the data published by us in the first report [1].

It was interesting to check the obtained cultures of yeasts, both of groups of cells with walls and without, for their capacity to ferment beer wort. In all, 11 cultures were examined, among which three were obtained from groups of cells which had walls. It proved that at 26° the fermentation of 8 cultures, obtained from cells, without walls, did not essentially differ from the XII race, [Begin p.422] while in 3 cultures, obtained from cells having walls (marked respectively 66-5; 66-6 and 66-9), the fermentation curve differed to a considerable degree. During the first 24-hour day of fermentation these cultures were behind in the intensity of fermentation of the XII race; during the second 24-hour day, on the contrary, the intensity of their fermentation went beyond that of the XII race (figure 9). At 30° these 3 cultures surpassed the XII race in the intensity of fermentation during the first and the second days (figure 10). The obtained comparative data about the intensity of fermentation of beer wort can be regarded as confirming the assumption about the hybrid origin of the cultures, which were obtained from cells with walls. Nevertheless, apparently no fusion of nuclei during the formation of these hybrids occurred.

[See picture of these figures following the complete translation]:

Title of figure 9. Fermentation curves of beer wort by initial species Sacch. cerevisiae (XII race) and Schizosacch. Pombe and hybrid cultures 66-5, 66-6 and 66-9 at the temperature of 26°. 1- Schizosacch. Pombe.; 2 - culture 66-9, 3-66-6; 4- 66-5; 5 - XII race.

Words in figure 9. To the left: Liberation of CO_2 (in g.) beneath - days of experiment.

Title of figure 10. Fermentation curves of beer wort by initial species Sacch. cerevisiae (XII race) and Schizosacch. Pombe and hybrid cultures 66-5, 66- and 66-9 at the temperature of 30°. 1 - Schizosacch. Pombe; 2 - culture 66-9; 3- 66-6; 4 - 66-5; 5- XII race.

Words in figure 10. To the left: Liberation of CO_2 (in g.) beneath - days of experiment.

CONCLUSIONS

1. In a mixed culture Sacch. cerevisiae (XII race) and Schizosaccharomyces Pombe cells were detected, which had walls, but multiplied by budding. The obtained pictures of copulation (zygotes) gave grounds to assume that such cells with walls appeared in consequence of copulation of haploid cells Schizosacch. Pombe with diploid cells of Sacch. cerevisiae (XII race), yet in this case, apparently, there occurred no fusion of nuclei.

2. Comparative study of intensity of fermentation of beer wort has shown that the fermentation curve of cultures, obtained from cells with walls, differs both from curves, obtained after fermentation with Schizosacch. Pombe and the XII race. This fact must be regarded as an additional confirmation of the supposition about the hybrid origin of cultures, obtained from cells

with walls.

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LITERATURE

1. Kosikov, K. V., Distant hybridization of yeasts. I. Obtaining of hybrids between *Saccharomyces cerevisiae* (race XI) and *Schizosaccharomyces Pombe*. Mikrobiologiia, v.25, no. 3, p.275, 1956.

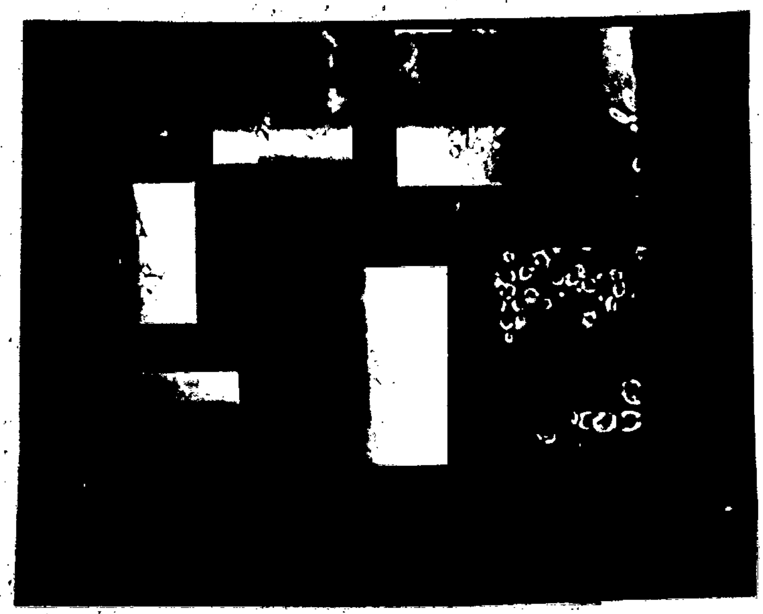


Figure 1. Typical case of copulation of cells of Schizosacch. Pombe.

Figure 2. Copulation of a cell of Schizosacch. Pombe with a cell of the XII race of Sacch. cerevisiae.

Figure 3. Same as of figure 2.

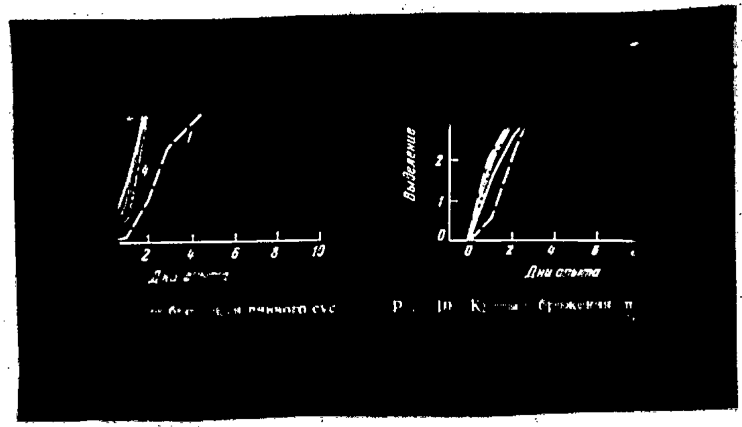
Figure 4. A group of budding cells, two of them have walls.

Figure 5. A group of budding cells, one of them has a wall.

Figure 6. Same as of figure 5.

Figure 7. From among two split elongated cells one formed large cells and the other small ones.

Figure 8. Small cells formed from isolated cells.



Title of figure 9. Fermentation curves of beer wort by initial species Sacch. cerevisiae (XII race) and Schizosacch. Pombe and hybrid cultures 66-5, 66-6 and 66-9 at the temperature of 26°. 1 - Schizosacch. Pombe.; 2 - culture 66-9, 3-66-6; 4 - 66-5; 5 - XII race.

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Title of figure 10. Fermentation curves of beer wort by initial species Sacch. cerevisiae (XII race) and Schizosacch. Pombe and hybrid cultures 66-5, 66- and 66-9 at the temperature of 30°. 1 - Schizosacch. Pombe; 2 - culture 66-9; 3 - 66-6; 4 - 66-5; 5 - XII race.

Words in figure 10. To the left: Liberation of CO_2 (in g.) beneath - days of experiment.

(In full)
vg/U

Grinbaum, F. T.

O nekotorykh sokhrodnykh zadachakh v razrabotke problemy izmenchivosti mikrobov.

[Some impending tasks in the development of the problem of variability in microbes].

Zhurn. Mikrobiol. Epidemiol. i Immunobiol., vol. 27, no. 2, p.3-7. Feb. 1950. 448.8 Z8

(In Russian).

During October of 1955, the Soviet people and the entire advanced, progressive humanity marked the centennial since the day of birth of Ivan Vladimirovich Michurin - an outstanding scientist-biologist, a great transformer of nature.

"The teachings of Michurin "writes T. D. Lysenko(1), "have now become Michurinian science, creative Darwinism. Michurin's biological science not only explains phenomena of the organic world, but on the basis of discovered regularities, as well as of those being discovered now, points to the way for controlling those phenomena, in common with practice, it seeks and finds methods for changing the nature, for transforming the organic world in the interest of practice for the good of the people".

Michurin's biology, based on dialectic materialism, develops the materialistic elements of Darwin's teachings, repudiates his mistakes and leads an irreconcilable struggle with metaphysical and idealistic falsifications of Neo-Darwinism-Weismannism.

Considering the organism in its oneness with the external environment, Michurin's biology imparts the deciding role in the formation of the organism to the conditions of its life and development, the change of

(1) T.D. Lysenko, For a further development of Michurin's teachings. Agrobiol.

which directs the process of species formation.

Microbes are those simplest of organisms, which are in the closest contact with external environment; most diverse processes of variability, correspondent to the factors which produced them, proceed in them in consequence of this. Depending on the quality and intensity of those factors, and in conformity with them, the acquired properties and features become fixed and are transferred hereditarily. That is the reason why Darwin's materialistic ideas have at one time found a strong support from I. I. Mechnikov, and the basic ideas of Michurin's biology not only are shared by all progressive microbiologists, but also find full confirmation and further development in our science.

The August, 1948, Session of the All-Union Academy of Agricultural Sciences imeni V. I. Lenin [VASKhNIL] which by itself marked final victory of Michurin's biology over the remainder of Weismannism-Morganism in our country, was a powerful thrust, which pushed forward manifold research in the field of variability of microorganisms. If before this the studying of variability of microorganisms was conducted chaotically, without a directing idea and, to a certain degree, under the influence of foreign reactionary conceptions of cyclogeneticists [sic] and mutationists, then after the August session the status of science has changed basically. The principles for the concrete use of Michurin's doctrine in microbiology became clearly visible, also the ways and directions of further successful development of works on variability of microbes. [Begin p.4].

A great role was also played by a Conference on the Variability of Microbes, conducted in Gor'ki very soon after the August session of VASKhNIL. At this Conference results of conducted works were summed up, mistakes were uncovered and basic problems outlined, which faced the researchers in the field of studies of variability of pathogenic microorganisms.

Among the problems, which required an immediate solution, the Conference outlined the following:

1) studies of external factors in the life and development of pathogenic microbes;

2) discovery of regularities, which condition the variability of properties and features of pathogenic microbes;

3) obtaining of vaccinal strains by means of directed variability;

4) improvement of diagnostics of infectious diseases and methods of indication of pathogenic microbes in the external environment considering their variability.

Besides this, problems were proposed, which are of great theoretical and practical importance, but which require a prolonged time for their solving. These questions can be formulated as follows:

1) studies of the role of variability of microbes in etiology, epidemiology, pathogenesis and immunity;

2) evolutionary systematics of microbes taking into consideration their variability, depending on the conditions of the habitat.

A big collective of Soviet medical microbiologists developed manifold research in the cited basic directions.

Although the time for summing up all the conducted work is not ripe yet nevertheless it is appropriate, at the moment when the centennial since the day of birth of Ivan Vladimirovich Michurin - the initiator of the new direction in all the branches of the biological science, is being marked, to share the already obtained data, to critically evaluate them and to plan means for further development.

Scientific conferences, which were conducted during the elapsed time, and the published monographs testify to the considerable successes in the development of problems of variability of pathogenic microbes.

Among the biggest conferences one should name one which was conducted by the Academy of Science, in 1951, in Moscow on directed variability and selection of microbes and the other one conducted by the Ministry of Health of USSR in 1954 in Gor'ki, on studies of live vaccines.

During this period the following monographs were published: G. M. Balina "Variability of pathogenic microorganisms" (1949), also his "Vegetative hybridization and directed variability of bacteria" (1952), again his "Development of microbe cells from precellular substance" (1954), V. A. Krestovnikov "On studies of stages of development of microorganisms" (1950), D. G. Kudlai "Variability of microbes of the intestinal group", S. V. Muromtsev "Variability of microorganisms and problems of immunity", V. L. Elin "Variability of microbes", I. G. Shiller "Directed antagonism of microbes".

One could point out with a certain satisfaction, that the works on variability of pathogenic microbes were widely developed at our scientific-research institutes, chairs and bacteriologic laboratories. The research was conducted especially intensely and systematically at the Gor'ki Institute of Vaccines and Sera, the Chair of Microbiology at the Chernov'tsy Medical Institute, Institute of Epidemiology and Microbiology imeni Gamaleia, and Moscow Institute of Vaccines and Sera imeni Mechnikov. In these establishments original directions in the development of the problem of variability of pathogenic microbes were formed and most reliable data, which deserve attention, were obtained. [Begin p.5].

We did not use the term "reliable" accidentally. The matter is that along with thoroughly irreproachable works at the same time works appeared which aroused great doubt on the part of both the theoretical premises, which their authors followed and the methodical and even purely technical execution. All this caused one to doubt the reliability of the facts reported there.

Unfortunately, the cited research was conducted by several laboratories and the data published by them not only obstructed the authentic science, but inaccurately informed the wide masses of readers (and not only the medical specialists), and to a certain degree discredited the whole problem of variability of microbes, rousing distrust in data, which were obtained by highly authoritative researchers and collectives of qualified microbiologists.

To the category of just such works belong: the widely known monograph of G. M. Bosh'ian "About the nature of viruses and microbes" and a less known monograph of M. M. Berulava "Variability of microbes and immunity".

Burying in sorrowless oblivion all these "works" and turning to real achievements of our science, we must mention the following basic ideas.

Firstly, one must consider as indisputable and not requiring further proofs the thesis about the fact that the cause of variability of properties and features of microbes is the change in the conditions of the habitat, of conditions of their life and development, whereupon the quality of occurring changes is proportional to the causes which produced them.

Secondly, with the change of properties and features of microbes a transmutation of one species into another can be observed, as well as a formation of a new species.

Finally, the weakening of heredity of the pathogenic microbe, under the influence of unfavorably acting factors, must be considered as a prerequisite to the appearance of variability.

The cited basic ideas, which were confirmed by vast materials, accumulated during the recent years through experimental research and observations of processes, which proceeded under natural conditions, are in full accord with principles of Michurin's idea. Nevertheless, certain factual data, especially of experimental order, became objects of theoretical discussions.

Thus, for instance, a fact is considered beyond any doubt, that one can achieve a directed change in properties and features of some microbes by growing them on products of active life or of decomposition of others. And certain researchers see in these facts a confirmation of the presence in these bacteria of the process of vegetative hybridization (Malina). But we think that there are hardly any reasons for considering these facts identical with those, which were the basis for the doctrine of Michurin, and of his followers, about the vegetative hybridization of plants. Generalization of facts which testify about the presence in bacteria of the so-called filterable forms is also a subject for discussions. Many authors (Kreutov-nikova, Malina) regard the filtorable forms of bacteria as one of the stages of their onto--genetic development. Other researchers (Marcatsev, Timakov, Mudlai, Grinbaum, Zhitova) think, that the filterable forms of bacteria arise as a result of influence on them of unfavorable factors of the external environment; while the difficulties of regeneration of filterable forms and the obtaining, in many cases, of different species does not confirm the notion of their being stages of normal ontogenetic development.

Comparison of data, accumulated during the past years, with those problems, which were set by the August Session of VASKHNIL, shows that a series of important questions on principle remains yet unsolved. Thus the exact knowledge is absent about the mechanisms of variability of pathogenic [Begin p.6] microbes. It is considered to be firmly established, that variability occurs as a result of change of conditions of life and development of organisms; that the basic active mechanism is the change of processes of metabolism. Yet, we have no data on what sort of numerical and qualitative changes there should be of this process in order to cause the weakening of heredity in microbes and to produce these or other changes of its nature. Absence of sufficiently exact knowledge does not permit us to master the cited process and to impart it a needed direction.

Becoming enthused with "vegetative hybridisation of bacteria" for the purpose of directed transformation of features and properties of some species, we forgot completely, that selection was one of the methods of Michurin's biology. None of us has seriously studied this method and did not use it for the purpose of directed transformation of bacteria. We forget the fact completely that I. V. Michurin himself, as well as his followers, obtained many species of plants useful in practice. As a result we, as yet, could not obtain a sufficient number and a necessary quality of new vaccinal strains, as well as could not improve those which we have.

As yet the exact knowledge is also absent about the nature of the so-called atypical bacteria and their role in etiology, epidemiology and pathogenesis of infectious diseases; about their importance for diagnostics and indication of microbes in the external environment, about their participation in the process of immunogenesis. It is beyond doubt that the so-called atypical bacteria, which are isolated from the organism of man and the external environment, appear as a result of variability of the pathogenic and saprophytic species known to us. Nevertheless, we as yet have no possibility in each specific case to recognise an atypical microbe, to indicate its origin, mechanism of formation, its features and properties.

Some authors (Peretts, Malina, Grinbaum) suppose that atypical microbes, which possess certain traits of similarity with typical pathogenic bacteria, are the result of saprophytism of the latter, which occurs under the influence of chemotherapeutic preparations, antibiotics, and, possibly, also under the influence of the protective arrangements of the organism. In the, thus obtained under experimental conditions, tranformed pathogenic bacteria, similar to those isolated from the organism, a lowering of virulence and immunogenity is noted the most often. These data permit one to express an assumption about a specific role of such strains in etiology and pathogenesis of dysentery. L. G. Feretts thinks that they are the cause of the mild, lenient, chronic form of this infection, and their high resistance to unfavorable factors in the external environment and their prolonged survivability outside the organism explains certain peculiarities of the epidemic process of modern dysentery. One could accept this idea on principle, but for its full confirmation special experiments and observations are required. Other researchers (Dumesh), pointing out to low virulence or its full absence in atypical strains, do not assign to the latter any importance in the epidemiology of infectious diseases (dysentery).

If one refuses to recognize any participation of atypical strains in the arising of infectious diseases and their role in the epidemic process, there yet remains an unsolved question about the possibility of their utilization for the purpose of diagnostics or indication of contamination of environment. This question is undoubtedly connected with the problem about the nature of atypical microbes. Nevertheless, all that is known to us about these microbes, permits us to raise the question now about the necessity to consider them as etiologic and epidemiologic indicators. The preliminary data at our disposal (Blokhina, Pogorel'skaia, Ivanova, Rasachek, Galunina - Gor'ki Institute of Vaccines and Sera) [Begin p.7] permit us to think it possible to conduct special research on utilization of atypical microbes in order to widen the diagnostics of infectious diseases and indication of pathogenic microbes in the external environment.

Up to the present time the problem of species and of species formation in bacteria remains unsolved. The determination of species, given by T. D. Lysenko, reveals the nature of this biological conception. Some researchers, proceeding from this determination, make an attempt to give concrete expression to it in reference to pathogenic bacteria (Murashov, Timakov, Kalina). But, nevertheless, one should take into consideration that, while determining the species of one or another pathogenic microbe, we must know all the features and properties which were developed and fixed in it during the process of evolution and which characterize it under natural conditions of habitat. We must, besides that, know the range and direction of variability of these features depending and in accordance with the change of conditions of life and development of the pathogenic microbe. From here proceeds the idea that a species comprises a certain capacity for variability and the latitude of variations characterizes the species.

Unfortunately, all these statements bear a general character, and we, as yet, have no full systematics of pathogenic organisms, which would reflect the ways of their evolutionary development and would take into consideration the change of their basic features and properties. We also do not have sufficiently correct understanding of the boundaries of species in bacteria, in consequence of which many forms are referred by some authors to independent species, others - to varieties, and so on. This question acquires an especially important meaning, when we meet with variability which escapes, as it is said, beyond the limits of species.

T. D. Lysenko (cited earlier) points out that "now it became possible to confirm by indisputable experiments the generation by some biological species of plants and microbes of other biological species". Indeed, it is possible to cite multiple and quite irreproachably conducted experiments as the result of which a transformation of one species of bacteria into another was observed to occur, for instance: conversion of plague rod to pseudotuberculer, from dysenteric Sonne - to intestinal, from Flexner's dysenteric - to paratyphoid, and so on (Zhukov-Vereshnikov, Lenskein, Turetto, Ivanova, and others). There is no doubt that this research has great theoretical value, but the question remains unsolved about the possibility of such variability under natural conditions and about its role in the infectious and epidemic process.

Thus, to the number of problems facing us, it is necessary to add also the problem of species and of the variability in the formation of species, having in view that, although its theoretical side can be considered sufficiently developed, the practical side, which worries us, especially during studies of the epidemical process, remains yet unsolved.

The considerations, expressed in the present article, as regards the problems of variability, which require solving as soon as possible do not pretend to be exhaustive. Some of them we might have missed or thrown insufficient light upon, some yet remain disputable. But in any case it is quite obvious that the research in the field of variability of pathogenic microbes must be raised to the next, highest degree in the scientific and methodical respect; and to solve in the shortest time the questions of this interesting problem, which has both theoretical and practical value.

We have no doubts about further successes; their guarantee is the remarkable teaching of I. V. Michurin, which was based on Marxian-Lenin methodology.

Trans. A-971
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Gauze, G. F., and Kochetkova, G. V.

Izmenchivost' i varianty produtsenta al'bomitsina.

[Variation and variants of the albomycin producing [organism].

Akademiia Nauk SSSR. Doklady, vol. 8, no. 6, p.1179-1181. 1956. 511 P444A

(In Russian)

(Submitted by Academician V. N. Shaposhnikov, Jan. 27, 1956).

In making a study of the albomycin producing organism, Actinomyces subtropicus, we observed a unique picture of variation of this ray fungus which differs sharply from the regularities described in literature with respect to the producing organisms of other antibiotics. We discovered different variants in the A. subtropicus culture, to wit: 1) variants that in addition to albomycin produce a small quantity of an antibiotic chemically sharply distinct from albomycin which we named the "second factor"; 2) variants that produce pure albomycin without any admixtures of the "second factor"; 3) "imperfect" variants producing primarily the "second factor" and only a small amount of albomycin. After long cultivation, some strains proved to be completely stable and retained permanently their membership [prinadlezhnost'] within a specific variant. Other strains, however, proved unstable and segregated during cultivation into different variants. As a result of our investigations, it was possible to establish the complex picture of variation within the limits of the Actinomyces subtropicus species that, in our opinion, is of theoretical as well as practical interest in maintaining the culture of the albomycin-producing organism in an active status for a long time.

The following is a convenient method for the detection and classification of the culture's variants. A spore suspension of an A. subtropicus culture is plated on the surface of an agarized culture medium in Petri dishes in various dilutions. After 48 hours of growth at 28° [C], individual colonies are cut out together with a small piece of surrounding agar and are floated into a melted and chilled, nearly congealed, culture agar, one colony each in the center of a Petri dish. Then, after 72 hours of cultivation at 28° [C] two staphylococcal cultures, one sensitive and the other resistant to albomycin action (see fig. 1) are put in streaks [shtrikhami] around each colony. A resistant staphylococcal culture was obtained from the sensitive one as a result of its adaptation to albomycin, and it developed adequately at an albomycin concentration equivalent to 1000 units/ml and above.

Fig. 1. Different variants of A. subtropicus during growth in Petri dishes

[Begin p.1180]. In experiments conducted in adaptation of staphylococci an albomycin preparation containing 100,000 units of activity per mg was utilized.

In utilizing the method indicated, we observed the following phenomenon (fig. 1). While inhibiting the growth of sensitive staphylococci, and some A. subtropicus colonies did not in the least inhibit the development of staphylococci resistant to albomycin that grew in the immediate vicinity of the albomycin-producing colony (variant A).

Further chemical investigations have demonstrated that cultures obtained from such colonies excreted only albomycin into the surrounding medium in submerged fermentation, without forming simultaneously other antibiotic substances. Colonies of variant B inhibited the growth of sensitive as well as of resistant staphylococci, although in the latter twice as weak as in the first. Chemical investigations have demonstrated that cultures obtained from such colonies produce, in the main, albomycin, but concomitantly also the "second antibiotic factor" that cannot be isolated from the cultural liquid by the method used in obtaining albomycin. And finally, the colonies of variant V inhibited in equal measure the growth of staphylococci sensitive to albomycin and those resistant to it. Chemical investigations have shown that cultures obtained from such colonies in submerged fermentation yield only a small amount of albomycin and produce chiefly the "second antibiotic factor" possessing a different mechanism of bacterial action.

Table 1.

Zone of inhibition of growth in staphylecocci by a single colony (in mm)

No. of colony	Sensitive	Resistant	No. of colony	Sensitive	Resistant
1	15	17	9	17	15
2	14	13	10	14	14
3	17	0	11	17	16
4	18	15	12	17	15
5	16	0	13	13	13
6	17	15	14	14	13
8	13	13	15	13	13

In making a study of the variation of the original albomycin-producing strain, that initially represented a pure line cultivated a laboratory for several years, we, during a plating of spore suspensions, isolated 49 colonies of variant B, 5 colonies of variant A, and 6 colonies of variant V. Similar results were obtain also in other analogous experiments. Thus, the colonies of variant B represt the fundamental, normal type of the albomycin-producing organism with a quantitative prepomderance over other variants.

After isolating different variants from the original culture, we investigated the question as to how firmly the individual lines retain[the characters of] their membership to a specific variant in cases of long cultivation and multiple passages on agarised media. For this purpose we, from time to time, plated spore suspensions of individual lines obtained from different original variants and analyzed their composition by the method described above. It proved that some lines were completely stable and retained their membership to a specific variant for several years. Thus, for example, of the lines which we investigated, one of variant A (line no. 8) which produces pure albomyein without an admixture of the "second factor" pseoved very stable; 124 cultures of the progeny of this line were investigated in the course of two years and all of them, without any exception, belonged to variant A. However, among the progeny of many other lines that belonged to variant A and to other variants, a segregation of properties and the appearance of variants of different types were observed. Thus, stability appears to be a property of a certain line or culture, but by no means a property of a certain variant.

In connection with the results obtained it was necessary to investigate the segregation character [Begin p.1181] in unstable cultures for the purpose of detecting reciprocal relations occurrring between the different variants. With regard to this, culture no. 13, a member of the "imperfect" variant V is of special interest. A typical segregation of properties which we observed among the offspring of a given culture is reflected in table 1.

Data in table 1 indicate that of 15 inspected single colonies isolated from a given culture, 13 colonies belonged to the "imperfect" variant V and 2 colonies (nos. 3 and 5) produced pure albomycin, i.e. they belonged to variant A.

We inspected a total of 108 single colonies of the progeny of the "imperfect" culture no. 13 of which 100 cultures belonged to the parent variant V, and 8 cultures to variant A. In a series of similar other cases we observed that during cultivation cultures of variant V segregated a small number of variant A cultures, but never did segregate any variant B cultures. It must be noted that variant A cultures which produce pure albomycin and had segregated from cultures of the "imperfect" variant V proved to be entirely stable in further cultivation; the 140 progeny of these cultures which we studied belonged without any exception to variant A.

In turning to the more complex variation cases which we have repeatedly observed, it must be noted that intermediate forms were observed between variants A and B; If variant B inhibits the growth of albomycin-resistant staphylococci by 50% as compared with the growth of sensitive staphylococci, then the intermediate forms that produce a smaller amount of the "second factor", inhibit the growth of resistant staphylococci by 10-20%. Intermediate forms are found also between the variants B and V which inhibit the growth of albomycin-resistant staphylococci by 70-80%.

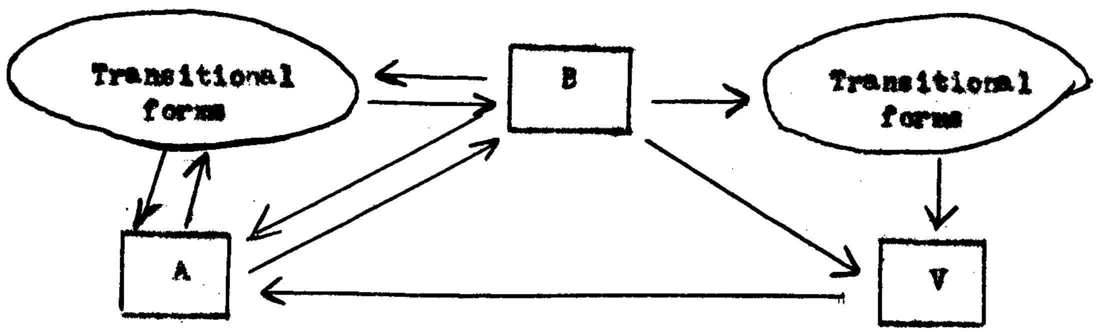

Fig. 2. Reciprocal relations between the different variants of A. subtropicus

In making a study of a series of variant A cultures it proved that they are capable of segregating cultures of variant B and also the intermediate cultures between A and B. These intermediate cultures are, in turn, unstable and segregate into A, B and intermediate forms. Some cultures of the "normal" B variant are also capable of segregating transitional forms with either an increased or decreased content of the "second factor".

Thus, a study of the variation of segregating cultures of A. subtropicus has led us to the scheme for reciprocal relations occurring between the different variants represented on fig. 2. The arrows on this scheme indicate the transition of some variants into others which actually were observed in our experiments.

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Conference on Filterable Forms of Microbes at the Institute of Experimental Biology of the Academy of Medical Science of USSR.

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(In Russian)

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A Conference on the problem of filterable forms of microbes was held on the 14-15th November, 1955, at the Institute of Experimental Biology of the Academy of Medical Sciences of USSR [AMN SSSR]. An active part in the Conference was taken by the Member of the AMN SSSR, Professor O. B. Lepeshinskaia, the Member of AMN SSSR, Professor N. N. Zhukov-Vereshnikov, Professor S. I. Sherisherina (Saratov), I. N. Maiskii, V. S. Gostev, F. T. Grinbaum, V. A. Krestovnikova, V. N. Kosmodamianskii (Leningrad), B. G. Vainberg (Odessa); Doctors of Biological Science D. G. Kudlai, P. E. Vizir' (Kiev) E. I. Zhitova (Gor'ki), M. M. Maden; Candidates of Medical Science E. N. Melikova, I. I. Rybas (Chernovitsy), A. G. Somova (Rostov-on-Don), R. V. Petrov, A. P. Pekhov, A. Ia. Zhelkevich, A. V. Pushkova, G. K. Kalashnikova, N. S. Goriachkina, G. Ia. Kagan, Z. G. Pershina and others; in all more than 70 persons.

A report was heard from Professor G. P. Kalina; it was entitled "Summary of studies of the problem of filterable forms of microbes and prospects for further development of this problem"; as well as a series of reports, which were conducted recently, on results of studies of filterable forms. Sixteen people took part in discussions. The Conference adopted the following unanimous decision:

"The conference states that lately in the Soviet Union, as well as abroad, a large work has been conducted on studies of problems of filterable forms of microbes. The peculiarity of works, which were accomplished in our country of late, was the methodological trend in the greatest part of research; in it, for the first time in history of studies of filterable forms, was found a reflection of the general biological regularity, and the filterable forms were studied from the prosition of the law of development. At the present time the fact of the existence of filterable forms has received an undisputable recognition. It is especially important to emphasize that, with the exception of single works it was pointed out in the greater part of research that the filterable forms of microbes represent a living substance, deprived of cell structure, and which was capable of developing into cell forms.

Analysis of the recently accumulated experimental material permits one to sum up the studies of the problem of filterable forms and to come to an unanimous understanding on many questions, connected with this problem.

1. The name "filterable forms" became obsolete in the light of modern ideas, and does not correspond to the meaning which was imparted to this understanding. Filterability is only one of the peculiarities of the living substance which does not have any cellular structure; also this feature is not the basic one and is not always inherent to this substance. The term "ultramicroscopic" also does not correspond to the reality of the present time in connection with successes which were attained in the field of studies of the problem with the aid of the electron microscope; the more so because the existence of a living substance of a noncellular structure was established, which is of a size that can be observed through an optical microscope. A name, more appropriate to modern ideas, is "a" living substance of microbes, which does not have a cellular structure "or for short

a" living substance of microbes", which is then suggested for general use by the Conference.

2. The living substance of microbes can be detected in cultures of any age without other additional injurious reactions. The basic physiological cause, which assists in the appearance of living substance in cultures, must be considered the physiological aging of cells, which is accompanied by their loss of multiplication function and autolysis. All the harmfully acting factors, both the natural (biological) as well as the artificial, only force the decomposition of cells and the release of living substance.

3. The living substance of microbes possesses a greater resistance to harmful physical, thermal, chemical, and biological factors, than the cell forms. Nevertheless the limits of resistance must yet be experimentally established.

4. During the process of development of cells from the living substance there takes place a passage through several phases (stages), which are characterized by morphological, biological, biochemical and antigenic properties specific for each stage.

5. The initial stage of development of microbe cells of different kinds from the living substance is characterized by the community of a series of features independent of to which species it belongs; [Begin p.127] formation of the species specificity of the developing cultures occurs during the following generations. In this case, there can take place both a reversion to the initial species through a series of intermediate forms, corresponding to phylogenetically earlier species, as well as a formation of other species, depending on conditions under which the development occurs.

6. There exist two basic points of view on the question of the nature and of the biological sense of the living substance of microbes, which do not have a cellular structure:

a) development of microbe cells from the living substance represents a result of adaptable variability of cells to unfavorable conditions of existence;

b) precellular living substance of microbes represents an initial stage of their ontogenic development.

7. A further development of methods is necessary for a productive study of the problem; studies of mechanisms of formation of the living substance, of its accumulation and its forcing of development of microbe cells from the living substance.

8. Demands for unconditional authenticity, provisions for controls and the highest approximation to natural conditions must be required of all methods.

9. The Conference considers desirable a conducting of comparative evaluation of the existing methods for the purpose of unification and for meeting the requirements of practice.

10. It is necessary to combine into a single complex the morphological, biological, biochemical and immunological methods of research, using extensively the method of decelerated microfilming when studying the development of cells from living substance and the formation of the latter.

11. The Conference recommends to pay special attention to further development of research on the living substance of microbes, as applicable to diagnostics of infectious diseases, their pathogenesis, immunogenesis and prophylaxis.

12. Taking into consideration the special plasticity of cultures, which

develop from the living substance, to utilise them in order to try to obtain living vaccinal strains.

13. The Conference considers it necessary to ask the Problem Committee on the Variability of Microbes at the AMN SSSR to take into consideration the recommendations of the present Conference when preparing the Five-Year-Plan.

14. The Conference considers as expedient the organisation of a methodical coordination center on the studies of problems of development of microbes from the living substance.

15. To ask the Organisation Committee of the All-Union Convention of Microbiologists, Epidemiologists, Infectionists, Hygienists and Sanitary Doctors to include the report on the development of microbe cells from living substance as one of the basic reports on the program question about the variability of microorganisms.

Trans. A-973
(In full)
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Popenenkova, Z. A.

Izmenenie soderzhaniia nukleinovykh kislot v kishechnoi palochke s priobretennoi grizeminoustoichivost'iu.

[Change of nucleic acid content in intestinal rod with an acquired grizemin-resistance].

Zhur. Mikrobiol. Epidemiol. i Immunobiol. vol. 27, no. 1, p.26-32, Jan. 1956. 448.3 Z4

(In Russian)

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Cases are described in literature of loss of acquired medicinal resistance after joint cultivation of resistant strains with the sensitive or after adding of extracts of the latter to the medium (Voureka, 1948). A more protracted research has shown, that a return from penicillin-resistant state to the sensitive one is connected to the presence of ribonucleic acid in the extract from the sensitive bacteria (George and Pandalai, 1949).

Moroz (1951), studying the contents of nucleic acids in grisemin-resistant and in the initial strains of the Staphylococcus aureus and of the intestinal rod in 6,12,24 and 48 hours after multiplication has established that in resistant strains the amount of ribonucleic acid is reduced while desoxyribonucleic acid remained unchanged. The greatest change in the contents of ribonucleic acid between the resistant and the sensitive strains was noted in the younger cultures. With aging this [Begin p.27] difference diminished. The purpose of the present work was to find out if the contents of nucleic acids changed during the process of multiplication of intestinal rods with an acquired resistance to grisemin.

For this work we utilized the initial strain of the intestinal rod no. 613, resistant to 15.6 tolerance units/ml of grisemin, as well as grisemin-resistant strain no. 613 U, which was developed in the presence of 256,000 tolerance units/ml (the strains were given to us by A. F. Moroz, Scientific Co-Worker of the Department of Experimental Chemotherapy). Ordinary meat broth with pH = 7.6 served as nutrient medium. We used grisemin, series no. 13 as the antibiotic; 1 mg of it contained 18,000 units. Into 2 large bottles, containing each 3 L of meat browth, which was heated to 37°, we added a 48 hour-old broth culture of the intestinal rod in a ratio of 3-10 X 10^6 bacteria per 1 ml of culture medium. Antibiotic was added to the medium together with bacteria.

In other respects the bacteriological and chemical research was conducted according to the method described in the report I[1]. In connection with the lag in the process of multiplication of the resistant strain the rating of colonies in dishes was conducted 48 hours later, after keeping it in the incubator at 37°. For the initial strain the colonies were determined after 24 hours.

When cultivating in a broth by a deep method, the intestinal rod, a strain resistant to grisemin, the duration of the lag phase was similar to that of the cultivation of the initial strain (about 1 hour - see figure 1).

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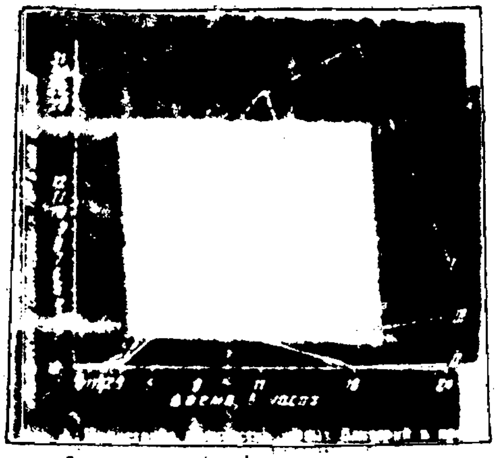
(1) ZMEI, 1955, no. 12.



Title of figure 1. Increase in the numbers of living bacteria during the process of multiplication in a meat broth. I - B. coli 613 - initial strain; II - B. coli 613 - grisemin-resistant strain without the antibiotic; III - B. coli 613 - grisemin-resistant strain in the presence of 50 tolerance units/ml of grisemin.
Words in figure 1. At the left: number of bacteria X 10^8 in ml of broth; beneath: time in hours.

Both strains of the intestinal rod began to multiply 1-1½ hours after the seeding. But since the first moment of multiplication it was clearly seen that the process of fission in the grisemin-resistant strain was retarded. To each 1 ml of broth 2,600 mln of living microbe bodies of the initial strain and 6 billion of grisemin-resistant strain were seeded. In 2 hours the number of bacteria in cultures became equal, and after 3-5 hours in the culture of the initial strain there were estimated 2 times more of living bacteria, than in the culture of the resistant strain.

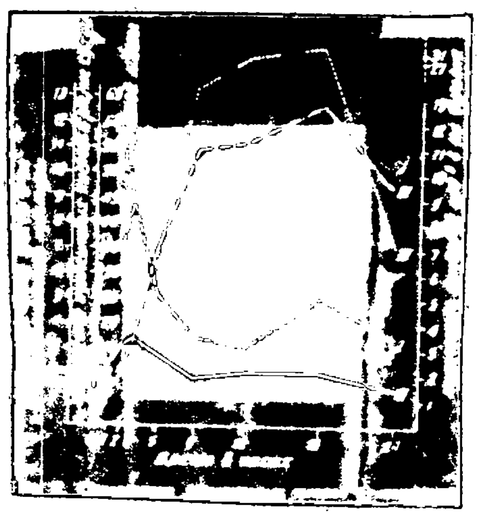
The most intensive multiplication in both strains was noted during the period between 3 and 5 hours. During this period the sensitive and the grisemin-resistant intestinal rods multiplied with about the same speed (the initial - 37 minutes, grisemin-resistant 44.6 minutes). In the initial strain after 5 hours the process of multiplication continued with a gradually diminishing speed of fission (growth in the numbers of living bacteria was.

noted up to 18 hours), but in the culture of the resistant [Begin p.28] intestinal rod only a slight multiplication of bacteria took place, and then the number of living bacteria began to decrease. With a deep method of culturing the grisemin-resistant rod divided slower than the sensitive; the period of its multiplication was shorter (the phase of dying off began after 8 hours, while in the initial strain after 18 hours).

It was also established by the research of Moroz (1951) that after the usual cultivation in a broth the grisemin-resistant intestinal rod divided slower than the sensitive, but the process of its multiplication in such a case continued for a longer time (48 hours).

When growing grisemin-resistant strain in a broth containing 50 tolerance units/ml of grisemin, we discovered the following. The resistant intestinal rod multiplied during the course of the first two hours in like manner as without the antibiotic. Multiplication in the presence of grisemin proceeded much more actively after two hours of cultivation (see figure 1). During the period between 3 and 12 hours, the grisemin-resistant rod multiplied with about the same speed as the initial strain. The process of multiplication of the grisemin-resistant intestinal rod lengthened in the presence of grisemin in the culture - the phase of dying off occurred approximately 4 hours later, than without the antibiotic. Grisemin produced a clearly stimulating action on the process of multiplication of grisemin-resistant intestinal rod. In its presence the speed of fission of bacteria approached the speed of fission of the initial strain. Thus, during the process of acquiring the resistance to grisemin, this strain also acquired a dependence on it.

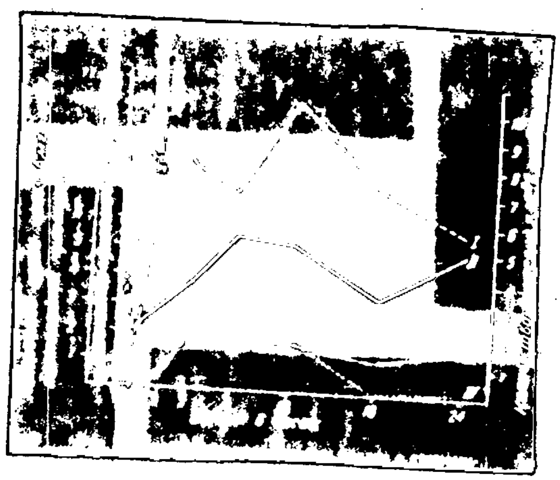
Analysis of contents of nucleic acids in the intestinal rods during the course of 24 hours of their multiplication has shown, that in the initial strain (figure 2) an accumulation of both types of nucleic acids began from the first moment of cultivation. The amount of nucleic acids was growing during the first half of the lag phase (during the course of the first 30 minutes), then during the period, which preceded the beginning of fission of bacteria, occurred its insignificant decrease. Comparison of the curve of accumulation of bacterial mass and of the curve of multiplication of bacteria showed that at the end of the lag phase the bacteria cells increased in size. May be this explained the decrease, during this period, of the amount of nucleic acids per weight unit of bacterial mass (figure 2).



Title of figure 2. Contents of nucleic acids in the initial strain of B. coli 013 during the process of multiplication in a broth. I - ribonucleic acid; II - desoxyribonucleic acid; III - amount of bacterial mass; IV - number of living bacteria.

Words in figure 2. At the left: amount of dry mass in mg X 10^2/L of bacterial culture. Amount of nucleic acids in mcg/mg of dry bacterial mass; below: time in hours; at the right side: number of bacteria X 10^8 in ml of broth.

Then their contents again increased and after 3 hours attained a maximum. During the period between 3 and 8 hours a drop in the amount of nucleic acids was noted. Their amount abruptly decreased during the period from 3 to 6 hours (during the moment of the most intensive [Begin p.29] multiplication of bacteria); after that the reduction proceeded somewhat slower (the speed of multiplication of bacteria fell). After 8-12 hours the decrease of the contents of nucleic acids stopped and their amount again began to increase somewhat (a sluggish, weak multiplication of bacteria proceeded in the culture). After 18 hours (phase of dying off of bacteria) an impoverishment in nucleic acids was noted in the intestinal rods.

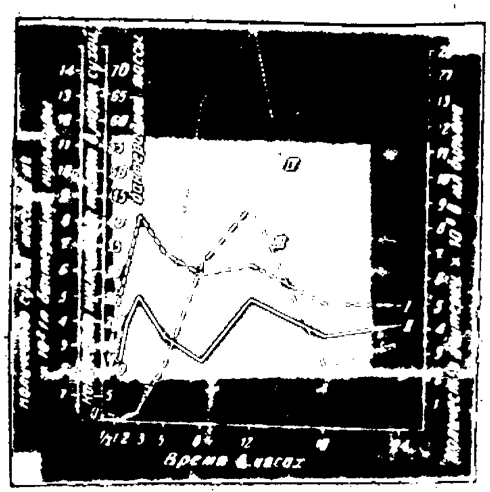


Title of figure 3. Contents of nucleic acids in grisenin-resistant strain of B. coli 613 during the process of multiplication in the broth. I - ribonucleic acid; II - desoxyribonucleic acid; III - amount of bacterial mass; IV - number of living bacteria.

Words in figure 3. At the left: amount of dry mass in mg X 10^2/L. of bacterial culture. Amount of nucleic acids in mcg/mg of dry bacterial mass. Below: time in hours At the right: number of bacteria X 10^8 in ml of broth.

It is seen from figure 3 that in grisenin-resistant culture during the lag phase the size of bacterial cells became larger, while the amount of nucleic acids decreased per weight unit. During the passing of bacteria from the lag phase to the phase of logarithmic growth the amount of nucleic acids increased in them. With the advance of the period of the fastest multiplication (from 3 to 5 hours) the amount of ribonucleic acid in intestinal rods decreased considerably. The intensity of multiplication did not tell on the contents of desoxyribonucleic acid, its amount continued to grow. With the cessation of multiplication of grisemin-resistant intestinal rods the amount of ribonucleic acid in them increased quickly, and the amount of desoxyribonucleic acid remained approximately the same. During the climax of the dying off phase of bacteria the rods became impoverished in nucleic acids.

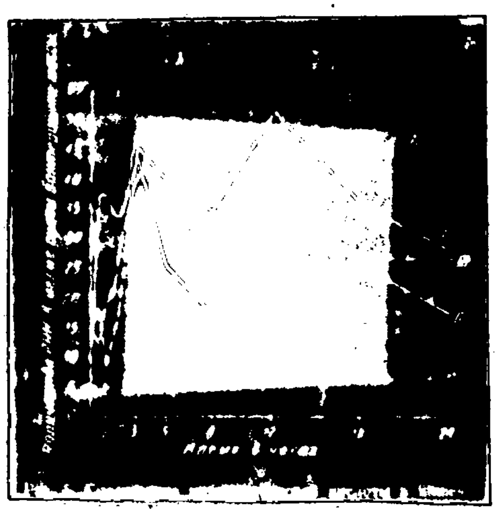
The following data (see figure 6) were obtained with the grisemin-resistant intestinal rod, which was grown in the presence of grisemin.



Title of figure 4. Contents of nucleic acids in grisemin-resistant strain of B. coli 613 during the process of multiplication in the broth in the presence of 50 tolerance units/ml of grisemin. I - ribonucleic acid; II - desoxyribonucleic acid; III - amount of bacterial mass; IV - number of living bacteria.
Words in figure 4. At the left: amount of dry mass in mg X 10^2/L. of bacterial culture. Amount of nucleic acids in mcg/mg of dry bacterial mass. Below: Time in hours. At the right: number of bacteria X 10^8 in ml of broth.

The amount of nucleic acids somewhat decreased during the first half of the lag phase (the size of cells increased), after that their amount rose, attaining the maximum after 3 hours. With the approach of the period of the most active multiplication (from 3 to 8 hours) the contents of both types of nucleic acids fell. After 8 hours the process of multiplication of grisemin-resistant rods in the presence of grisemin slowed down and the amount of nucleic acids again increased. With the approach of the phase of [Begin p.80] dying off of bacteria (after 12 hours of growth) the intestinal rods became poorer in nucleic acids. Thus, the contents of nucleic acids in both strains of intestinal rods was in close interdependence with the process of multiplication.

When comparing the curves of contents of ribonucleic acid in the sensitive and in the grisemin-resistant intestinal rods (figure 5), it was seen that their dynamics in the sensitive microbe, as well as in that which became resistant to grisemin, were similar.



Title of figure 5. Contents of ribonucleic acid in the intestinal rod during the process of multiplication in a broth. I - grisemin-resistant strain 613; II - initial strain 613; III - grisemin-resistant strain 613 in the presence of 50 tolerance units/ml of grisemin.

Words in figure 5. At the left: Amount of RNA in mcg/mg of dry bacterial mass. Beneath: time in hours.

But in the intestinal rod, which was resistant to grisemin, a considerably smaller content of ribonucleic acid (approximately by 2-3 times) was noted during the course of the first two hours of growth (lag phase and the beginning of logarithmic growth). After the third hour, the moment of the most intense multiplication, its contents in both strains became approximately equal; after this the amount of ribonucleic acid in the resistant strain exceeded the amount in the sensitive strain, because it multiplied slower than the sensitive and during the course of a shorter time.

In grisemin-resistant intestinal rod, which was cultivated in the presence of grisemin, the curve of contents of ribonucleic acid occupied a middle position between the contents of the initial and grisemin-resistant strains. Under the cited conditions (addition of grisemin) the contents of ribonucleic acid in grisemin-resistant bacteria increased during the lag phase and at the very beginning of the phase of logarithmic multiplication; after this occurred its much stronger reduction, when compared to the grisemin-resistant strain, which was grown without the antibiotic, because the addition of grisemin stimulated the process of multiplication of grisemin-resistant intestinal rods.

As for desoxyribonucleic acid, the comparison of the corresponding curves (figure 6) points to the change of dynamics of its contents in the intestinal rod, which was resistant to grisemin.

Title of figure 6. Contents of desoxyribonucleic acid in the intestinal rod during the process of its growth in broth. I - B. coli 613 - initial strain; II - B. coli 613 - grisemin-resistant strain; III - B. coli 613 - grisemin-resistant strain in the presence of 50 tolerance units/ml of grisemin.

Words in figure 6. At the left: amount of DNA in mcg/mg of dry bacterial mass. Beneath: time in hours.

If in the initial strain the accumulation of the indicated acid was detected since the first moment of bacterial cultivation, then in the grisemin-resistant strain its quantity decreased during the whole lag phase. In the initial strain the contents of desoxyribonucleic acid attained their maximum after 8 hours, then dropped abruptly (with the approach of the period of fast multiplying); but with the slowing down of multiplication they again increased somewhat and finally [Begin p.31] decreased during the period of dying off. In the grisemin-resistant strain the process of accumulation of desoxyribonucleic acid did not stop after 3 hours, although at that moment the grisemin-resistant intestinal rod was dividing with the greatest speed; the amount of acid increased during the course of 8 hours of fission. With the onset of the phase of dying off a drop in the amount of desoxyribonucleic acid began at first gradually, but after a while more quickly.

[Begin p.32]

Grisemin-resistant intestinal rod, which grew in a medium containing grisemin, occupied a middle position in dynamics of the contents of the latter. During the lag phase the curve resembled the curve of the grisemin-resistant strain. After that the curve acquired a similarity with the curve of the initial strain (as the process of multiplication under such conditions approximated to the process of growth of the initial strain); that is, the amount of acid increased up to 3 hours, and then dropped. With the lag in the process of growth the amount of desoxyribonucleic acid in grisemin-resistant bacteria, in the presence of grisemin, increased far greater, than in the initial strain, approaching its amount in grisemin-resistant bacteria which were cultivated without grisemin. At the beginning of the phase of dying off the contents of the acid dropped. And we succeeded to note that the grisemin-resistant strain during the extent of the first three hours of growth (during the lay phase and at the beginning of the phase of logarithmic growth) contained a somewhat smaller amount of desoxyribonucleic acid (about 1½ times); the grisemin-resistant intestinal rod surpassed the sensitive one in the amount of the cited acid during the next period of its development.

CONCLUSIONS

1. Intestinal rod, with an acquired resistance to grisemin, contained a smaller amount of nucleic acids than the initial, during the course of the lag phase and at the beginning of the phase of logarithmic multiplication.

2. In the intestinal rod, resistant to grisemin, dynamics of contents of ribonucleic acid during the process of growth were essentially similar to its dynamics in the sensitive strain, while the dynamics of desoxyribonucleic

acid somewhat changed to a growing direction.

3. In the intestinal rod contents of nucleic acids are in close interconnection with the process of multiplication.

4. With a deep method of cultivation the grisemin-resistant intestinal rod multiplied slower than the sensitive and the period of growth was shorter (the phase of dying off began 10 hours earlier) than in the initial form.

5. Grisemin produced a stimulating action on the process of multiplication of the grisemin-resistant intestinal rod.

LITERATURE

Moroz, A. F., On the question of the essence of the process of acquirement of resistance to chemothérapeutic preparations by bacteria. Autorepórt, dissertation, M., 1951. - George M. and Pandalai, K., Lancet, 1949, № 11, p.955. - Voureka, A., Lancet, 1948, N. 2, p.62.

Trans. A-974
(In full)
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Moroz, A. F.

Dinamika obrazovaniia in vitro ustoichivykh form bakterii k antibiotiku grizeminu.

[The dynamics of formation in vitro of resistant bacterial forms to the antibiotic grisemin].

Zhur. Mikrobiol. Epidemiol. i Immunobiol., vol. 27, no. 12, p.65-71, Dec. 1956. 448.3 Z4

(In Russian)

Drug-resistant forms of bacteria are formed after their repeated re-seedings on media which contain chemotherapeutical substances in sub-bacteriostatic doses. In such cases, apparently, two processes take place: on the one hand, there occurs a selection of bacteria which are less sensitive to the given concentration of the preparation after the elimination of all individuals sensitive to the preparation; on the other hand there proceeds a process of adaptation of the survived forms of bacteria to the increasing concentrations of the preparation, which proves to be for the microbe an unfavorable factor of the external environment. The process of adaptation is of predominant importance in the acquiring of resistance to the medicinal substance by the microbes.

From the position of Michurin's biology the resistance of micro-organisms is a regular effect of interaction of the microbe cell with the medicinal substance, which changes the processes of metabolism; and, thus, causes the formation of new resistant forms or death of the sensitive bacteria.

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The antibiotic grisemin, which was chosen by us for the studies of dynamics of the formation of resistant forms of bacteria, is a dry preparation; it is highly soluble in water; it was first obtained in the Department of Infectious Pathology and Experimental Therapy of the Institute of Epidemiology and Microbiology imeni Gamaleia of AMN SSSR [Academy of Medical Sciences of USSR] under the leadership of Professor Planel'es. This preparation retains its activity during the course of unlimited time when in the dry form; it is also preserved quite stably while in solution. Grisemin produces a sharply expressed bacteriostatic action on all bacteria sensitive to its reaction; under certain conditions it can also react bactericidally.

It was necessary to test the sensitivity of bacteria to grisemin before beginning the studies of dynamics of formation of grisemin resistant forms of bacteria. We studied the sensitivity of two strains of B. coli, of two strains of staphylococci, two strains of bact ria of Grigor'ov-Shiga, of one strain of Flexner's dysenteric rod and of a strain of hay bacillus.

Grisemin chloride (series no. 6), which we utilized for the research, contained 16,000 antibacterial units in 1 mg. For the preparation of working solutions of grisemin we dissolved the dry preparation in distilled water at a rate of 1 mg per 1 ml. We utilized in our work a method of serial dilutions in test tubes with the addition of agar. Results were taken from test tubes where the smallest amount of grisemin fully inhibited the growth of bacteria.

It is seen from table 1, in which the results of this preliminary experiment are summed up, that the sensitivity to grisemin in various strains and species of microorganisms is different.

After that we proceeded to study the conditions under which the formation of grisemin resistant forms of bacteria occurred. The obtaining of grisemin-resistant forms of bacteria in vitro was conducted by two methods:

1) cultivation on media, which contained constant low concentrations of the preparation, and

2) cultivation on media, which contained progressively increasing concentrations of the antibiotic. [Begin p.66]

Table 1.

Sensitivity of bacteria to grisemin

Microorganisms	Concentration of grisemin in gamma per/ml of medium						Control, without the antibiotic
	0.45	0.9	1.95	3.9	7.8	15.6	
Staphylococcus aureus no. 5	+	+	+	+	+	+	++
Wood's Staphylococcus	+	+	-	-	-	-	++
B. coli no. 613	+	+	+	+	-	-	++
B. coli no. 865	+	+	+	+	+	-	++
Grigor'ev-Schiga bacillus no. 913	+	-	-	-	-	-	++
The same, no. 1360	+	+	-	-	-	-	++
Flexner's bacillus no. 1160	+	-	-	-	-	-	++
Hay bacillus	+	+	+	+	-	-	++

Conventional signs: - presence of the inhibiting action; + absence of action.

Concentration in 7.8 tolerance units/ml was chosen as a fixed concentration of grisemin, in the presence of which we passaged the strains studied by us. Before proceeding with a systematic daily passaging of cultures on agar with the indicated constant concentration of the preparation, the strains, which were sensitive to a smaller amount of grisemin (strain of Wood's Staphylococcus, both strains of bacillus Grigor'ev-Shiga and of Flexner's bacillus), were adapted in succession to 1.95; 3.9 and 7.8 units of grisemin per 1 ml of medium. We utilized the meat-peptone salt-free agar of double concentration as a medium. After a 24-hour stay of the culture in the incubator on a medium with the antibiotic, we made reseedings, first of all, on a medium with the same concentration of the antibiotic, and, secondly, on a medium, containing increasing concentrations of the preparation. This procedure was repeated up to the time when the resistance of strains increased and they began to grow in the presence of 7.8 units of grisemin.

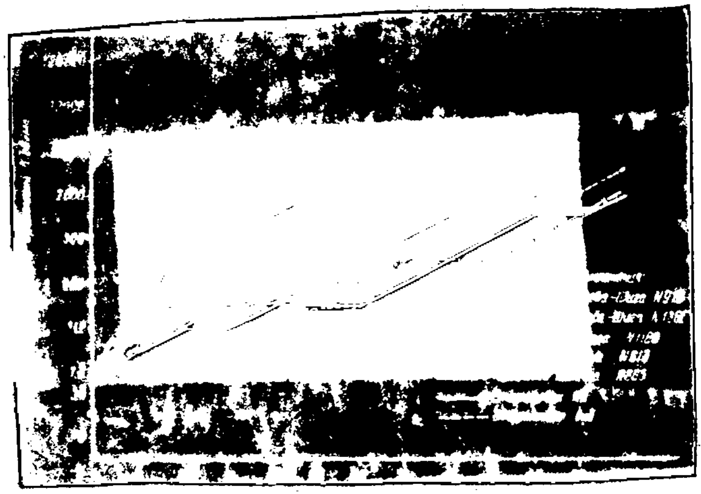
Having obtained strains, which were resistant to the indicated concentration of grisemin, we proceeded with adaptation of all cultures to this concentration of the antibiotic. Passages were conducted at an interval of 48 hours. After each 5 passages the resistance of strains was tested on the same nutrient medium, containing further consecutively increasing concentrations of the antibiotic. With such a method of cultivation a rather fast increase in resistance was observed in some strains.

As it is seen from figure 1, the resistance increased the quickest in, dysenteric bacteria, especially in the Grigor'ev-Shiga bacillus, no. 913; it increased somewhat slower in the other dysenteric strain of Grigor'ev-Shiga no. 1560. The resistance of dysenteric strain of Flexner no. 1160 increased by 500 times after the 50th passaging.

The resistance of B. coli no. 613 increased by 125 times when nearing the 35th passaging. In the strain of hay bacillus, examined by us, the resistance to grisemin increased also, after passaging this preparation on subbacteriostatic concentrations. [Begin p.67]. The slowest increase in resistance to grisemin was observed in staphylococci.

Thus, all the cited experiments showed, that the bacteria examined by us, which were originally sensitive to grisemin, formed resistant variants after a considerable number of reseedings in the presence of a constant con-

centration of the antibiotic (7.8 tolerance units/ml).



Title of figure 1. Increase of resistance of bacteria to the antibiotic grisemin after passaging through constant concentrations of the preparation.

Words in figure 1. At the left: concentration of grisemin in tolerance units/ml.; below. passagings; inside the picture – Conventional signs: Grigor'ev-Shiga bacillus no. 913; Grigor'ov-Shiga bacillus no. 1560; Flexner's bacillus no. 1160; B. coli no. 613; B. coli no. 865; Staphylococcus no. 5; Wood's Staphylococcus.

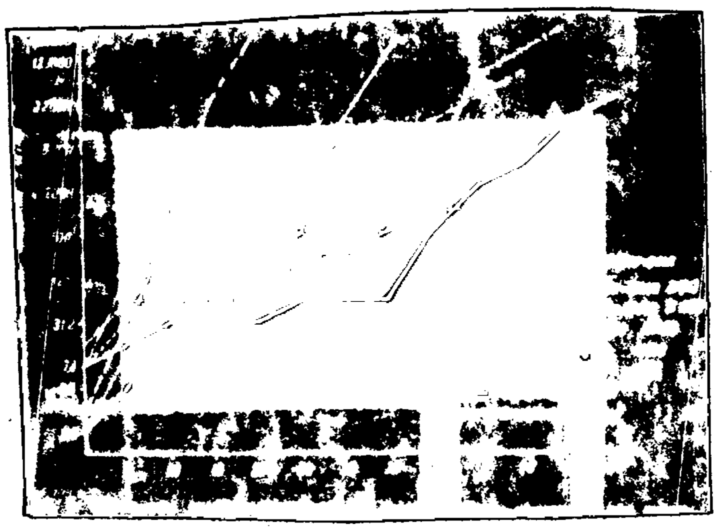
Passagings through media, containing the increasing concentrations of the preparation, were conducted in the following manner. From test tubes with a concentration of the preparation which produced a noticeable bacteriostatic action, reseedings to a nutrient media, containing the same or a higher concentration of grisemin, according to the intensity of the growth of the corresponding strain were made with a loop. The above cited salt-free meat-peptone agar of double concentration was used as a medium. At the same time control passagings of the same strains were conducted on the salt-free agar, which did not contain any antibiotic.

The regularities, which were uncovered by us, on the rise of the resistance to grisemin during such a method of cultivation, are cited in figure 2.

One can see from the cited data that, after cultivation of bacteria on media with increasing concentrations of the antibiotic, a comparatively fact formation of the grisemin resistant forms occurred.

One can see from the cited curves that the dysenteric cultures acquired a comparatively high degree of resistance to grisemin. Highly resistant variants were also obtained in B. coli and in hay bacillus. The staphylococcal strains reached somewhat slower the high level of grisemin resistance.

Thus, all the cited experiments showed that bacteria, tested by us, after a considerable number of reseedings on media which contained increasing concentrations of grisemin, became resistant to rather high concentrations of the preparation. [Begin p.68]



Title of figure 2. Increase of resistance of bacteria to antibiotic grisemin after its passaging through increasing concentration of the preparation.
Words in figure no. 2. At the left: concentration of grisemin in tolerance units/ml; below: passagings; inside - Conventional signs: Grigor'ov-Shiga bacillus no. 918; Grigor'ov-Shiga bacillus no. 1360; Flexner's bacillus no. 1160; B. coli no. 613; B. coli no. 865; Staphylococcus no. 6; and Wood's Staphylococcus.

Origin of variants, which have a high degree of resistance to grisemin, is, positively, a response of microorganisms to the presence in the medium of a specific substance in relation to which a resistance is developing.

When comparing the results, obtained after passaging the bacteria by different methods, one can observe an extremely energetic adaptability of microbes during the second method of cultivation (passages on media, containing increasing concentrations of grisemin). Comparison of the rise of resistance during both methods of culturing of bacteria is represented in the combined table 2.

Apparently, the difference in the speed of the rise of resistance of bacteria to grisemin is explained by the fact that in case of their culturing on media which contain a constant low concentration of grisemin, there, basically, taxes place an adaptation to the antibiotic substance, whereas during cultivation on increasing concentrations of the preparation there take place both the adaptation and the selection of the more resistant organisms.

We have checked the stability of the resistance to grisemin, acquired by the bacteria, after their prolonged storing in an agar columella under vaseline oil, as well as after a great number of reseedings on agar, which did not contain the antibiotic. Observations have shown that the artificially acquired resistance to grisemin by the culture did not decrease after storing under vaseline oil for the duration of three years.

Cultures, resistant to grisemin were seeded in test tubes with meat-peptone agar and after an 18-20 hour incubation at 37° again were reseeded to the same agar. After 260 such reseedings these cultures' resistance was tested on meat-peptone agar, containing grisemin. It was established that the cultures did not lose their acquired capability to grow on a medium containing high concentrations of the preparation. Consequently, the resistance to grisemin, acquired by the cultures, can be preserved for a long time and be transmitted hereditarily. [Begin p.69].

Table 2.

Increase of bacterial resistance to grisemin when cultivating them on increasing and constant concentrations of the antibiotic (composite table)

Microorganisms	Growth at a concentration of grisemin in tolerance units/ml	When passaging through increasing concentrations		When passaging through constant concentrations	
		Number of passages	Multiplicity of the increase of resistance	Number of passages	Multiplicity of the increase of resistance
B. coli, no. 613	7.8	35	16,000	35	125
B. coli, no. 865	15.6	60	16,000	60	125
Hay bacillus	7.8	35	16,000	35	125
Staphylococcus aureus no. 5	7.8	70	8,000	70	250
Wood's Staphylococcus	1.95	70	32,000	70	2,000
Grigor'ev-Shiga bacillus no.1360	1.95	35	8,000	35	2,000
Same, no. 913	0.97	20	256,000	20	16,000
Flexner's bacillus no. 1160	0.97	50	64,000	50	4,000

A large number of cases is described in literature when the resistance of bacteria to one antibiotic involves a simultaneous increase in resistance to many other preparations. From this point of view it seemed interesting to find out if a crossed resistance takes place in grisemin resistant bacteria to other chemotherapeutic substances. We conducted a research in studies of crossed resistance of grisemin resistant cultures to streptomycin, penicillin, aureomycin and chloromycetin. We examined simultaneously the initial sensitive strains and the grisemin resistant variants.

As it is seen from table 3, in bacteria, which acquired a resistance to grisemin, a simultaneous increase in resistance to other antibiotics was detected: to penicillin, streptomycin, aureomycin, and partially to chloromycetin. Grisemin resistant variants of B. coli and of Staphylococcus aureus proved to be cross resistant to penicillin (from 3 to 64 times). Of greatest interest was the change in sensitivity to streptomycin in B. coli, hay bacillus, Staphylococcus aureus and dysenteric culture of Grigor'ev-Shiga after acquiring the resistance to grisemin. In strains of B. coli, which were resistant to grisemin, resistance to streptomycin increased simultaneously by 500-1,000 times. In grisemin resistant variants of Staphylococcus aureus of hay bacillus and of the dysenteric bacillus Grigor'ev-Shiga the resistance to streptomycin also increased simultaneously by 25-125 times. Apparently, the inner reorganization of the bacterial cell, which acquired the resistance to grisemin, spreads to a complex of chain reactions, which, to some measure, include substrata, that are reacted upon by streptomycin also.

In B. coli an increase was also simultaneously detected in the resistance to aureomycin (by 26 and 51 times) and to chloromycetin (by 2 times); in dysenteric cultures of Grigor'ev-Shiga and of Flexner - to chloromycetin (by 2-4 times). [Begin p.70]

Table 3.

Microorganisms	Growth at a concentration of grisemin in tolerance units/ml	Crossed resistance: Penicillin — Sensitivity in tolerance units/ml	Penicillin — Miltiplicity of the increase of resistance	Streptomycin — Sensitivity in tolerance units/ml	Streptomycin — Miltiplicity of the increase of resistance	Aureomycin — Sensitivity in tolerance units/ml	Aureomycin — Miltiplicity of the increase of resistance	Chloromycetin — Sensitivity in tolerance units/ml	Chloromycetin — Miltiplicity of the increase of resistance
B. coli no. 613, initial	7.8	62	64	0.2	1,000	10	31	7.8	2
B. coli no. 613, resistant	128,000	4,000		200		312		15.6	
B. coli no. 865, initial	15.6	40	50	0.4	500	12	26	15.6	
B. coli no. 865, resistant	256,000	2,000		200		312		31.2	
Hay bacillus, initial	7.8			0.8	125				
Hay bacillus, resistant	128,000			100					
Staphylococcus aureus no. 5, initial	7.8	0.05	16	2	100				
Staphylococcus aureus no. 5, resistant	64,000	0.8		200					
Wood's Staphylococcus, initial	1.9	0.02		0.8	25				
Wood's Staphylococcus, resistant	64,000	0.16	8	20					
Bacillus Grigor'ev-Shiga, no. 913, initial	0.9			1.6	125			1.9	4
Bacillus Grigor'ev-Shiga, no. 913, resistant	256,000			200				7.8	
Bacillus Grigor'ev-Shiga, no. [illegible], initial	1.95								
Bacillus Grigor'ev-Shiga, no. [illegible], resistant	16,000								
Flexner's bacillus no. 1160, initial	0.9							7.8	2
Flexner's bacillus no. 1160, resistant	64,000							15.6	

An assumption was expressed in a series of works that the resistance acquired to one or another substance was a specific phenomenon. Some researchers suggested utilizing antibiotic resistant bacteria for the identification of strains of Actinomycés—producers of antibiotic substances when isolating them from the soil. In the practice of our laboratory this assumption was not confirmed, as it was established that grisemin resistant variants of B. coli and of Staphylococcus aureus showed an increased resistance to several [Pegin p.71] newly isolated strains of Actinomyces-producers of antibiotics, which, as it was disclosed later, produced antibiotic substances that differed from grisemin.

CONCLUSIONS

1. After a considerable number of passages of bacteria in the presence of increasing concentrations of grisemin a rise in resistance, was noted, which exceeded the initial one by 8,000-256,000 times.

2. When cultivating these same bacteria at a constant low concentration of grisemin (7.8 tolerance units/ml) the resistance to the antibiotic increased much slower and reached a much lower degree - from 125 to 16,000 times.

3. The resistance to grisemin, acquired by the bacteria, was preserved during the course of three years both when stored in a columella under vaseline oil as well as after 80 reseedings on meat-peptone agar, which did not contain the antibiotic.

4. When studying crossed resistance to other chemotherapeutic substances it was shown that grisemin resistant bacteria acquired crossed resistance of various strength to many other antibacterial substances (streptomycin, penicillin, aureomycin and chloromycetin.

(In full)
vg/A

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Materialy k voprosu ob izmenchivosti kishechnoi palochki.

[Material concerning the problem of variation in the enteric bacillus].

Akademiia Nauk Latviiskoi SSR. Institut Mikrobiologii. Trudy. no. 5, p.27-45. 1956. 448.39 R44

(In Russian)

In recent years extensive investigations have been conducted of the study of variation in the enteric bacillus under influences exerted by the most varied factors. Thus, for example, it has been established that changes occur in the enteric bacillus under the influence of a prolonged stay in river, sewer, sterile or chlorinated water, and in sterile and ordinarily tillable soil.

A study has been made of the changes occurring in the enteric bacillus under conditions of long growth on various culture media. Unusual and sometimes fairly stable variants of the enteric bacillus have been isolated from patients suffering from infectious and non-infectious diseases.

Para-agglutination of the enteric bacillus is now considered a resultant of unique, associated reciprocal relations between pathogenic microbes of the typhoid-paratyphoid and dysenteric groups.

F. F. Lebedev has demonstrated stable changes that have taken place in cultures of the enteric bacillus exposed to the influence of leucocytes.

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The works of a number of researchers (Gracheva, Kudlai, Lebedev, Timakov, Semchev and others) have demonstrated the possibility of obtaining "directed" variants of the enteric bacillus under conditions of concurrent growth with live and killed pathogenic microorganisms of the enteric group, or under the influence exerted by the antigenic products of their activity. Thus, variants were obtained that in their biochemical characters, antigenicity and even pathogenicity are closely related and similar to typhoid-paratyphoid and dysenteric microorganisms.

In addition to this, variation of the enteric bacillus occurring under the influence of antibiotic preparations continues to be insufficiently investigated; there is a dearth of experimental data needed for the characterization of the variation range of the enteric bacillus; the regularities in its changes have not been disclosed; the degree of the relationship and nearness of the enteric bacillus to other pathogenic and conditionally pathogenic microorganisms has not been studied; neither a model nor conditions for regular obtaining of objectively directed variants of the enteric bacillus needed for the selection of apathogenic vaccines against enteric diseases have been worked out in detail. [Begin p.28].

Variation of the enteric bacillus occurring under the influence of antibiotic preparations continues to be inadequately investigated. Yet, at the same time, the latter deserves attention on the strength of its widespread use and sometimes long intake by way of the mouth of preparations of a broad spectrum of activity the action of which pertains also to the enteric bacillus. Injury by antibiotics of conditionally pathogenic microorganisms, violation of the specific composition of normal, intestinal flora, and phenomena of disbacteriosis have been described by a number of authors and are considered a resultant of inefficient use of antibiotics. Injury by antibiotics of the enteric bacillus - a constant and active member of the microbe association of the intestines - is associated with the activation of other conditionally pathogenic microorganisms (Proteus, bluepus bacillus, yeast-like fungi, enterotoxic staphilococci), increase in putrefactive processes in the intestines, entry of poisonous products and the most conditionally pathogenic microorganisms into the blood. In the wake of this, there develop pathological processes, in particular diarrhea, intoxication, disseminated Candida mycosis etc.

The given work is the next link in our investigations devoted to the variation of pathogenic and conditionally pathogenic microorganisms of the enteric group under the influence of biological factors.

The task of our investigations was detection of variation in the enteric bacillus under the influence of the most distributed antibiotics of a wide spectrum of activity, contrasting and study of antibiotic variants as compared with those obtained under the influence of other biological factors. The influence of a microbe association as of a factor of microbe variation no longer arouses any doubt. With respect to the enteric bacillus, it has been established in nature as well as under experimental conditions. In a widespread distribution in nature (soil, water, food products, organic substrates, excrements of man and animals etc.) the enteric bacillus is constantly under the influence of various biochemical actions of other representatives of the microbe association.

We dwelled on soil ameba as one of the representatives of the latter and as being alluring for experimental investigations for a number of considerations. Ameba is not at all a rare member of microbe associations in sewer waters, soil and refuse. Their feeding on microorganisms has been known long since and is readily exposed in cultural and pathological material. They have at their disposal a fermentative complex at various stages of the digestive process which injures variously enteric bacilli, and they determine the changes. We used in our experiments the cultures of soil amebae obtained at one time by A. A. Konokotina and fed supplementarily in our laboratory with saprophytes. By means of specific seeding and reseeding during a whole series of passages, the transfer of amebae from yeast nutrition to cultures of an experimental strain of the enteric bacillus was made possible and a firm association of amebae with the enteric bacillus on a meat-peptone agar-agar was created. Two strains of the enteric bacillus, Nos. 32 and 36, were used in the experiments [Begin p.29]; with respect to all characters these strains corresponded with the typical culture of the microorganisms indicated. We dwelled on these cultures chiefly because their variation has been widely investigated in the laboratory of GIDUV [State Postgraduate Institute for Physicians]. It has been established that they undergo changes under the influence of tissue enzymes (leucocytes, connective tissues, spleen and others) and various antibiotic preparations, and also under conditions of museum cultivation. Besides, strain no. 36 had been obtained at one time by F. F. Lebedev from one cell.

Methodology of work. In both experimental series passages were carried out either on meat peptone agar, or in a culture of leucocytes with a gradually increasing antibiotic content at intervals of 5-7 days; a similar experiment was conducted with an amebae culture. From each passage of reseeding, seedings were carried out on Endo's medium for the purpose of making a study of the growth character of the enteric bacillus. Ten colonies were taken from every tenth passage for a study of biochemical activity and specific antigenicity of cultures. The cultural and microscopic characteristics, biochemical activity and antigenicity in unusual variants and highly adapted strains have been investigated. Many variants (160) obtained in the process of adaptation to action exerted by antibiotics and amebic cultures have been subdivided into several types taking into account their biochemical activity on media of a "variegated series" and have been subjected to a further microbiological study. For the purpose of detecting regularities, the variants obtained were contrasted with those in the original cultures, and were analysed as to the origin of the variants (antibiotics, amebae); as a result, characteristics of similarity and differences have been detected.

Let us dwell on the results of the experiments we conducted.

The initial passage was conducted on media containing one third of an antibiotic bacteriostatic dose. With each new passage the antibiotic content in the medium was gradually increased. In rare cases with a meager growth on new antibiotic concentrations it was necessary to repeat the seeding on the same medium and after that to switch over to a new [medium] with a higher antibiotic content.

Adaptation of the enteric bacillus to different antibiotics is accomplished variously: adaptation to some is fairly easy and rapid, to others, conversely, it is slow and does not attain high indicators. In the main, 2 types of adaptation curves were determined: the highest ones - to streptomycin and the lower ones - to levomycetin. Increase in resistance to streptomycin begins with the first passages and reaches high indicators fairly rapidly. Conversely, increase in resistance to levomycetin begins very slowly, requires replicate reseedings on the same medium, and shifts in adaptation are observed on the third passage. The final resistance indicators in cultures adapted to levomycetin are not high, they do not approach those on streptomycin media.

Adaptation to levomycetin proceeds according to the "penicillin type", [Begin p.30]. Increase in resistance is also inhibited in microorganisms that have a sensitivity to it.

Adaptation to syntomycin is accomplished somewhat more readily, but it comes closer to it [penicillin type] in relation to levomycetin.

Dynamics of variation in experimental cultures varied in relation to the action exerted by one factor or another. The earliest changes occurring in cultural characteristics emerge in the process of adaptation to antibiotics, [Begin p.31] in particular, under the influence of streptomycin, then levomycetin and syntomycin. Unusual variants appeared considerably later in seedings [taken] from associations with amebae.

Table 1 illustrates variation dynamics of the biological properties of some strains in the process of adaptation to antibiotics and amebae. Data in the table demonstrate the variety of biochemical activity of cultures of the enteric bacillus that have undergone passaging, the absence of a strict relation between the appearance of some varieties or others and the multiplicity of the passages and the nature of the action-exerting factor.

Table 1.

Origin	Passage	Arabinose	Glucose	Levulose	Galactose	Saccharose	Lactose	Maltose	Glycerin	Mannite	Milk	Methyl-red	Simmons medium	F. Voges-Proskauer	H_2S	Indole	Agglutin. titer with "orig." serum
Original		AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	-	-	-	+	up to 1:18000
Streptomycin	10	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	+	-	-	-	No agglut.
	20	A	A	-	A	—	—	—	—	—	-	+	+	-	-	-	No agglut.
	30	AG	AG	AG	AG	AG	AG	AG	+	AG	-	+	+	-	-	-	No agglut.
	40	A	A	—	—	—	—	—	—	—	-	+	+	-	-	-	No agglut.
	50	—	—	—	—	—	—	—	—	—	-	-	-	-	-	-	1:6000
Syntomycin	10	AG	AG	AG	AG	—	AG	AG	AG	AG	A +	+	-	-	-	+	1:6000
	20	AG	AG	AG	AG	—	AG	AG	AG	AG	A +	+	-	-	-	+	1:8000
	30	AG	AG	AG	AG	—	AG	AG	AG	AG	A +	+	-	-	-	+	1:1000
	40	AG	AG	AG	AG	—	—	AG	AG	AG	A +	-	-	+	-	+	1:1000
	50	AG	AG	AG	AG	—	—	AG	AG	AG	A +	+	-	-	-	+	1:6000
Levomycetin	10	AG	AG	AG	AG	—	AG	AG	AG	AG	A +	+	-	-	-	+	[illegible]
	20	AG	AG	AG	AG	—	AG	AG	AG	AG	A +	+	-	-	-	+	1:1000
	30	AG	AG	AG	AG	—	AG	AG	AG	AG	A +	+	-	-	-	+	1:500
	40	AG	AG	AG	AG	—	AG	AG	AG	AG	A +	+	-	-	-	-	1:600
	50	—	—	—	—	—	—	—	—	—	A, +	+	-	+	-	-	1:12000
Original		AG	AG	AG	AG	—	AG	AG	AG	AG	-	-		-	-	+	1:6000
Amoebae	10	AG	AG	AG	AG	—	AG	AG	AG	AG	-	-	-	-	-	-	1:6000
	20	AG	AG	AG	AG	AG	AG	AG	AG	AG	-	-	-	-	-	+	No agglut.
	30	—	A	—	—	A	—	A	—	—	-	-	+	-	-	+	No agglut.
	40	—	—	—	—	—	—	A	—	—	-	+	-	-	-	-	No agglut.
	50	—	—	—	—	—	—	—	—	—	-	-	-	-	-	-	No agglut.

As special investigations have demonstrated, the seeming variety of changes is due to the different depth and stability of the changes that had occurred in the different specimens of a given culture and their viability in further passages. Nonetheless, regardless of the diversity of the same adaptive strain, some regularities have been established in the frequency and time of the appearance of unusual variants.

Thus, the first variants to appear in the process of adaptation to antibiotics and, in part, to the action of amebae are those that are losing the capacity to produce acid and gas-like products either on one or on several carbohydrates, then cultures close to paracoli and Coli citrovorum and later "alkali-producing" variants that, as to depth and stability of changes, come close to the cultures of the fecal alkali-producing agent [Alcaligenes fecalis]. We have detected the indicated changes in cultures under the influence of all experimental antibiotics and when exposed to the action of soil amebae.

Alkali-producing variants are not inherent only in the enteric bacillus. As demonstrated by systematic observations conducted by fellows of the Faculty of Microbiology GIDUV [State Postgraduate Institute for Physicians], they emerge under action exerted by leucocytes in cultures and under the influence of specific sera and antibiotic preparations in various representatives of pathogenic microorganisms of the enteric group.

Thus, K. M. Zlatina has found them in dysenteric bacilli of Grigor'ev-Shiga, V. F. Kondrat'eva - in Flexner's bacilli, E. F. Rozenfel'd - in the Kruse-Sonne bacillus, F. F. Lebedev - in the enteric bacillus, A. L. Sluvko - in the paratyphoid breslau microbe, [B. breslaviensis], and V. P. Iamshchikov - in Morgan's bacillus. The alkali-producing variants have been described by D. G. Kudlai as a regular stage of adaptive variation. They must actually be considered as the first stable signals of profound changes occurring in metabolism of experimental microbes under the influence exerted by a whole series of factors.

In the process of adaptation to antibiotics and soil amebae, we obtained 160 variants subdivided into 15 groups on the basis of [their] biochemical activity and antigenicity. Characterizing data are cited in table 2. The variants obtained were subjected to a scrutinizing microbiological characterization along the line of cultural and microscopic characteristics, [Begin p.32] and biochemical activity with respect to carbohydrates, aminoacids, presence of some enzymes and viability.

Table 2.

No. Conses.	Types	Origin of strains	Biochemical characteristics: Number of strains	Arabinose	Glucose	Levulose	Galactose	Saccharose	Lactose	Maltose	Glycerin	Mannite	Milk	Methyl-red	Simons medium	F. Voges-Prosk.	Indole	H_2S	Nitrate reduct.
1	I	Orig.	1	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	-	-	+	-	+
2	II	Strept.	100	AG	AG	AG	AG	AG	AG	AG	AG	AG	-	+	+	-	-	-	-
3	III	Strept.	22	A	A	—	A	—	—	—	—	—	-	+	+	-	-	-	+
4	IV	25 passag.	8	A	A	A	A	—	A	A	A	A	-	+	-	-	+	-	+
5	V	Strept.	7	AG	AG	AG	AG	AG	AG	AG	AG	AG	-	+	+	-	-	-	+
6	VI	Strept.	13	AG	AG	AG	AG	AG	—	AG	AG	AG	-	+	+	-	-	-	+
7	VII	20 passag.	1	AG	AG	AG	AG	—	—	AG	AG	AG	-	+	-	-	+	-	+
8	VIII	10 passag.	1	—	—	—	—	—	—	—	—	—	-	+	-	-	-	-	-
9	IX	5 passag.	1	—	—	—	—	—	—	—	—	—	-	+	+	-	-	-	-
10	X	Strept.	1	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	+	-	-	-	+
11	XI	Strept.	1	AG	AG	AG	AG	AG	AG	AG	—	AG	-	+	+	-	-	-	-
12	XII	Strept.	1	—	—	—	—	—	—	—	—	—	+	-	-	+	-	-	-
13	XIII	20 passag.	1	AG	AG	AG	AG	—	AG	A	AG	AG	-	+	-	-	+	-	+
14	XIV	25 passag.	1	—	A	A	—	A	—	A	—	A	-	+	+	-	-	+	-
15	XV	10 passag.	1	A	AG	AG	AG	—	AG	A	AG	AG	-	+	-	-	+	-	+

Let us dwell on each section separately.

The cultural characteristics we studied on meat-peptone agar and on Endo's medium; the pH of the medium was 7.2. A description of the cultures was made on the fifth day of observation; for the appearance of variants of daughter and secondary cultures the seedings had to be kept for 12 days at room temperature.

Endo's medium proved most favorable for the detection of polymorphism of cultural characteristics. Apart from the size and forms of the colonies, here it was possible to observe the different shadings of the cultures resulting from an alteration in the biochemical activity of variants on a given medium.

With regard to cultural characteristics, the variants which we obtained can be subdivided into several groups.

1. Large, smooth, red colonies with a metallic hue, a flat center and a slanting, fairly wide periphery. Under a microscope they were found to have a preponderance of short gram-negative bacilli, infrequently short little chains were encountered.

2. Large, smooth, red and rose-colored colonies without a metallic luster, flat at the center and concentrically striated on the periphery. Under a microscope, short coccobacteria and fairly long thread-like bacilli [niti] have been encountered in them side by side with typical [bacilli]. [Begin p.38].

3. Smooth, round colonies slightly dome-shaped, with an even edge, at first entirely colorless, later (8th-12th day) rose-colored and even reddish. Under a microscope, short and long bacilli, more rarely coccobacteria and little chains of gram-positive bacilli were found among them.

4. At first colorless, later turning red, small, round, smooth colonies, sometimes with a small depression at the center. They are composed of short and long gram negative bacilli; thread-like forms are rare.

5. Smooth, round, very small (0.3-0.5 mm in diameter) dwarf-like colonies of a red and rose color, sometimes colorless at the beginning, later turning rose-colored. Under a microscope they are found to have a preponderance of small coccobacteria; thin and long bacilli are found to be a rare exception.

6. Colorless, round, sometimes rampart-shaped colonies with an even or wavy edge, transparent, with a rose-colored hue only at the center. Under a microscope polymorphic short and long, and thin gram-negative bacilli are found in them.

7. Dome-shaped, smooth, colorless or rose-colored colonies of a mucous consistency. Under a microscope, short and thin bacilli, infrequently small chains and small heaps of wider coccobacteria are found among them.

8. Round, smooth, flat, colorless or rose-colored colonies with a similar wavy edge. On meat-peptone agar the colonies are lusterless and yelllow colored. Under a microscope, short and thin bacilli and threads, as well as chains of coccobacteria are found among them.

9. Round colonies, smooth at the center, radially [radiarno] or disorderly striated at the periphery, with an uneven, dented edge. Under a microscope, short bacilli, individual coccobacteria and chains are found among them. First place as to frequency among our variants is occupied by colorless, transparent, smooth colonies that later on turn rose-colored. Colorless or rose-colored mucous colonies, as well as colorless colonies with a rose-colored center and rampart-shaped edges are found much more rarely. Striated and dwarf-like colorless or red colonies must be considered as rare.

Besides, they proved to be the least stable in reseeding; they lost [their] unusual characteristics after 5-8-12 reseedings on solid media with no active factor.

We have studied the biochemical activity of adapted cultures and unusual variants with respect to carbohydrates and aminoacids. Carbolytic properties we studied on 16 media of an analytical "variegated" series. Observations were conducted repeatedly in the process of adaptation as well as outside the active factor for the purpose of detecting the stability of unusual characters. [Begin p.34].

Table 3.

No. of strains	Origin	Quantity of strains	Biochemical characters															
			Arabinose	Glucose	Levulose	Galactose	Saccharose	Lactose	Maltose	Glycerin	Mannite	Milk	Methyl red	Simons medium	Voges-Prosk. reac.	Indole	H_2S	Nitrate reduc.
1	Orig.	No. 38	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	-	-	+	-	+
2	Strep.	100	AG	AG	AG	AG	AG	AG	AG	AG	AG	-	+	+	-	-	-	-
3	"	22	A	A	—	A	—	—	—	—	—	-	+	+	-	-	-	+
4	"	13	AG	AG	AG	AG	AG	—	AG	AG	AG	-	+	+	-	-	-	+
5	"	7	AG	AG	AG	AG	AG	AG	AG	AG	AG	-	+	+	-	-	-	-
6	"	1	AG	AG	AG	AG	AG	AG	AG	—	AG	-	+	+	-	-	-	-
7	"	1	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	+	-	-	-	+
8	"	1	—	—	—	—	—	—	—	—	—	-	-	+	-	-	-	-
9	"	1	—	—	—	—	—	—	—	—	—	-	+	+	-	-	-	-
10	"	1	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	+	-	-	-	+
11	"	1	AG	AG	AG	AG	AG	AG	AG	—	AG	-	+	+	-	-	-	-
12	"	1	—	—	—	—	—	—	—	—	—	+	+	-	+	-	-	+
13	"	1	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	-	-	+	-	+
14	"	1	—	A	A	—	A	—	A	—	A	-	+	+	-	-	+	+
15	"	1	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	-	-	+	-	+
16	Orig.	No. 32	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	-	-	+	-	+
17	Ameba	1	—	—	—	—	—	—	—	—	—	-	+	-	-	-	-	-
18	"	1	—	—	—	—	—	—	—	—	—	-	+	+	-	-	-	-
19	"	8	A	A	A	A	—	A	A	A	A	-	+	-	—	+	-	+
20	"	1	A	AG	AG	AG	—	AG	AG	AG	AG	-	+	-	-	+	-	+
21	"	1	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	-	-	+	-	+
22	"	1	AG	AG	AG	AG	—	—	AG	AG	AG	-	+	-	-	+	-	-
23	"	1	—	A	A	—	A	—	A	—	A	-	+	+	-	-	+	-

Continued on next page

Table 3, Continued

No. of strains	Origin	Quantity of strains	Biochemical characters: Arabinose	Glucose	Levulose	Galactose	Saccharose	Lactose	Maltose	Glycerin	Mannite	Milk	Methyl red	Simons medium	Voges-Prosk. reac.	Indole	H_2S	Nitrate reduc.
24	Ameba	1	—	—	—	—	—	—	—	—	—	-	+	+	-	-	-	-
25	"	1	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	-	-	-	-	+
26	Synt.	1	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	-	-	+	-	+
27	"	1	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	-	-	+	-	+
28	Strep.	1	—	—	—	—	—	—	—	—	—	-	-	-	-	-	-	-
29	Levomyc.	2	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	-	-	+	-	+
30	Biomyc.	1	AG	AG	AG	AG	—	AG	AG	AG	AG	-	+	-	-	+	-	+

The results of comparative investigation are cited in table 3. Data in the table show the more substantial changes in the carbolytic activity of experimental microbes; they pertained to the loss of acid and gas formation separately as well as together, with respect to individual as well as to all carbohydrates used in experiments. We studied changes in metabolism of nitrogenous substances by the assimilation of ammonium sulfate and some aminoacids at our disposal, and also in relation to the formation of indole and hydrogen sulfide.

In the study of assimilation of aminoacids, we used Belopol'skii's synthetic medium specially modified for use in research work. It is composed of the following: [Begin p.35].

ammonium sulfate or the aminoacid under investigation....0.3
sodium bicarbonate..0.1
sodium chloride...0.3
disubstituted ammonium sulfate............................0.2
magnesium sulfate...0.1
pH - 7.2

The culture medium poured out in test tubes and sterilized at 115° [C] in autoclave was seeded in equal amounts (500 thousand microbe bodies) with original and adapted cultures of the enteric bacillus; the seedings were kept for 24 hours in an incubator at 37° [C]. Assimilation effectiveness was judged by the intensity of microbe growth determined by the nephelometry method and compared with that of similar [microbes] in original, non-adapted cultures. We took the yield of original cultures as one unit.

Results of experiments conducted with variants of the enteric bacillus adapted to antibiotics and amebae are cited on figure 1.

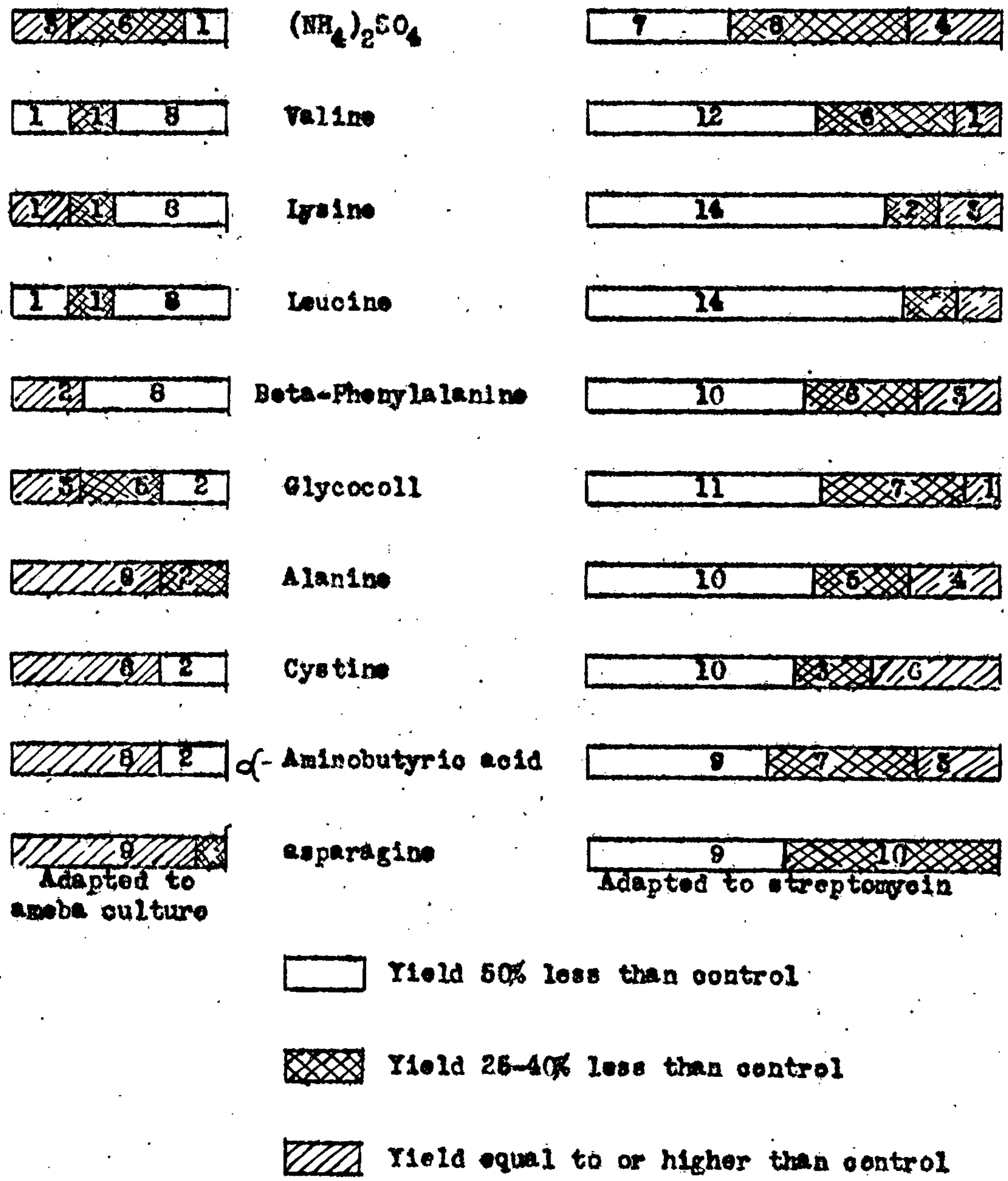
A common characteristic of strains adapted to antibiotics is the considerable lagging of their growth on synthetic media containing aminoacids as compared with the non-adapted control strain. A preponderant majority of experimental cultures produces a yield 40-80% lower than that of the original, control [strain]; a certain number of strains scarcely approached the growth intensity of the original [strain] and very few produced a yield equal to that of the original strain.

The latter is expressed more clearly on media with cystine, in part with alanine and alpha-aminobutyric acid. The yield of all experimental strains on a medium with asparagin was lower than that of the control strain. As far as assimilation of mineral nitrogen used experimentally in the form of ammonium sulfate is concerned, the latter is assimilated by all strains and a preponderant majority of strains produces a yield close to that of the control strain, while the yield of some strains (4) is even somewhat higher than that of the original culture.

The growth intensity in the different variants obtained from cultures of soil amebae on different sources of nitrogen varies. The most luxurious growth, equal or exceeding in yield the growth of the control strain, detected in alanine, cystine, alpha-aminobutyric acid and, particularly, in asparagine came close to that of the control strain - in glucose and ammonium sulfate. A considerable lagging in growth intensity behind the control [strain] has been observed in the preponderant majority of strains in a synthetic medium with valine, lysine, lecithin, beta-phenylalanine and glycocoll.

In comparing the growth intensity of variants adapted to antibiotics with similar indicators in those adapted to soil amebae, the considerably greater growth intensity can be readily seen in the amebae variants on many aminoacids. The latter [circumstance], obviously, is connected with a more thorough-going impairment of metabolism [in cultures] under the influence of antibiotics, than in cultures adapted to soil amebae. [Begin p.36]. The intensity in the assimilation of nitrogenous substances, and the development and yield of the latter approach fairly closely similar indicators in non-adapted control cultures.

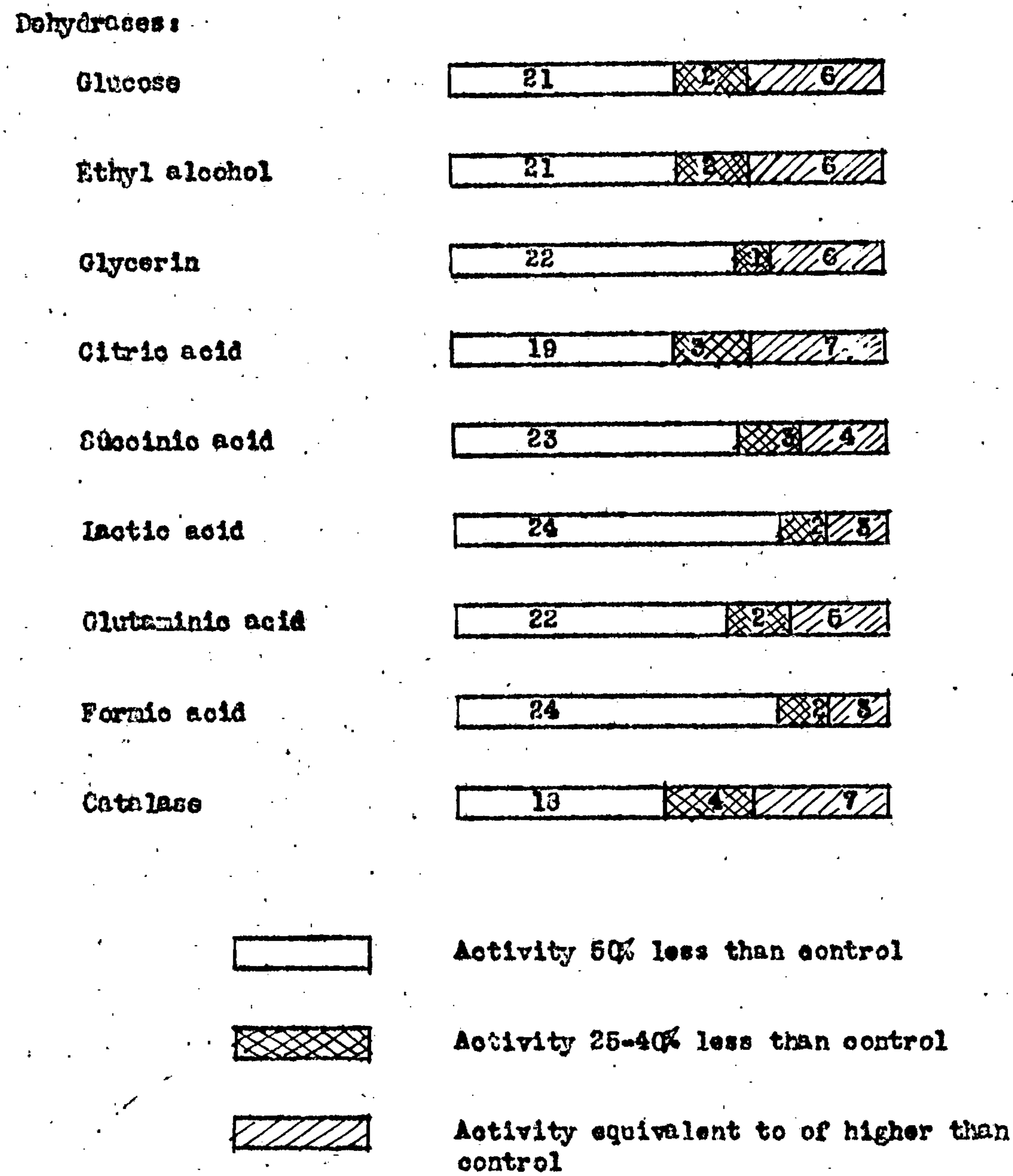
For the purpose of comparing changes occurring in adpated and in original cultures, we conducted a study of the a ctivity of some enzymes, in particular of catalase and dehydrase, [Begin p.37] which play an essential role in the metabolism of microorganisms. Catalase we determined by the gasometric method described by Beloserskii and Proskuriakov, and also by Pershin. In comparing catalase activity of experimental cultures with the activity of original ones, it was found that catalase activity had decreased in all variants of the enteric bacillus adapted to antibiotics, with the exception of strain no. 4. adapted to streptomycin. In most variants adapted to soil amebae, catalase activity is considerably higher than in original ones.



Figures in colums denote number of strains

Fig. 1.

Dehydrase activity of experimental and control cultures was studied by the Tunberg method as modified by B. I. Zbarskii I. B. Zharskii, and L. I. Solntsev. In detecting dehydrase we dwelled on the activity in relation to glucose, ethyl alcohol, glycerin, citric, succinic, lactic, glutaminic and formic acids that are of essential importance in the metabolism of various carbohydrates and proteins, particularly in the oxidation of glucose.



Figures in columns denote number of tested strains

Fig. 2.

Experimental results are cited in fig. 2. Here, too, most experimental strains possess decreased dehydrase activity on all substrates. And only a small number of strains possess a dehydrase activity that is close or similar to the control one, and very few surpass the latter by a mere trifle. In comparing dehydrase activity in variants adapted to antibiotics with that in variants adapted to soil amebae, [Begin p.38] are noted some differences in traits, namely - variants adapted to antibiotics possess less dehydrase activity than the variants obtained in amebae cultures.

However, due evaluation of dehydrase activity requires a further, more diversified investigation.

Along with catalase and dehydrase activity, we determined organic acids as products of culture activity. The investigation was conducted in meat-peptone broth with glucose. Of organic acids we detected acetic, lactic and formic acids by the method described by A. N. Belozerskii and N. I. Proskuriakov. We undertook detection of organic acids chiefly because of so-called inert variants that do not produce any visible acid or gas on media of a variegated [biochemical test] series for the purpose of comparing the results with those [obtained] from gas-producing variants of the enteric bacillus.

As a result of the investigation, the absence of formic acid was established in nearly all strains, with the exception of the variant adapted to streptomycin in leucocyte cultures. Acetic acid was detected in all experimental strains, but its content was smaller than that in strains adapted to amebae in which the formation of acetic acid surpassed that in control [strains]. The content of lactic acid was also smaller in all experimental strains than in controls. It must be emphasized that we have found organic acids not only in cultures that decompose glucose with the formation of acid and gas, but also in cultures of so-called "inert" variants, that grow on glucose without forming acid or gas.

In connection with this, the absence of the acid and gas formation phenomenon does not justify a negation of the presence of acid in "inert" cultures. Obviously, minimal gas formation is not exposed by indicators in media of a "variegated [biochemical test] series" and is, possibly, camouflaged by alkali products of metabolism of the given strain.

For the purpose of characterizing original and adapted cultures, we made a study of: 1) desoxyribonucleic acid by the colorimetric method with a diphenylamino reagent according to the manual by A. N. Belozerskii and N. I. Proskuriakov; 2) tryptophane according to Vuazen's [Wasen's (?)] reaction in alkali hydrolysate, after testing for complete hydrolysis on amine nitrogen and 3) arginine on Sakaguchi's reaction. The latter was used for experimental purposes as a factor of possible alkalization of the medium in the presence of organic acids as a result of decomposition of carbohydrates.

As regards tryptophane, experiments were not conducted with all strains, but only with 10 adapted to streptomycin in leucocyte cultures (7) and (3) on solid media (one to each, syntomycin, streptomycin and levomycetin). As a result, for most experimental strains, as compared with controls, changes were established in the aminoacid composition [Begin p.39] of the microbe protein in favor of a tryptophane increase, and only in one variant adapted to levomycetin a considerable decrease. A correlation between antigenic properties and tryptophane content was not disclosed. Arginine was determined in variants adapted to amebae. In 5 out of 8 variants its content in cultures was higher, in 8 variants somewhat lower than in controls. An increase in arginine in "inert" alkali-producing variants was not detected.

Nor were any substantial changes found in the content of desoxyribonucleic acid which we investigated in 25 out of 29 experimental strains. Apparently, more essential changes are required in microbes in order to achieve more brilliant shifts in the content of desoxyribonucleic acid.

We have also made a study of the antigenic properties of variants as compared with those in the original cultures of the enteric bacillus. They were studied in agglutination reaction with a whole series of immune sera. The most important were agglutination reactions with a serum against the original strain, then with sera against different varieties of the enteric bacillus, and also with polyvalent and monovalent sera against typhoid-paratyphoid and dysenteric microorganisms and against the fecal alkali-producer [Alcaligenes fecalis]. Observations were conducted by means of an analytical [pazvernutoi] agglutination reaction with dilutions in test tubes up to the titer of each serum. We did not observe spontaneous agglutination in any of the experimental strains. Sera used against original strains had sufficiently high titers (1:12800) and they produced positive reactions only with corresponding strains. The observation results are cited in table 4.

Table 4. shows that variants adapted to antibiotics decrease and even lose the capacity for agglutination with sera against the original strain; the latter can be seen particularly well with respect to the more resistant variants obtained in leucocyte cultures under the influence of streptomycin. Along with this, there appeared in a whole series of adapted strains the capacity for agglutinating with sera against other pathogenic and conditionally pathogenic microbes of the enteric group. Thus, for example, a clear agglutination reaction was obtained with a serum against the Grigor'ev-Shiga

[or Grigoroff-Shiga] dysenteric bacillus, against B. paracoli and against the fecal alkali-producer [Alcaligenes]

Some variants manifest clearly a capacity for agglutinating with a serum in dilutions in hundredths against the microbe which they approach in their biochemical activity in media of a variegated series. Cross reactions with sera of rabbits immunized with corresponding cultures adapted to streptomycin, syntomycin, levomycetin and biomycin bear witness to the thorough changes that have taken place in the antigenic properties of variants adapted to antibiotics. [Begin p.40].

Table 4.

No. of strains	Origin	Similarity with other microbes in biochemical characters	Orig. of strain B. coli 1:12800	Sera against strains: Grigor'ev-Shiga [or Grigoroff-Shiga], 1:12800	Flexner, 1:3200	B. paracoli, 1:1600	B. faecal. alcalig. 1:1600	B. coli, syntomycin variant 1:1600	B. coli, streptomycin variant 1:1600	B. coli, biomycin variant, 1:1600	B. coli, levomycetin variant, 1:1600
1	Streptomycin in leucocyte culture	Orig. strain B. coli	1:12800	—	—	—	—	1:3200	1:1600	1:1600	1:1600
2		B. coli citrovorum	—	—	—	—	—	—	—	—	—
3		B. paracoli	—	—	—	1:320	—	—	—	—	—
4		B. coli communis	—	—	—	—	—	—	—	—	—
5		B. paracoli	—	—	—	1:160	—	—	—	—	—
6		B. paracoli	—	—	—	1:20	—	—	—	—	—
7		B. paracoli	—	—	—	1:40	—	—	—	—	—
8		B. faecal alcal.	—	—	—	—	1:10	—	—	—	—
9		B. faecal. alcal.	—	—	—	—	1:10	—	—	—	—
10		Citrate assim var. of B. coli	—	—	—	—	—	—	—	—	—
11		Paratyphoid	—	—	—	—	—	—	—	—	—
12		B. paracoli	—	—	—	—	—	—	—	—	—
13		Paratyphoid	—	—	—	—	—	—	—	—	—
14		Citrate assim. var. of B. coli	—	—	—	—	—	—	—	—	—
15		Paratyphoid.	—	—	—	—	—	—	—	—	—
16	Ameba enzymes	B. faecal alcal.	—	—	—	—	1:20	—	—	—	—
17		B. faecal alcal.	—	—	—	—	1:20	—	—	—	—
18		B. coli anaerogenes	1:800	—	—	—	—	—	—	—	—
19		B. coli communis	—	—	—	—	—	—	—	—	—
20		B. coli communis	1:400	—	—	—	—	—	—	—	—
21		B. paracoli	1:640	—	—	1:6400	—	—	—	—	—
22		B. faecal alcal.	—	—	—	—	1:10	—	—	—	—
23		B. faecal alcal.	—	—	—	—	—	—	—	—	—
24		B. typhi abdom.	—	—	—	—	—	—	—	—	—

[Continued on next page]

Table 4, Continued

No. of strains	Origin	Similarity with other microbes in biochemical characters	Sera against strains								
			Orig. of strain B. coli 1:12800	Grigor'ev-Shiga [or Grigoroff-Shiga], 1:12800	Flexner, 1:3200	B. paracoli, 1:1600	B. faecal. alcalig. 1:1600	B. coli, syntomycin variant 1:1600	B. coli, streptomycin variant 1:1600	B. coli, biomycin variant, 1:1600	B. coli, levomycetin variant, 1:1600
25	Syntomycin	B. coli alcal.	1:1600	1:50	1:50	—	—	1:6400	1:800	1:160	—
26	"	B. coli alcal.	1:1600	1:50	1:50	—	—	1:6400	1:800	1:160	—
27	Streptomycin	B. coli alcal.	1:100	1:50	—	—	—	1:50	1:3200	1:100	—
28	Levomycetin	B. faecal alcal.	1:1600	1:50	—	—	—	1:3200	1:1600	1:3200	1:1600
29	Levomycetin	B. coli alcal.	1:1600	1:50	—	—	—	1:3200	1:1600	1:3200	1:1600
30	Biomycetin	B. coli alcal.	1:1600	1:50	—	—	—	1:1600	1:400	1:1600	—

[Begin p.41]. Data of fig. 2 bear witness to the clearly positive reactions brought about with cultures of variants adapted to the same antibiotic. Reactions in agglutination with microbe cultures resistant to chemically related antibiotics are considerably milder. A negative agglutination reaction, or one in low dilutions, has been established with variants adapted to antibiotics of a remote chemical nature.

Thus, for instance, a serum against a strain resistant to streptomycin produces a positive reaction up to titer in agglutination with streptomycin variants, to be sure, not with all of them. Sera are considerably milder against syntomycin variants - they agglutinate up to titer only corresponding variants twic as weak - levomycetin and the original strain of the enteric bacillus.

The same can be said about sera obtained against variants resistant to levomycetin and especially to biomycin.

Strains adapted to soil amebae change their antigenic properties in exactly the same manner. But these changes are less pronounced; obviously the injury sustained by the antigenic apparatus of the enteric bacillus while under the influence of amebae bears a less profound character. Nonetheless, here also a considerable attenuation has taken place, and for some strains it involved a loss of their ability to agglutinate with sera obtained against the original culture. Here, too, a series of variants produced a positive reaction in agglutination with sera against microbes with biochemical characters similar to their own. With sera against pathogenic microorganisms of the typhoid-paratyphoid group, against the dysenteric bacilli of Flexner, Kruse-Sonne and others, agglutination reaction was always negative in all experimental strains adapted to antibiotics and soil amebae.

And thus, in the process of adaptation, the antigenic properties of experimental microbes undergo a change; the similarity with control and original (maternal) strains is lost, there appear new antigenic characters as a result of a new microbe habitat and new components of their metabolism. Under the influence of antibiotics, the changes in antigenic properties of variants are more thorough, deviations from original cultures are sharper than in variants obtained under the influence of soil amebae in cultures.

To be able to judge the thoroughness and the stability of changes that had occurred in cultures of experimental microbes, we conducted special experiments for the purpose of determining their specific and non-specific resistance to the action exerted by chemical and biological antiseptics.

We studied the viability of experimental cultures by exposure to the action of chemical and biological antiseptics and rabbit leucocytes.

The results of similar comparisons with respect to the original strain and in corresponding coefficients (relation between resistance of an original strain and an adapted one) [Begin p.43] are cited in table 5.

In most variants of the enteric bacillus an increase in resistance to antibiotic influence and a considerably drastic decline in viability when exposed to the action of other antiseptic preparations appear to be a regularity. Just as much of a regularity should be considered an increase in group resistance to antibiotic substances of a related nature, as, for instance, in strains adapted to syntomycin with respect to levomycetin, and in levomycetin strain to syntomycin. Attention has been attracted by the appearance of group resistance to the action of levomycetin and syntomycin in strains adapted to streptomycin, in levomycetin strains to biomycin, and somewhat milder in syntomycin strains to biomycin.

Table 5.

No. in consec. order	Origin	Degree of Adaptation to antibiotics [in multiples of original concentration]	Resistance coefficient as compared with original [strains]															
			Streptomycin	Syntomycin	Levomycetin	Biomycin	Asparagine	Albomycin	Phenol 1%	Chloramine 0.5%	$KMnO_4$ 0.1%	Formalin 1%	$CuSO_4$ 1%	Rivanol 0.1%	KOH 1%	HCl 1%	Phagocytic index
1	Strept.	Original	0.05 unit	40 unit	3.9 unit	1.9 unit	0.006 unit	2.2 unit	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	
2	"	2	2	1	2	8	2	1	50	25	100	100	50	200	100	100	5.3
3	"	2	2	1	2	8	1	1	50	25	100	100	50	200	100	100	
4	"	16	16	128	1	16	2	1	50	25	100	100	50	150	100	100	
5	"	16	16	1	4	16	2	2	50	25	100	100	100	200	100	100	5.5
6	"	64	64	256	2	8	4	1	50	25	100	100	50	100	100	100	
7	"	16	16	8	1	4	16	1	50	25	100	100	50	100	100	100	
8	"	16	16	8	1	4	2	2	50	25	100	100	50	200	150	100	12.4
9	"	16	16	8	2	1	2	1	50	25	100	100	50	100	100	100	
10	"	64	64	32	2	16	2	1	50	25	100	100	50	100	100	100	
11	"	64	64	16	1	8	2	2	50	25	100	100	100	200	100	100	
12	"	64	64	64	2	8	4	1	100	25	200	100	50	200	100	100	15.4
13	"	128	128	16	4	4	2	1	50	25	100	100	50	100	100	100	
14	"	128	128	1	2	1	1	1	50	25	100	100	50	100	100	100	
15	"	128	128	2	1	2	1	1	50	25	100	100	50	100	100	100	
16	Amebae	Original	0.1 unit	20 unit	3.9 unit	3.9 unit	0.006 unit	2.2 unit	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	44
17	"	10th passage	1	1	1	8	2	1	25	100	100	100	100	100	100	50	27.6
18	"	5th "	1	1	1	1	4	1	50	100	100	100	100	50	100	50	
19	"	10th passage	1	1	2	1	4	1	50	150	100	100	100	50	100	50	2:7
20	"	10th passage	1	1	2	1	4	1	50	100	100	100	100	50	100	50	2.7
21	"	20th passage	1	1	1	1	8	1	50	100	100	100	100	50	100	50	
22	"	20th "	1	1	1	1	1	1	50	100	100	100	100	100	100	50	27.6
23	"	23rd "	1	1	1	1	1	1	50	100	100	100	100	100	100	50	27.6
24	"	25th "	1	1	1	1	1	1	50	125	100	50	200	50	125	100	
25	Synt.	81	1.34	81	32.2	6.6	4	1	50	50	25	33	50	66	50	50	
26	"	81	2.6	81	32.2	6.6	4	2	50	50	50	66	50	33	50	50	
√ 27	Strept.	8569	8569	32.2	16.1	6.6	4	2	25	25	25	33	50	33	50	50	
28	Levom.	43	0.67	32.2	43	6.6	8	1	50	50	50	66	100	66	50	50	
29	"	32	13.4	32.2	43	34.8	8	1	50	50	50	66	50	66	50	50	
30	Biom.	64	0.67	32.2	32.2	64.1	8	1	50	50	50	66	50	33	100	50	

Group resistance in microorganisms to antibiotics remote as to their chemical nature is of essential importance in the selection of the latter for the purpose of complex therapy, for the replacement of some inactive preparations with others and in the evaluation of their influence upon intestinal microflora. Attention has also been attracted by the viability of variants adapted to soil amebae which, despite their similarity as to biochemical characters and antigenicity are essentially distinct from variants obtained under the influence of antibiotic preparations.

All variants adapted to amebae either retain their resistance on the same level as that in the original strain, or they increase it with respect to aspargine, levomycetin, chloramine, copper sulfate and biomycetin. And only with respect to the action of phenol, hydrochloric acid and, in part, rivanol a decline in resistance takes place the same as in cultures adapted to antibiotics.

Thus, in the process of adaptation of the enteric bacillus to the action of antibiotics and soil amebae changes occur in the characteristics of its metabolism and there emerge unusual variants which in the complex of their characters are distinct from original and control cultures.

The changes occur in cultural and microscopic characters, biochemical activity, viability and antigenicity.

The most permanent characters acquired in the changes occurring in microbes under the influence of biological factors are the attenuation and loss of carbolytic activity and the appearance of inert variants with respect to individual carbohydrates as well as to a complete selection of them in differential media of a variegated series.

An increase in carbolytic activity and the appearance of new comprehensive fermentative properties also take place, even though they occur considerably more rarely and are not distinguished by resistance without the action of the generative factor. [Begin p.44].

Cultures of the enteric bacillus adapted to antibiotics are distinguished by a lower assimilation of aminoacids as compared with controls.

There emerge under the indluence of antibiotics variants with diverse components resembling very much such famous varieties of the enteric bacillus as B. paracoli, B. coli aerogenes and B. coli citrovorum which are similar to the faecal alkali producer [Alcaligenes] and, with regard to the complexity of fermentative characters, reminiscent of some representatives of the pathogenic typhoid-paratyphoid and dysenteric microorganisms. Attenuation and loss of antigenic activity in reactions with specific sera is a regularity for the majority of unusual variants of the enteric bacillus, and for some it is the acquisition of a capacity to enter into a reaction with immune sera against other species of microorganisms.

Side by side with high resistance to the corresponding antibiotic, adapted variants are distinguished by decreased viability when exposed to the action of other physicochemical and biological factors and to phagocytic activity of leucocytes.

Along with unstable variants that lose their unusual characters fairly rapidly, there arise under the influence of antibiotics hereditarily stable variants that retain their new characteristics for years.

Thus, under the influence of antibiotics, there occur thorough changes in the enteric bacillus, impairment of its fermentative activity and viability. These changes take place also in the organism of patients after a long application of antibiotics, which has been confirmed by our observations of shifts in the microflora of patients treated with streptomycin and syntomycin.

It can hardly be considered that all of these changes are inconsequencial to the organism, if the important role of the enteric bacillus for man, its substantial influence upon many intestinal microorganisms, including the putrescent ones, is taken into account.

Injury of the enteric bacillus is connected with disturbances in the normal flora in man and animals, the appearance of disbacteriosis, activation of conditionally pathogenic microorganisms, and changes in the vitamin economy of macroorganisms which is essentially important for specific and non-specific protective reactions of the organisms and for the success of therapy and prophylaxis of various infections as has been demonstrated by research conducted by A. M. Kirkhenshtein and his collaborators.

CONCLUSIONS

1. Changes of varying extent and stability occur in the enteric bacillus under the influence of antibiotics and soil amebas; those occurring under the influence of syntomycin and streptomycin and, in part, levomycetin and biomycin are more distinct and more stable. Unusual variants differ from typical and original ones in morphological-biochemical properties, antigenicity and resistance to the action of specific and non-specific factors.

Variation in the enteric bacillus is more distinct after a long exposure to subbacteriostatic doses and gradual increase in the content of antibiotic preparations in the medium.

Changes occurring in the enteric bacillus under the influence of antibiotics take place also in the organism of patients, especially when antibiotics of a broad spectrum of action, such as streptomycin, syntomycin and levomycetin have been taken by way of mouth for an extended time.

2. Unusual variants of the enteric bacillus, especially those inactive with respect to glucose and lactose, and also those resembling the alkali-producer [Alcaligenes], can lead to errors in sanitary-bacteriological investigations; this makes it obligatory that analysis and appropriate evaluation of microorganisms adaptable to antibiotics be conducted more carefully.

3. Under the influence of antibiotics, especially during the process of long exposure, there occur severe injuries of the enteric bacillus, a decrease in its viability and its disappearance from the microbe association. The latter may lead to disbacteriosis phenomena, to increased activity of conditionally pathogenic microorganisms, to an emergence of intoxication and Candida mycosis, to a violation of the vitamin economy in macroorganisms and to a decrease in their specific and non-specific resistance.

4. Antibiotic preparations applied efficiently are useful chemotherapeutic means of treatment and prophylaxis for infectious diseases. In damaging the causal microbe, they render it more accessible to the action of juices and tissues of the organism which insure a favorable outcome of the disease.

Violation of the regime of antibiotic therapy, extremely long use of antibiotics of a wide spectrum of action, especially without taking into account the sensitivity which the causal agent has to such action, lead to injury of the enteric bacillus and to a change in the normal flora of man, and, with it, to a whole complexity of undesireable phenomena, justly considered as complications of antibiotic therapy.

5. Adaptive variation [brought about] by antibiotic action is inherent in pathogenic as well as in conditionally pathogenic microorganisms. Knowledge of the characteristics of unusual variants, of their viability and antigenicity is most essential in insuring early diagnosis of the corresponding diseases so as to be able to evaluate accurately the results of sanitary-bac-

teriological investigations and to widen the scope of our knowledge concerning changes occurring in specific characters of pathogenic and conditionally pathogenic microbes.

Trans. A-976
(In full)
vg/A

Ruban, E. L.

Khemosintez i problema spétsi-
fichnosti mikroorganismov.

[Chemosynthesis and the problem of
specificity in microorganisms].

Mikrobiologiia, vol. 25, no. 6, p.723-726.
Nov/Dec. 1956. 448.3 M582

(In Russian)

The discussion begun on the pages of the journal "Mikrobiologiia" of problems raised in Kalinenko's [5] article must be developed not merely as a deliberation concerning the personal opinion of a given author and his experimental data.

A discussion of the problem of chemosynthesis on a wide scope is very timely for the elucidation of its importance in the development of the biological thought in general.

Works on physiology and biochemistry lead many authors to draw the conclusion that there is a biochemical unity in microorganisms [8, 11, 13, 14], on the premise that glycolysis, phosphorylation and the cytochrome systems take part in the metabolism of all microorganisms, and that they posses a uniform composition of aminoacids.

Extreme enthusiasm for the principle of biochemical unity leads to a one-sided approach to the study of physiology and even to a negation of the real existence of physiological groups of microorganisms [5].

It would seem that the problem of contemporary microbiology and biochemistry ought to be not only a study of the general [aspect] that brings microorganisms together with each other and with macroorganisms, but also a penetration into the delicate physiological specificity of the individual microbe groups.

Only in the unity of the general and the specific can the explanation of the rigid adaptability of individual microorganisms to a specific habitat be found, and an elucidation approached concerning the reciprocal relations between individual groups of microorganisms in nature and the role which they play in the general process of the cycle of substances.

The chemosynthetic phenomenon is a very convincing illustration of the position stated. Chemosynthesizing microorganisms actually possess a series of systems and processes characteristic of other heterotrophic microorganisms and living plasma in general, but at the same time they are highly specific with respect to the oxidisable substrate, sources of energy and carbon, and this [specificity] renders their metabolism sufficiently unique.

The conclusions concerning the presence of heterotrophic metabolism in nitrifying [bacteria] are substantiated very inadequately. Thus, Lees [13] arrived at this [conclusion] merely on the basis of the aminoacid composition found in Nitrosomonas cells. It is, however, sufficient for one to recall that the possible number of combinations of nucleic acids alone comprises 10^{63}, and a similar conclusion turns into a gross analogy. The discovery of carbohydrates in the cells of nitrifying bacteria [13,14] and thiono acid bacteria was also considered a sufficient basis for heterotrophia of their metabolism. However, the negative influence of sugars upon the growth of chemoautotrophs contradicts this assertion (van Niel [16]).

In making use of the principle of biochemical unity and of opinions formed by analogy, many authors arrive at the conclusion that, apart from their capability to utilize the energy of oxidation of inorganic substances, chemosynthesizing microorganisms do not differ in any way from the ordinary heterotrophs. The factual data available is, however, entirely inadequate for wsuch a conclusion. [Begin p.724]. The consumption of oxygen by dormant cells of Nitrosomonas in the absence of oxidation of the substrate, established by Boemeke [11], has been accepted by many authors [14, 15] as an adequate basis for the assertion that endogenous heterotrophic respiration is prevalent in Nitrosomonas, although no one had found CO_2 liberated by dormant Nitrosomonas cells.

The works of Umbreit and collaborators [16] disclosed that in oxidation of sulfur in the absence of CO_2, Thiobacillus thiooxidans accumulates oxidation energy within the cells in the form of phosphorus compounds and afterwards is able to assimilate CO_2 in the absence of sulfur. By analogy, this process was transmitted to the metabolism of other chemoautotrophs, even to such [forms] as hydrogenous bacteria. An experimental examination of Umbreite's and Baalsrood's (Baalsrood a. Baalsrood [10]) data failed to confirm the possibility of separating in time sulfur oxidation and CO_2 assimilation.

There is no doubt that chemosynthesizing microorganisms are not only entirely different from heterotrophic organisms but that each group of autotrophs is in many respects distinct from other microorganisms capable of chemosynthesis. Microbiological, biochemical and physiological data offer no basis for a uniting of all chemotrophs and heterotrophs by the principle of a single metabolism, and their specificity has been investigated inadequately. Chemosynthetic phenomena and a capacity for autotrophic nutrition have until recently scarcely been associated with the study of the physiology and biochemistry of chemosynthesizing [microorganisms] and autotrophs. Facts concerning the utilization of the energy of oxidation of mineral substance in biological synthesis of organic substances and the possibility of building up a carbonic skeleton of protein molecules at the expense of carbon dioxide assimilation has been firmly established.

There is a complete dearth of data on the physiology and biochemistry of microorganisms accomplishing chemosynthesis. There are extremely few data on the mechanism of chemosynthetic reactions, on physico-chemical conditions of environment and on their influence on the chemosynthetic process. The enzymatic complexities of chemosynthesizing [microorganisms] have scarcely been studied and the need for investigations in the this sphere is quite obvious. Undoubtedly, chemosynthesizing [mcroorganisms] possess a series of enzymes that are absent in other microorganisms: an example for this can be found in the diametrically contrasting behavior of the autolysates of nitrifying [bacteria] and heterotrophs. In the latter an accumulation of ammonia was observed when left standing, but in the first its disappearance was observed [1-4].

Autolysates of Nitrosomonas are capable of oxidizing hydroxylamine, this capability is absent in heterotrophs [4]. Furthermore, the capacity of Nitrosomonas autolysates to oxidize ammonia and hydroxylamine disappears after heating.

The question concerning the relationship between chemosynthesizing [microorganisms] and organic substances in the substrate is a very important one and must be resolved for reasons other than either a negation of the existence of a chemosynthetic process or its confirmation. The chemosynthetic phenomenon will not cease to exist, regardless as to whether or not the organic substance that can be assimilated by Nitrosomonas will be found.

An elucidation of the relationship between nitrifying [Bacteria] and complex organic substances in the external environment should help to solve the contradiction existing between the results of laboratory investigations and processes occurring in nature and production.

It is known what degree of intensity can be reached by the nitrifying process in cleaning installations [6], in tropical soils [12] and in saltpeter works, regardless of the absence of considerable amounts of organic substances.

Under laboratory conditions, an addition of soluble organic substances to the culture medium inhibits sharply the growth of nitrifying bacteria and the accumulation of nitrates [7].

All of this renders it imperative that a detailed study be made of the composition of organic substances in the soil, since our information concerning this realm is very inadequate and general. Besides the quantity of humic acid of the total carbon and the individual fractions [Begin p.725] soluble in different solvents, there are practically no data available.

The role of accompanying microorganisms and the surrounding microflora in the activity of nitrifying [bacteria] and other chemosynthesizing [microorganisms] has not been studied in detail up to now, many authors have merely noted the positive influence exerted by accompanying [microorganisms] upon the nitrification processes.

In summarizing the above-said, it must be emphasized that the investigations conducted within the sphere of a study of the chemosynthetic phenomenon and of autotrophy should be extended also to the domain of biochemical relations existing between autotrophic and heterotrophic microorganisms and to the sphere of a detailed study of the conditions of their habitat in nature, [only] then shall we be able to broaden considerably our conception concerning the activity of microorganisms and of their role in the cycle of substances.

Omitting a review of Kalinenko's [5] article, made in sufficient detail by Shaposhnikov [9], I shall take the liberty to answer the remarks made by Kalinenko concerning the work by Imshenetskii and Ruban [1].

It was demonstrated in the given work that oxidation of ammonia by non-cellular Nitrosomonas autolysates was possible. For this purpse, cultures of nitrifying [bacteria] were grown on the usual Winogradsky culture medium in large quantities, cells were filtered, segmented and autolysed, and the autolysates were filtered through bacterial ultrafilters.

Autolysates of heterotrophic bacteria served as controls.

After five days of maintenance at 37° [C], there occurred a decrease in the amount of ammonia in the autolysates of Nitrosomonas, and an increase of it in heterotrophs. Evaporation of ammonia did not occur, since the total amount of nitrogen remained constant.

Kalinenko's criticism of the work referred to is not really concerned with its substance.

His criticism concerning the fact that Nitrosomonas used in the experiment was grown on Winogradsky's medium and the heterotrophs on ordinary agar media is entirely incomprehensive. He sees in this a violation of equation and of conditions of cultivation; yet the growing of organisms that are sharply distinct from one another on the same medium is precisely a violation of this [particular] equation. Besides, we tried to grow an oligocarbophylic [oligokarbofil'nyi] microorganism of Pseudomonas fluorescens on Winogradsky's medium and we obtained from it an autolysate that in no way differed from the autolysate of agar cultures.

Kalinenko's censure regarding quantitative comparisons and "fine quantitative experiments" is also entirely unfounded. In the works under discussion comparative data were obtained and nothing was said about balanced experiments.

The initial and the final quantities of ammonia and nitrites was compared after the autolysates had been kept for five days, so that quantitative changes concerned only the original concentrations of ammonia and nitrites and, hence, there was no need to equalize the bacterial masses, since the amount of the biomass would not have changed the direction of the process.

It is incomprehensible why Kalinenko called the process observed by the authors a process of "nitriteless autolysis" ([5] p. 560). It is generally known that in autolysis desamination of aminoacids and an accumulation of ammonia is observed, and it was observed also when autolysates of heterotrophic microorganisms were kept. In all probability, the process of autolysis with splitting off of ammonia occurs also in autolysates of *Nitrosomonas*, but there was no accumulation of ammonia observed; conversly, its concentration decreased in the constant total amount of nitrogen; consequently, the authors were justified in saying that ammonia of *Nitrosomonas* autolysates was converted to an oxidized form, but the process did not reach nitrites, at least not quantitatively, i.e. it stopped at a certain degree of oxidation.

[Begin p.726]. The authors did not aim to confirm the chemosynthetic theory, since they believe it to be sufficiently confirmed by a large quantity of data of a number of authors; nor did they intend to elucidate the possibility of developing *Nitrosomonas* on an absolutely inorganic medium in the given investigation, and for that reason they used the usual Winogradsky medium and tap water.

Hence, Kalinenko's comment that the use of tap water in the work by Imshenetskii and Ruban does not confirm the theory of chemosynthesis was also made with disregard of the main objective of the investigations.

The only conclusion which the authors have drawn from their works (not by far fully cited in Malinenko's list of literature) was that enzymatic complexes of non-cellular autolysates of Nitrosomonas and heterotrophic microorganisms differ from each other in that ammonia contained in the autolysates of Nitrosomonas disappears, while it accumulates in the autolysates of heterotrophs at a constant total amount of nitrogen in one case or another. It is assumed that the ammonia oxidation process, obviously, is realized to a small extent in two phases. At the beginning the ammonia is oxidized, probably, up to an intermediate product which in turn is oxidized up to nitrites. The first phase passes actively in the filtrates of Nitrosomonas autolysates.

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Klein, B. I.

"Sintez" virusu

[Synthesis of viruses].

Mikrobiol. Zhur., vol. 18, no. 3:
p.59-61. 1956. 448.3 M54.

(In Ukrainian)

Recently, in some scientific as well as scientific popular journals information was published that scientists from California, Fraenkel-Conrat and Williams, students of the well-known virologist Stanley, succeeded in "synthesising" the tobacco mosaic virus. This news has also appeared in the general press, where it was announced about the beginning of a "new era" in virology, about "synthesis of life in a test tube", about the possibility of "synthesising living matter" from inanimate components.

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A lot was exaggerated in this information, yet, undoubtedly, the new facts, described therein, merit further investigation and require serious verification.

According to the cited authors, from a chemical aspect, viruses "represent simply a grouping of chemical components", and, in particular, the tobacco mosaic virus can be resolved into two components: protein (95%) and nuclein (5%).

Molecular weight of proteins of the protein fraction is 100,000, and of nuclein - 250, 000. Protein and nuclein fractions - these are macromolecular chemical compositions with a high molecular weight. Virus proteins represent complex compositions of 16-17 long chemical chains of aminoacids, namely aspartic and glutamic acids (13.5-11.3%), arginine (9.8%), leucine

(9.3%), valine (9.2%) and tryptophan and others, in smaller amounts.

The nuclein component is still more complex; it has a molecular weight of 250,000 and represents a combination of several nucleotides. The nucleotides are composed of phosphoric acid, carbohydrate (ribose) and of pyrimidine elements (cytosin, uracil, adenine and guanine), which contain carbon, hydrogen and nitrogen in various proportions. Some of the nucleotides form a molecule of nucleic acid by means of polymerization, whereupon some of the smaller molecules combine into one larger one.

Reactions of polymerization generally are wide-spread in chemistry. Thus, for instance, were obtained gigantic molecules of artificial silk, of plastic masses, and so on.

Polymerized molecules undergo a recurring process (depolymerization) under the influence on them of various physical-chemical factors.

Electron microscopic research, together with methods of ultracentrifugation, made it possible to establish that the tobacco mosaic virus, which in the electron microscope had an appearance of a long rod, was composed of a protein capsule inside of which nucleic acid was found. This is as though a protein tube with a canal is filled with nucleic acid.

Acting upon the tobacco mosaic virus with solutions of certain disinfecting substances one can damage one end of the virus tube and then [Begin p.60] the nuclein contents will flow from it as vaseline does when the end of the vaseline tube is pressed. It is seen on pictures, taken from an electron microscope, that nucleic acid flows out from the damaged end of the virus rod.

In this manner the above mentioned authors isolated the protein component of the virus from the nuclein; after that, under the reaction of a whole series of physico-chemical factors (such as, for instance, change of pH of the medium, heating, and so on), which assisted in depolymerization, they changed the albumen of the protein fraction to low-molecular protein and depolymerized the nuclein fraction down to nucleotides and further. In such a form both fractions were examined under an electron microscope and no virus rods were found. The electron microscope's field was "optically empty". At the same time this transmuted virus lost its faculty to produce the "mosaic disease".

After this both fractions were subjected to a reverse process, and by means of physico-chemical reactions a polymerization was brought about. Macromolecular structures of the protein and nuclein fractions became visible again; then both fractions reunited, and the obtained mass underwent an examination under the electron microscope. A curious result was obtained thus: in the mass, where there were no virus rods, rod-like structures again reappeared, which were characteristic to tobacco mosaic virus, and the mass, which lost the faculty to infect tobacco leaves, again produced in them the mosaic disease on contact with the leaves.

It appeared further on that the mass can be again divided in two fractions, a depolymerization produced, as well as the loss of ability to infect; then again to polymerize, produce the appearance of virus rods and the ability to infect the leaves. Thus, all these processes were "chemically reversible".

Can one call this a "synthesis" of the virus? In reality this is not a synthesis of viruses from the simplest chemical compounds, but only the restoration of viruses from their own fractions - the protein and the nuclein. But one cannot obtain a tobacco mosaic viruses from these same fractions, which were obtained from another virus. That is why this process can not be called a "synthesis" but just a restoration - "reconstitution".

This research, certainly, will require repeated checking. However, in case it becomes confirmed, one more objection is possible. It is known, that microbes, visible under the light microscope, can take up invisible forms.

It is possible, that virus rods of tobacco mosaic, under the influence of the applied physico-chemical factors, change to very small forms, invisible even through the electron microscope, and afterwards, when both fractions again polymerize and join together, some of these fragments again grow up to a shape of typical rod-like forms. It is interesting that the intensity of infection by the restored virus is insignificant compared to the initial. But regardless of how this problem will be solved, the general direction taken by the present work with viruses is of great interest. All this prompts to a substantial revision of the problem about the nature of viruses and bacteriophages.

In connection with this it is interesting to mention the works of F. G. Straub (Budapest) about synthesis of protein substance. Straub propounds a hypothesis, according to which the protein system of ribonucleic acid can re-create itself when given an appropriate protein substance. In the opinion of Straub, to such self-re-creative systems belong "protein substances - enzymes, which cause the processes of metabolism, that characterize life". We know that antibiotics function "by means of interfering with the protein synthesis of microbes".

The works of S. E. Bresler are also known about the re-synthesis of protein substances from products of decomposition by means of applying great pressures. [Begin p.61].

R. B. Khesin succeeded in tracking the synthesis of the amylase enzyme in homogeneous extracts of the pigenn's pancreas.

F. G. Straub points to the fact, that in extracts from pancreas, after a full destruction of the cell strudtures, some of the amylase increased by 30-50% in half an hour by means of synthesis.

All these data lead us to the problem about re-synthesis of protein substances, as well as about enzymes, which are the main causes" in processes of metabolism, that characterize life". The problem about the nature of viruses and of the bacteriophage has been recently considered in the aspect of macromolecular protein compounds and enzymes.

In virology it is necessary to mention one more great improvement in connection with the fact that the newest research has removed the boundary between the animal and plant viruses. Up to recently, viruses which crystalise were known only among plant viruses (tobacco mosaic), but of late (in 1955) Californian scientists Schwerdt and Schaffer have stated that they succeeded in obtaining the first animal virus in the form of crystals, namely - poliomyelitis virus, which now is the center of attention of theoretics, clinical physicians (surgeons) and epidemiologists. For the research of the above mentioned scientists the tissue cultures of the monkey's kidney tissue, infected with poliomyelitis, served as the initial material.

The reproduced virus was obtained in a concentrated form from 16 L of virus culture of kidney tissue, treated with weak solutions of acids and salts and as a result of this 1 mg of virus of extraordinary strength was obtained; insignificant parts of which could produce the disease; this virus was crystalized in the test tube, whereupon "brilliant crystals" were produced.

A theoretical importance of this fact is very great, but its practical value is exaggerated in the general press.

All the above cited facts are, undoubtedly a considerable incentive to the development of a great deal of verification research. But one can expect more or less accurate conclusions only in the future.

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Trans. A-978
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vg/M

Elin, V. L., and Vasiurenko, K. I.

Prorist geterotrofnykh bakterii na seredovishchi, pozbavlenomu organichnykh rechovin.

[Growth of heterotrophic bacteria on a medium which has been deprived of organic matter].

Mikrobiol. Zhur., vol. 19, no. 2, p.11-13. 1957 448.3 K54

(In Ukrainian)
(Summary in Russian)

Cultivating some heterotrophic bacteria (B. coli commune, B. pyocyaneum, B. proteus vulgaris) on Winogradsky's culture medium, which does not include, as it is known, any organic compositions, we have established that these bacteria reproduced. This gave grounds for assuming that the indicated bacteria can be autotrophic.

First of all we decided to solve the problem if the mentioned microbes really utilize carbon dioxide of the air.

We took 12 test tubes with 8 ml of Wingradsky's culture medium in each for the experiment, conducted with this purpose in view. Into the first three we introduced B. coli commune, into the other three - B. pyocyaneum and into the next three - B. proteus vulgaris. Bacteria were introduced with such a calculation that each milliliter of the culture medium of the first test tubes would contain 1,000 microbes bodies, the second - 100 and the third - 10 microbe bodies. The three remaining test tubes were not seeded - they served as controls.

All 12 test tubes and a dish with 1% caustic barium for absorption of carbon dioxide of the air were placed in a glass jar, which was hermetically sealed and left for 2 hours at room temperature in order that, before the

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beginning of growth of microbes, a reaction should take place between the carbon dioxide of the air and the caustic barium. After this the vessel was carefully transferred to the incubator at a temperature of 37° C. Three days after these were taken out from the incubator and the contents of the dish were tested for the presence of barium carbonate. From each test tube 0.1 ml of fluid was seeded into test tubes with the liquified and slightly cooled agar and they altogeth r were poured into Petri dishes, which then were placed in the incubator at a temperature of 37° C. In 24 hours they were removed from the incubator and the number of the grown colonies computed. It was discovered that countless colonies grew up on the experimental dishes, while no growth was observed on the control.

Several replications of this experiment gave similar results.

Also, bacteria of B. coli commune, B. pyocyaneum and B. proteus vulgaris grow on Winogradsky's culture medium in the absence of carbon dioxide in the air.

After this we decided to investigate the balance of ammonium nitrogen in Winogradsky's culture medium after the growth in there of experimental microbes basing ourselves on the idea that if these microbes would utilize the oxidation of ammonia gas as a source of energy the amount of ammonium nitrogen during the process of their growth on the Winogradsky's medium will decrease and at the same time nitrous acid will appear in the culture medium.

Determination of the contents of ammonium nitrogen in the medium were conducted after Krapivin and by the method of Konvei [transliteration] dishes. The contents of nitrite and nitrate nitrogen were determined by the usual methods which are practiced for the determination of contents of nitrite and nitrate nitrogen in drinking water and in sewage. [Begin p.12]

The experiment was conducted thus. We introduced 100 ml of Winogradsky's culture medium into five small bottles. To the first bottle were added 10,000 microbe bodies of B. coli commune, to another as much of B. pyocyaneum, to the third the same amount of B. proteus vulgaris; the fourth and fifth bottles were not seeded and served as controls. All five bottles were placed into the incubator at a temperature of 37° C. Ten days after they were removed from the incubator and examined for the growth of microbes by the above-mentioned method. From 0.1 mg of medium, which was taken from experimental bottles, a countless number of colonies grew on lamellate agar, while seedings from control bottles produced no growth.

Having become convinced of the presence of growth of microbes in experimental bottles and of their absence in the control, we then determined the contents of the ammonium, nitrite and nitrate nitrogen in the bottles.

It was discovered that during the process of growth of experimental microbes on Winogradsky's medium the contents of ammonium nitrogen did not decrease. In bottles with B. coli commune it was: when determining after Krapivin - 380 and by the method of Konvei dishes - 402 mg/L; in bottles with B. pyocyaneum respectively 410 and 416 mg/L; for B. proteus vulgaris - 440 and 434 mg/L; in control bottle no. 1 - 320 and 364 mg/L, and control no. 2 - 320 and 375 mg/L.

Thus the use of energy at the expense of oxidation did not decrease ammonia, on the contrary, we even observed a certain increase in the contents of ammonium nitrogen in the medium, probably, at the expense of deep decomposition of microbe protein during protracted growth. The absence of nitrites and nitrates in the medium also spoke of the fact that oxidation of ammonium nitrogen did not decrease. Similar results were obtained after repeated experiments.

Thus, the experiments have shown that the microbes, examined by us, did not utilize either carbon dioxide of the air as a source of carbon, or the oxidation of ammonium as the source of energy.

In order to confirm the experiment, which demonstrated that our bacteria did not use oxidation of ammonia gas for obtaining the energy necessary for their growth, we utilized the same Winogradsky's medium for cultivation of examined microbes but without ammonium sulfate. Thus, the new medium had the following composition: K_2HPO_4 - 0.75 g, KH_2PO_4 - 0.25 g, $Fe_2SO_4 \cdot 7H_2O$ - 0.01 g, $MnSO_4 \cdot 7H_2O$ - 0.01 g $MgSO_4 \cdot 7H_2O$ - 0.03 g, $CaCl_2$ - 0.02 g, distilled water - 1,000 ml.

This medium was poured into four bottles (per 100 ml in each) and sterilized. Into one bottle were introduced 10,000 microbe bodies of B. coli commune, into another - the same amount of microbe bodies of B. pyocyaneum, into the third as much of B. proteus vulgaris, the fourth was the control. All bottles were placed into the thermostat for 10 days at a temperature of 37° C; after this 0.1 ml of medium were seeded from each bottle into test tubes with liquified and cooled agar. After that the same happened as in the first experiment: in each dish with 0.1 ml of medium countless numbers of microbe colonies grew up, while on the control dish no growth of bacteria was observed.

It was seen from this experiment that microbes of B. coli commune, B. pyocyaneum, B. proteus vulgaris were capable of multiplying on Winogradsky's medium without ammonium sulfate, which fact again attested that oxidation of ammonia gas did not serve as a source of energy for their growth. Several replications of this experiment gave similar results.

And, finally, we cultivated microbes on Winogradsky's medium without ammonium sulfate and without absorption of carbon dioxide by caustic barium in our last experiment. We poured 100 ml of Winogradsky's medium, without ammonium sulfate, per bottle and sterilized. Into one bottle we introduced 10,000 microbe bodies of B. coli commune, into another - 10,000 microbe bodies of B. pyocyaneum, into the third - the same amount of microbe bodies of B. proteus. vulgaris, the forth was the control. [Begin p.13]

These bottles and the dishes with caustic barium $Ba(OH)_2$ were placed into a glass container which was hermetically sealed and all was left at room temperature for the course of 2 hours, after which they were placed into the incubator for 10 days at a temperature of 37° C.

Countless numbers of colonies grew up from seedings on agar of 0.1 ml of medium from each bottle, but the seeding from the control bottle did not produce any growth. Replications of experiments brought similar results.

Thus, this experiment has shown that B. coli commune, B. pyocyaneum and B. proteus vulgaris grew on Winogradsky's medium without ammonium sulfate and without the presence in the air of carbon dioxide.

A question arises - wherefrom did the microbes, that we experimental with, obtain the carbon and energy necessary for their life and multiplication? We suppose that there is only one source - volatile organic compounds of the air.

From Char'kov Institute
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Received
March 17, 1956.

ABOUT THE GROWTH OF HETEROTROPHIC
BACTERIA ON MEDIUM DEPRIVED OF ORGANIC MATTER

V. L. Elin and K. I. Vasiurenko

Summary (In Russian)

Research has shown that B. coli commune, B. pyocyaneum and B. proteus vulgaris multiply on Winogradsky's medium in the air deprived of carbon dioxide.

When cultivating these microbes on Winogradsky's medium the amount of ammonium nitrogen in it did not decrease, nitrites and nitrates did not form. This attests to the fact that oxidation of ammonia from ammonium sulfate was not the source of energy for the growth of these microbes.

The tested microbes multiplied also on Winogradsky's medium, which was deprived of ammonium sulfate; this supports the preceding statement.

The microbes under consideration grow on Winogradsky's medium which was deprived of ammonium sulfate, from which carbon dioxide was absorbed.

From these facts one must draw a conclusion that B. coli commune, B pyocyaneum and B. proteus vulgaris receive carbon and energy necessary for their multiplication from volatile organic substances of the air.

Thus, in the present work it was established that in the presence in the medium of inorganic salts, certain microbes can draw out carbon and energy, necessary for their growth, from volatile organic compounds of the air.

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Markov, V. N., Bardarov, and Popov.

Opyty vosstanovleniia penitsillino-chuvstvitel'nosti u rezistentnykh k penitsillinu stafilokokkov.

[Experiments in restoring penicillin-sensitivity in staphylococci resistant to penicillin].

Zhurnal Mikrobiologii, Epidemiologii i Immunobiologii, no. 5, p. 76-82.
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(In Russian, submitted from a Bulgarian institution).

The mass use of penicillin in practice has brought about an increase in penicillin-resistant microbes. According to Barber's and Whitehead's (1949) data, in a children's hospital, out of 45 staphylococcus patients 86% were infected by penicillin-resistant forms.

According to investigations conducted by Bardarov and Neichev (1950), 25.8% of purulent diseases in ambulant patients had been caused by staphylococci resistant to penicillin, and in postoperative purulent infections this indicator has reached 43.5%. Among personnel of surgical clinics (physicians, nurses etc.) 19.5% were found to have penicillin-resistant staphylococci in the pharynx [nosoglotka].

The mechanism of penicillin-resistance has not as yet been fully clarified, but there are available indications that its appearance is definitely due to the role played by penicillinase that destroys penicillin (Ravich, Woodruff [Vudruf], Foster and others). Hence, we have undertaken

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the task of investigating the possibility of suppressing the action of penicillinase.

We proceeded from the hypothesis that in penicillin-resistant microbes it is possible to restore their original sensitivity to penicillin, if the action of penicillinase is stopped either by discontinuing its production, or by exerting physico-chemical influences, or, finally, by neutralizing it by the use of microbiological methods. In our own experiments, we tried to utilize high-titrate antipenicillinase sera.

We found no appropriate data in the literature at our disposal and had to search for methods of our own in order to accomplish the task we had set ourselves.

[Begin p.77]. In the present article we have given in principle the arrangement of the entire work and have presented the results of our investigations only in general. More detailed data are summarized in the work entitled "Investigations of penicillinase and of antipenicillinase sera" which has been submitted for printing.

For the purpose of obtaining penicillinase we used a strain of a sporogenous [sporonosnogo] soil microbe (the strain Is) that produces a considerable quantity of extra-cellular penicillinase. The method we used to obtain it adds up to the following: after a 9-16-day cultivation of the microbe in a specific medium, on the day when the penicillinase concentration reached the maximum, the culture was acidified up to pH=5.2 with glacial acetic acid, adsorbed with aluminum oxide, and then eluated [eliuirovali] with alkaline water and filtrated through a Seitz filter.

We developed also a method for penicillinase titration. As a penicillinase unit, we took the minimal amount of the penicillinase solution that destroys 100 units of penicillin at room temperature and pH=7.0 within an hour.

The titration method was based on the following principle: penicillin is destroyed when it is mixed with penicillinase and, as a result, the mixture ceases to inhibit the development of the sensitive staphylococcus (strain no. 209) under and around the sheet of the filter paper that is placed on the surface of agar seeded with this microbe, if, however, the penicillin is not destroyed, then a sterile zone appears around the sheet of filter paper. The latter [zone] denotes that the amount of penicillinase had been insufficient to destroy 100 units of penicillin, and, consequently, the latter [penicillin] manifests its action. A dilution of the penicillinase solution indicates directly a 1 ml content of penicillinase. This method proved very convenient and entirely adequate for practical work (table 1).

Table 1.

Titration of penicillinase in relation to strain no. 209 of the gold-colored staphylococcus [Staphylococcus aureus] sensitive to penicillin

Reaction components (in ml)	Dilution of penicillinase			Controls	
	1 : 500	1 : 600	1 : 700	1	2
Penicillinase	1	1	1	-	1
Penicillin (100 units)	0.1	0.1	0.1	0.1	-
Physiological solution	-	-	-	1	0.1
Results - presence of sterile zone	+	+	+	+	-

Experiments were also conducted for the clarification of the relationship between penicillin and penicillinase required for their reciprocal action. The investigations have demonstrated that small amounts of penicillinase are capable of destroying considerable quantities of penicillin by simultaneously reducing the titer of penicillinase, i.e. in reciprocal action with penicillin the amount of penicillinase decreases, and the destruction of penicillin is determined by the duration of its [penicillinase's] action and its concentration.

In the order of the study made of the immunobiological properties of penicillinase, we first of all had to establish its antigenic character, and, to be able to answer this question, we had to test its non-injuriousness for laboratory animals. Investigations have demonstrated that white mice weighing 16 gm [Begin p.78] survived an intraperitioneal injection of 100 units of penicillinase without any symptoms. For rabbits, doses up to 500 units of penicillinase proved harmless when injected intravenally. After intravenal injections of larger doses (1,500 units), the rabbits were observed to suffer from sluggishness and paralysis of the rear extremities [the symptoms of] which disappeared after 1-1½ hours. In the case of a hypodermic injection of penicillinase in rabbits (2,500 units) and in guinea pigs (1,500-2,500 units) no reactions of either a localized or general character were noted.

After several hypodermic and intravenal injections of penicillinase there appeared in rabbits the corresponding antibiodies - antipenicillinase, which bore witness of the presence of antigenic properties in penicillinase.

We made a study of some properties of antipenicillinase sera. Thus, we established that they possess neutralizing properties, i.e. they bind penicillinase and neutralize its action. The mechanism of this neutralization is at present still being studied, but proceeding on the premise that an antipenicillinase serum possesses precipitative properties (Table 2), we consider that neutralization, probably, occurs on the principle of a toxin neutralization by an antitoxin. In addition, we established that an antipenicillinase serum possesses an agglutinative property - it agglutinates [Begin p.79] penicillin-resistant staphylococci, but does not agglutinate strains sensitive to penicillin. In this case the agglutination titer is in direct proportion to the degree of resistance (table 3).

Table 2)

Agglutination Experiment

Series	Reaction Components (in ml)	Dilution of serum: From 1 : 50 up to 1 : 800	Dilution of serum: 1 : 1600	Dilution of serum: 1 : 3200	Controls: 1	Controls: 2
First	Antipenicillinase serum................	0.5	0.5	0.5	-	-
	Suspension of microbes (1956)...............	0.5	0.5	0.5	0.5	0.5
	Physiological solution	-	-	-	0.5	-
	Normal rabbit serum	-	-	-	-	0.5
	Results................	++++	-	-	-	-
Second	Antipenicillinase serum................	0.5	0.5	0.5	-	-
	Suspension of microbes (209)...............	0.5	0.5	0.5	0.5	0.5
	Physiological solution	-	-	-	0.5	-
	Normal rabbit serum	-	-	-	-	0.5
	Results...............	-	-	-	-	-
Third	Antipenicillinase serum	0.5	0.5	0.5	-	-
	Suspension of microbes	0.5	0.5	0.5	0.5	0.5
	Physiological solution	-	-	-	0.5	-
	Normal rabbit serum	-	-	-	-	0.5
	Results	++++	+++	-	-	-

In the titration of antipenicillinase sera we used our own method. It is based on the reaction of penicillinase to its neutralization by antipenicillinase; in the presence of penicillinase, the antiserum exerts its action so that during a supplementary addition of penicillin, the latter manifests its antibiotic action; if the amount of antipenicillinase is insufficient, then penicillinase destroys the added penicillin, and the staphylococcus (strain no. 209) sensitive to penicillin fails to develop. We used the minimal amount of serum [sufficient] to neutralize 1 unit of penicillinase within 60 minutes at 37° [C] as a unit of antipenicillinase action (table 4).

Table 3.

Precipitation Experiment

Reaction components (in ml)	Dilution of antipenicillinase serum		Controls		
	From 1 : 2 up to 1 : 256	1 : 512	1	2	3
Antipenicillinase serum	1	1	-	1	-
Penicillinase (10 units)	0.5	0.5	0.5	-	0.5
Physiological solution	-	-	1	0.5	-
Normal rabbit serum	-	-	-	-	1
Results	+	-	-	-	-

Table 4.

Titration of Antipenicillinase Serum

Reaction components (in ml)	Dilution of Antipenicillinase serum		Controls					
	From 1 : 2 Up to 1 : 256	1 : 512	1	2	3	4	5	6
Antipenicillinase serum	0.5	0.5	0.5	0.5	-	-	-	-
Penicillinase (1 unit)	0.1	0.1	0.1	-	0.1	0.1	-	0.1
Physiological solution	-	-	-	0.1	0.5	0.6	0.6	-
Normal rabbit serum	-	-	-	-	-	-	-	0.5
Keeping at 37° [C] for 1 hour								
Penicillin (100 units)	0.1	0.1	-	0.1	0.1	-	0.1	0.1
Keeping at room temperature for 1 hour								
Results (presence of sterile zone)	+	-	-	+	-	-	+	-

[Begin p.80]. A study made of the neutralizing, precipitative and agglutinative properties of antipenicillinase sera has permitted us to make the following conclusions:

1) penicillinase is associated with penicillin-resistance in microorganisms, particularly in staphylococci;

2) penicillinase possesses clearly pronounced antigenic properties, yet at the same time the differences between the antigenicity of intracellular and extracellular penicillinase cannot be established;

3) in immunizing with penicillinase it is possible to obtain high-titer antisera exerting specific action upon penicillinase;

4) antipenicillinase sera possess neutralizing, precipitative and agglutinative properties;

5) the agglutination capacity of an antipenicillinase serum manifests itself only in relation to penicillin-resistant microorganisms, and this indicates that penicillinase enters the structure of penicillin-resistant microorganisms as an antigen.

Data bearing witness to the antigenicity of penicillinase and to the possibility of utilizing antipenicillinase sera for medical purposes are available in literature. We report briefly our observations in vivo made in a study of the action exerted by antipenicillinase sera upon penicillin-resistant staphylococci. The experiments were conducted in three directions.

In the first place, we studied the action of antipenicillinase sera in passively immunized animals. Investigations were conducted on guinea pigs passively immunized with a rabbit's antipenicillinase serum. The experiment was conducted as follows: A few days prior to the experiment 3 [guinea] pigs were given 4 ml of antiserum each, after which all experimental animals and three control animals of the same weight were injected with 400 million staphylococci each (strain no. 2584 resistant to 1,600 units/ml of penicillin). Penicillin treatments were begun the following day - every morning and evening each animal was injected 1,000 units/ml of penicillin with pyramidon (2.5%). One of the control guinea pigs was not treated. We weighed the animals daily, counted the white blood corpuscles, watched the white blood picture and the general condition of the animals.

On the day following the inoculation the general condition of the control guinea pigs deteriorated considerably - the animals scarcely moved, refused food, lost weight, the number of [their] white blood corpuscles increased heavily and leucocytosis and lymphopenia were clearly pronounced. The control guinea pig not treated with penicillin perished after 6 hours, the second control guinea pig perished after 30 hours, and the third after 3 days, even though it had been given 4,000 units of penicillin. An autopsy of the control animals disclosed at the place of the injection purulent, necrotic, readily tearing off masses; in the internal organs (liver, lungs) - severe hyperemia and hemorrhage spots. Staphylococci identical with Staphylococcus 2584 were found in microscopic preparations and in seedings from internal organs and from the place where the culture had been introduced.

In the experimental guinea pigs there appeared on the place of the injection a slight infiltrate that was rapidly resorbed, and after a brief change in the white blood picture, the number of leucocytes also rapidly returned to normal, which prompted us to discontinue the penicillin treatments. The animals survived.

The experiments were repeated with a decreased amount of the antipenicillin serum, and they demonstrated that passively immunized animals that had undergone combination penicillin treatments proved considerably more resistant to staphylococci than control animals. In these [the immunized] animals the staphylococcal process was rapidly ended. [Begin p.81].

In the second place, we studied the action of antipenicillinase sera in actively immunized animals. Rabbits and guinea pigs actively immunized with penicillinase were used in the experiments. The experiments were conducted as follows: experimental rabbits were preliminarily immunized with penicillinase (the total amount of penicillinase comprised 10,000 units), a week later, when the immunization was finished, an experimental and a control rabbits of the same weight were each injected intravenally with 3 billion staphylococci of strain no. 1555 resistant to 15,000 units of penicillin. Penicillin treatments were begun the same day - each of the animals was injected with 10,000 units of penicillin with pyramidon in the morning and in the evening.

The control rabbit died 48 hours later. During autopsy large numbers of abscesses were established in all internal organs. The experimental rabbit survived as many as 13 days of treatments (the total amount of penicillin comprised 260,000 units), the number of leucocytes and the white blood picture became normal and the animal was completely healthy.

The experiment was prepeated several times with rabbits as well as with guinea pigs, and also with other penicillin-resistant staphylococcal strains and produced the same results even when treatments were carried out with decreased doses of penicillin.

An experiment was also conducted in intradermal injection of the penicillin-resistant staphylococcal strain no. 1555 in an immunized and a normal rabbits. In the experimental rabbit localized changes disappeared on the 7th day without any suppuration or fistulization, while the control animal had an infiltrate of considerable size, fluctuation appeared on the 14th day, a fistule developed on the 18th day, and convalescence set in only on the 30th day.

The experimental results indicate that animals actively immunized with penicillinase become more resistant to penicillin-resistant staphylococci, and antipenicillinase that develops within the organism restores the sensitivity of staphylococci to penicillin, and as a result, produces a therapeutic effect.

Finally, we made a study of the action of an antipenicillinase serum within the organism of actively immunized animals. Inasmuch as neutralizing, precipitative and agglutinative antibodies are present in antipenicillinase sera, we conducted the experiments without the use of penicillin treatments.

The experiments were conducted the same as the previous ones: one [guinea] pig we immunized with penicillinase, and one control [guinea] pig we injected with 400 million staphylococci (strain no. 2584). The animals, as indicated above, received no penicillin.

The control animal died 26 hours after the inoculation; observations of the experimental animal disclosed at the beginning a loss of weight, displacement of leucocytes which disappeared on the 8th day, and a considerable infiltrate at the place where the injection was made, which disappeared completely on the 11-12th day. The animal survived.

This experiment indicates that the presence of neutralizing, precipitative and agglutinative antibiodies in antipenicillinase sera increases the resistance of animals to penicillin-resistant staphylococci.

CONCLUSIONS

1. Antipenicillinase sera possess neutralizing, precipitative and agglutinative properties.

2. The therapeutic effect produced by antipenicillinase sera must be credited to the following factors:

a) the serum binds the penicillinase of microbes resistant to penicillin and thus provides for the action exerted upon them by penicillin; [Begin p.82];

b) antipenicillinase sera with its neutralizing, precipitative and agglutinative antibodies increases the resistance of macroorganisms.

3. Animals (rabbits and guinea pigs) actively immunized with penicillinase and passively immunized with antipenicillinase sera are more re-

sistant and manifest a milder reaction to inoculation with penicillin-resistant staphylococci, than control animals. Penicillin treatments lead to a complete and rapid recovery from staphylococcal infections caused by penicillin-resistant microbes.

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Sravnitel'noe izuchenie aktivnosti katalazy i nekotorykh drugikh biokhimicheskikh pokazatelei u fagoustoichivykh i fagochuvstvitel'nykh form aktinomitsetov.

[Comparative activity studies of catalases and some other biochemical factors in phage-resistant and phage-sensitive actinomycete strains].

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(In Russian)

After affecting a phage-sensitive culture with a specific phage, often variants develop which are resistant to the phage in question. A culture which is sensitive to several phages can be made resistant to them by the reaction of these phages. The newly acquired property, the phage-resistance, is stably transmitted hereditarily [3].

What kind of changes occur in the microbe cell when it becomes resistant to certain phages? This question, which is of great theoretical and practical importance, has, evidently, not been sufficiently studied. In our previous work, which was given over to comparative study of certain biochemical properties of phage-sensitive and phage-resistant forms of actinomycetes [1], it was shown that phage-resistant (PR) cells differ from cells of the initial phage-sensitive culture (PS) according to their enzymatic-protein complex and some other properties. It proved to be that cultures resistant to the phage differ from phage-sensitive cultures by the great activity of their catalase and its great resistance to inhibitors.

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Studies of the enzymatic activity in the above cited work were conducted on mycelium preparations, which were fixed in alcohol and which could be preserved for a specific time; this could in some manner, change the initial activity, that was peculiar to the fresh mycelium.

Therefore, it was especially interesting to study the activity of catalase in the fresh material and at the earliest possible hour of development of the actinomycetes' culture, when it is the most sensitive to the effect of the phage. Together with this, we intended to study the activity of catalase also in spores of the phage-resistant and phage - sensitive cultures.

A more detailed study of the catalase in spores and mycelium of actinomycetes seemed to us to be important also for the following reasons. In literature there are many works which are given over to the studies of catalase of bacteria. Yet, this problem was not sufficiently studied for actinomycetes. Detailed data about the presence and role of catalase in bacteria are set forth in Porter's book [5]. It appears that there are species of bacteria which do not produce catalase, and species which produce all its forms. Certain properties of bacteria are connected with the activity of catalase. Thus, for instance, Huddleson and Stahl (see Porter [5]) considered the activity of catalase in different species of genus Brucella as a criterion of their virulence.

Virtanen and Pulkki [6], who studied catalase in Bac. mycoides, have ascertained that vegetative cells of this microorganism contain catalase, while catalase was not detected in its spores.

The object of research in this work were two cultures of the species Actinomyces globisporus streptomycini Kras.

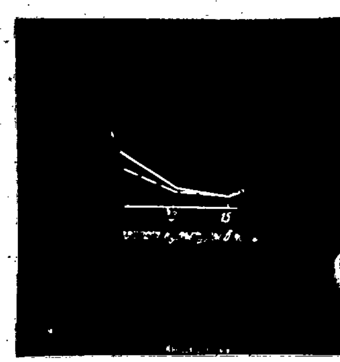
Culture B-6 (phage-sensitive) represented a typical culture of Actinomyces globisporus streptomycini, which was sensitive to three different types of actino phages I, II and III, that differ one from another in their virulence, [Begin p.467] in the forms of negative colonies and certain other properties [2]. Culture 1072 (phage-resistant) was obtained from culture B-6 as a result of reaction on it with three types of actino phages in succession and of selection of the phage-resistant cultures arisen after this. Culture 1072 was selected from among the obtained phage-resistant variants; it did not differ from the initial phage-sensitive culture in its cultural, morphological, physiological and antibiotic properties. The basic difference between the two cultures of actinomycetes was their relation to the actinophages. Culture B-6 (phage-sensitive) was lysed by all the three cited types of actinophages; the phage-resistant culture 1072 was resistant to all these three actinophages and was not lysed by them either on liquid or on solid media, which were favorable to lysis of culture B-6. Culture 1072 stably preserves its phage-resistance during the course of several years, in spite of frequent reseedings on media which do not include actinophages.

The activity of catalase was studied in spores of both cultures, phage-sensitive and phage-resistant, as well as in mycelium of different age: on the 6th, 10th 15th, 24th and 36th hour of its development.

The cultures were grown during the course of 10 days on potato agar for obtaining sporal material; while for certain experiments for 15 days on Czapek's medium at a temperature of 26-27°. The collected spores were washed with water; one part of them was taken for analysis in a fresh state, and the other was fixed in 96° [per cent ?] alcohol, in which it was preserved for five days; after this the spores were removed from alcohol, dried in a vacuum-desiccator and in such a form underwent analysis on the activity of catalase.

Cultivation of mycelium was conducted in flasks on a circling rocking device, 120-150 r.p.m., at a temperature of 26-27°. The spores served as seeding material. Fish broth, with the addition of 2% of glucose, was used as culture medium. Mycelium of certain age was centrifuged, separated from the cultural liquid and was carefully washed with water; both the fresh mycelium and the one fixed in alcohol underwent analysis.

Determination of the activity of catalase in the material was conducted by the gasometric method; the activity was expressed in milliliters of the liberated oxygen per 1 mg of absolutely dry substance (mycelium or spores). A weighed portion of mycelium or spores was triturated with sand for the course of 30 minutes in a certain volume of a phosphate buffer, at pH 6.8. For each determination 5 ml of the mixture were taken, to which 5 ml of water and 3 ml of 0.5% H_2O_2 were added; the length of reaction was 5 minutes. For inhibiton 3 ml of 3 M solution of sodium nitrate were introduced into the biomass instead of 3 ml of water. The time of the inhibitor's activity was 30 minutes; the activity of catalase was determined after that. A boiled mycelium, which did not show any catalase activity served as a control in the experiments. Data on determination of activity of catalase in the spores and in mycelium of actinomycetes are presented in table 1; they are also depicted in the form of curves in figure 1.



Title of figure 1. Curve of catalse activity of phage-resistant (PR) and phage-sensitive (PS) cultures (According to the amount of oxygen liberated during 3 minutes per 1 mg of the absolutely

Title of figure 1 continued. 2 - PS (phage-sensitive) culture.
Words in figure 1. At the top: O_2 in ml; beneath the picture: Age of the culture in hours.

It is seen from data of table 1 and figure 1 that the greatest activity of catalase was in the sporal catalase, while in the phage-resistant form of actinomycetes the activity of catalase was somewhat higher than in the phage-sensitive. The characteristic features in the activity of catalase in phage-sensitive and phage-resistant forms were preserved in actinomycetes [Begin p.478] when cultivating the spores on various media. Further on it was found that during the first hours of development of mycelium (6 hours) the activity of catalase of actinomycetes fell greatly compared to the intensity of activity in spores; the activity of catalase during this period of development was slower in the phage-sensitive form than in phage-resistant. The fall of activity of catalase continued up to 15 hours of the growth of mycelium and at that time it became similar for both the phage-resistant and phage-sensitive forms. Up to 15 hours of development the activity of catalase was higher in the phage-resistant culture, and after this it became higher in the phage-sensitive.

Table 1.

Catalase activity in ml of oxygen per 1 mg of absolutely dry substance in fresh and fixed specimens of phage-sensitive (PS) and phage-resistant (PR) cultures.

Material and age of the culture (in hours)	Fresh material		Material fixed in alcohol	
	PS	PR	PS	PR
Spores cultivated on potato agar	5.12	5.98	5.31	5.44
Spores cultivated on Czapek medium	5.37	6.17	-	-
Mycelium:				
6 hrs of development	1.46	1.93	-	-
10* " " "	1.20	1.63	-	-
10 " " "	0.63	0.70	0.22	0.18
15 " " "	0.40	0.40	0.21	0.20
24 " " "	1.44	1.23	1.05	0.82
36 " " "	1.26	1.17	1.00	0.92

*Culture of actinomycetes in the experiment in question was developed at a temperature somewhat lower than is usually utilized in experiments (18-20°) and, apparently, lagged behind the culture of the same age, grown at 25-26° in physiological development.

When comparing intensities of activity of catalases in fresh mycelium and in mycelium fixed in alcohol, a circumstance attracts one's attention; namely, that the activity of catalase in mycelium decreases considerably as a result of fixation in alcohol. This decrease was sharply expressed in the younger mycelia (up to 24 hours of development). Data on the activity of catalase are cited in table 2.

Table 2.

Loss of activity of catalase as a result of fixation of mycelium in alcohol (in percent to the intensity) of the primary activity of catalase in the fresh material

Age of culture (in hours)	PS (phage-sensitive)	PR (phage-resistant)
10	65.20	74.29
15	47.50	50.00
24	27.01	33.34
36	20.64	18.81

In our previous research [1] the values of catalase activity for phage-sensitive and phage-resistant forms of actinomycetes were considerably smaller.

This difference is, apparently, the result of fixation of the material in alcohol, as well as the length of preservation (½ to 1 year). Virtanen and Pulkki, in their experiments with Bac. mycoides [6], have also observed similar considerable loss in the activity of the enzyme in dry preparations, after storing them.

When examining the activity of catalase, we paid attention to the fact that actinomycetes have two forms of catalase: those soluble and the insoluble in water. In order to compute the numbers of these forms we conducted a research of the catalase activity in actinomycetes both in the biomass and after filtering it through a paper filter (table 3).

As it is seen from table 3 the amount of the soluble form of catalase changed with the age of the culture and differed in phage-sensitive and phage-resistant forms. [Begin p.469]

Table 3.

Amount of general and soluble form of catalase

Material and age of culture (in hours)	Activity of catalase in the fresh material				% of the soluble form of catalase	
	Mixture		Filtrate			
	(PS) phage-sensitive	(PR) phage-resistant	PS	PR	PS	PR
10	0.63	0.70	0.36	0.35	57.14	50.00
24	1.46	1.18	1.24	0.70	84.93	59.32
Spores	5.12	5.98	3.23	4.43	63.08	74.08

We have noted that after the influence of the inhibitor - sodium nitrate - on the catalase system of actinomycetes it was fully depressed at all stages of development of the mycelium, as well as in spores, which were examined by us in cases where the material was fixed in alcohol; it is interesting to mention, as far as the fresh material is concerned, that in all preparations examined by us, after a 30 minute reaction with nitrate, some catalase activity remained; it was not suppressed by the inhibitor and disappeared after boiling. We did not detect any essential difference between the intensity of the remaining catalase activity, which was not depressed by the inhibitor, in the cases of phage-sensitive and phage-resistant forms during the early hours of the mycelium's development.

In order to discover other possible differences between phage-sensitive and phage-resistant forms, we examined also their reducing power in regard to methylene blue. The experiment was conducted in the following manner: equal portions of the material (raw mycelium, spores), in the amount of 200 mg, were triturated with sand in 5 ml of phosphate buffer; after this, on attaining a vacuum, to the mass in each one of Tunberg's test tubes were added 0.5 ml of solution of methylene blue in a concentration 1:10,000. Data of the experiment are cited in table 4.

Table 4.

Reducing power of mycelium of Actinomyces globisporus streptomycini.

Material and age of culture (in hours)	Time of decolorization of methylene blue (in minutes) by an equal amount of mycelium	
	phage-sensitive [PS]	phage-resistant [PR]
19	21	30
15	15	30
24	3	3
Spores	12	21

It is seen from data of table 4, that during the early hours of development the mycelium of actinomycetes of the phage-sensitive form possesses, a greater reducing power than the mycelium of the phage-resistant form. This feature of the phage-sensitive form is preserved also in spores.

Znamenskaia and others [2] have noted that after oxidation of the developing mycelium of actinomycetes by different oxidizers the amount of DNA is somewhat lowered in it. It was interesting to trace if this reaction proceeded with the same intensity in phage-sensitive and phage-resistant forms of mycelium. For the clarification of this question through the suspension of mycelium (of a 24-hour growth), carefully ground with sand, a current of oxygen was passed through the water during the course of 6 hours under equal conditions, at room temperature. The amount of DNA in mycelium was determined before and after the passage of oxygen. As a result of the experiment it was ascertained that, during a similar time of reaction, oxygen lowers the percentage of DNA in the phage-sensitive culture to a greater degree than in the resistant. In the sensitive culture, as a result of reaction of oxygen, in the mycelium remained about 70% of the initial amount of DNA, while in the case of the phage-resistant form about 90% remained. Thus, [Begin p.470] in respect to the reaction of oxygen of the air, which affects the preservation of the amount of DNA in a cell, the phage-resistant form of actinomycetes is far stabler then the phage-sensitive.

Table 5

The amount of biomass per 1 L. of cultural fluid in 1 g of raw mycelium

Age of culture (in hours)	Phage-sensitive [PS]	Phage-resistant [PR]
6	0.35	0.26
10	1.63	1.54
15	4.75	4.20
24	6.75	6.35
36	6.94	6.71

In order to study the possible differences during development of phage-resistant and phage-sensitive forms a calculation of the yield of biomass for both forms was conducted (table 5). Accumulation of biomass in phage-resistant culture was lagging somewhat, especially during the first hours of development of mycelium as compared with the phage-sensitive culture. But toward the 36th hour of development of the culture this difference levelled off. Some differences and peculiarities in the development of phage-sensitive and phage-resistant forms of actinomycetes, which were observed by us, were noted again and again during their repeated cultivations on one and the same medium, under similar conditions of the experiment. The observed by us somewhat intenser activity of the catalase and somewhat smaller reducing power in spores and in mycelium during the earliest stages of development in the phage-resistant form of actinomycetes are, perhaps, some of the many factors which are connected to the phage-resistance of the culture under consideration.

CONCLUSIONS

1. Cultures of Actinomyces globisporus streptomycini Kras., both the phage-sensitive and the phage-resistant, contain catalase not only within the mycelium, but also in spores, and the activity of this enzyme changes during the process of ontogenesis.

2. The phage-resistant form of actinomycetes shows a greater activity of catalase than the sensitive one both in the sporal material and during the early hours of mycelium development.

3. Spores of the phage-resistant culture contain more of the soluble form of catalase then spores of the phage-sensitive.

4. When fixing mycelium in alcohol, the activity of catalase, both in phage-sensitive and in phage-resistant cultures, is lost to a considerable degree; and the percentage of the loss of activity is greater in young cultures.

5. No differences were detected during the early stages of development in respect to the inhibitor, sodium nitrate, in both the phage-sensitive and phage-resistant cultures of actinomycetes.

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Mansurova, V. V., Sakharov, V. V., and Khvostova, V. V.

Chuvstvitel'nost' diploidnykh i autotetraploidnykh rastenii k gamma-izlucheniiu.

[Sensitivity of diploid and autotetraploid plants to gamma-radiation].

Botanicheskii Zhurnal, vol. 43, no. 7, p.989-997. July 1958. 451 R923.

(In Russian)

INTRODUCTION

In our time, ionizing radiation is used increasingly in plant industry. This is connected with attempts to stimulate plant growth with weak doses of ionizing radiation, and also with the great importance of higher radiation doses used in obtaining economically valuable mutants in agricultural plants. As a result, the problem of plant sensitivity to ionizing radiation has acquired great importance.

Data concerning the varied sensitivity of seeds, as well as of the plants themselves as, they develop in a gamma-field are available in literature (Gustaffson, 1944; Gelin, 1953, 1956; Nybom, 1956; Carter, 1956). In these works radiosensitivity was measured by various characteristics, including: the quantity of mutations that emerge in the progeny; the number of chromosome rearrangements determined visually in the cytological preparations of young rootlets and microspores; the degree of plant sterility; the degree of growth inhibition in irradiated plants and, finally, simply the number of plants that had survived until fruiting.

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It proved that the difference in radiosensitivity between some plants is very great. As an example we shall cite some data from the works of Gustaffson (1944). He treated seeds with roentgen rays and determined the critical doses after which there was left a sufficient number of viable plants X_1 (developed from irradiated seeds) in whose progeny a considerable number of mutations and chromosome rearrangements were detected. The dose for peas and hemp was about 7.5 kr, for barley, oats and wheat 10-20 kr, for flax 40-60 kr and for mustard over 92 kr.

In a study made of radiosensitivity of plants that grow in a gamma field, it was disclosed that severe injuries are also inflicted on different plants by different doses: for Lilium longiflorum and Tradescantia paludosa a mere 30-50 r per day [24 hrs] are sufficient, for flax 801-1600 r, for gladiolus, Luzula multiflora and L. pallescens 1600-6000 r. The reasons for such differences in radiosensitivity have not as yet been explained. On the basis of such investigations Nybom (1956) suggested a hypothesis according to which the differences in radiosensitivity are associated with the size of chromosomes. But this, of course, is not the only reason.

The problem of influence exerted by polyploidy upon radiosensitivity must be analyzed in particular. Interesting data and considerations on this issue are cited in the work of Mackey (1954). Polyploids have more chromosomes, but the number of chromosome breaks and mutations per unit length of a chromosome are, according to some experimental data (Conger, 1956), in diploids and tetraploids approximately the same; hence it can be expected that polyploids will have a number of chromosome rearrangements and "point [tochechnykh]" mutations. Consequently, from this point of view, polyploids must be more sensitive to irradiation than diploids. However, impairment of the nucleus in polyploid plants manifests itself phenotypically considerably less than in diploids. Polyploids prove to be more stable morphologically as well as physiologically; this is due to the larger number of multiple repetitions of their homologous chromosomes, [Begin p.90], and, consequently, also to the genes arranged upon them lengthwise. An injury in any chromosome of a diploid plant, for instance, the appearance of the "bridge" in anaphase in mitosis, thanks to translocation, often leads to the circumstance that the cell is deprived of a section of one chromosome or another and thereafter usually perishes. This is one of the causes of the death of cells followed by inhibition of growth and deformation of plants. In polyploids, however, such a disturbance is covered up by the presence of another pair of chromosomes which leads to the well-known stability or, as it is called, a "buffering" of the organism. Even after irradiation with high doses, polyploid plants display a greater productivity and they endure better chromosome rearrangement. In the light of this Stadler's (1929) old data gain special importance; he irradiated wheat of 14, 28 and 42 chromosomes with roentgen rays and established a reversible relation between the number of mutations occurring in the progeny and the number of chromosomes found in irradiated forms.

It is interesting to compare his data with the results obtained in the works of Swedish investigators (Frö̈ier, Gelin, Gustaffson, 1941; Frö̈ier, Gustaffson, Tedin, 1942) in which they determined the percentage of cells with chromosome rearrangement, in the rootlets of einkorn hard and soft wheats after roentgen irradiation of dormant seeds with doses of 5, 10 and 15 kr. After irradiation with doses of 5 kr, in Triticum monococcum out of 2586 cells 10.98% of cells were found to have aberrations, in T. dicoccum - out of 1573 cells 24.41%, in T. durum - out of 1932 cells 19.98%, in T. vulgare - out of 1438 cells 29.35%; after irradiation of these species with a 10 kr dose, an analysis of over 1000 cells disclosed in each of them respectively 30.55, 71.33, 57.89 and 61.69% of cells with aberrations. These data demonstrated clearly that: 1) the percentage of cells with chromosome rearrangements is larger in polyploid wheats than in diploid; 2) in *T. dicoccum* more cells [were found] with chromosome rearrangements than in *T. durum*, despite the identical number of chromosomes in these species.

The conclusion drawn from these investigations is plain: more mutations occur in polyploids, but a smaller number of them manifest themselves in the progeny, since polyploids have not [only] two, but four or more homologous chromosomes.

It must be assumed that radioresistance must be especially pronounced in autopolyploids in which the same genome recurs 4 times.

The characteristics of polyploids must be taken into consideration when they are utilized in experimental radiobiology as well as in radioselection. It is important to remember that the larger portion of cultural plants (particularly soft and hard wheats, many fruits and berries, ornamental plants and others) are polyploids by nature. Usually they are not simply autopolyploids, but complex allopolyploids. Hence, it follows that their reaction to irradiation is also complex.

The reactions of polyploid plants to irradiation are not by far sufficiently investigated. A profound study of these reactions promises to produce [information] that will be of much interest to theory as well as to practice.

Material and working methods

We undertook the task of conducting a comparative study of the resistance of diploid and autotetraploid plants to various forms of ionizing radiation. In the present report, which is the first one, are set forth data dealing with the action exerted upon plants by one of the most penetrating (hard radiations - gamma-rays). The source of the radiation was the radioactive cobalt isotope (Co^{60}) and the dosage rate was 580-600 r/min.

Two forms of seed buckwheat served as the investigation object: 1) the diploid, 16-chromosome form is the Bol'shevik variety of I. A. Pul'man's selection; 2) the autopolyploid, 32-chromosome buckwheat is the Tetraploidnyi Bol'shevik variety obtained experimentally from the preceding one and selected by V. V. Sakharov, S. L. Frolova and V. V. Mansurova.

Dry seeds (more accurately fruits) were irradiated with doses of 10, 15, 20 and 30 kr. Non-irradiated diploid and tetraploid seeds served as controls. Irradiation took place on August 13, 1956, upon which the seeds of all experimental variants and the control seeds were soaked simultaneously for germination. The seeds that had begun to germinate on two [different] dates (all tetraploids on August 15, all diploids on August 16) were seeded on a rack in a hothouse.

The following characters were used in calculating the influence exerted by different doses of gamma-radiation upon diploid and tetraploid plants: 1) inhibition of germination (sprouting) of soaked seeds; 2) decrease in sprouting of seeds, and death of plants that were already growing; 3) inhibition of growth of experimental plants (measurements were taken twice, on the 45th and the 52nd day after the soaking); 4) appearance of peculiar, chimerical sections on the blades of leaves readily observed in the form of brighter spots.

Let us turn to the examination of the data obtained.

The Experimental Part

The experimental results of the influence of radiation exerted upon both investigated forms of buckwheat are presented in the table.

Influence of various doses of gamma-radiation upon diploid and autotetraploid buckwheat

Forms of buckwheat	Radiation dose	Seeds soaked and seeded: Total	those germinated: Absolute quantity	those germinated: in %	Seeds that did not sprout and plants that perished: Absolute quantity	Seeds that did not sprout and plants that perished: in %	Number of plants the height of which was measured: Sept. 27	Number of plants the height of which was measured: Oct. 4
Diploid	Controls	500	172	34.4 ± 1.3	95	19.1	438	405
	10000 r	1350	216	16.0 ± 1.0	249	18.4	1131	1101
	15000 r	1000	176	17.6 ± 1.2	182	18.2	846	818
	20000 r	1190	233	19.6 ± 1.1	229	19.2	985	981
	30000 r	1130	169	15.0 ± 1.1	343	30.3	819	737
Tetraploid	Controls	500	135	19.4 ± 1.8	16	3.6	486	482
	10000 r	960	57	6.0 ± 0.8	87	9.1	899	873
	15000 r	1050	78	7.4 ± 0.8	112	10.7	959	938
	20000 r	1070	45	4.2 ± 0.6	115	10.7	984	955
	30000 r	970	41	4.2 ± 0.6	57	5.8	956	913

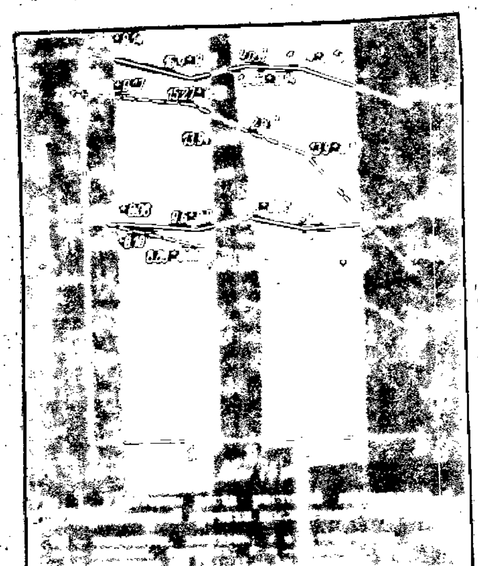
In examining the data of both experiments relating to the percentage of germinated seed, one may be convinced merely that germination is definitely inhibited under the influence of irradiation with any of the investigated doses. But the available material, unfortunately, does not permit conducting a detailed comparison of the results of both experiments, since the planting of the seeds and the counting of the germinated seeds of tetraploids was carried out a day earlier than in the case of diploid plants. This explains the considerably smaller number of germinated seeds found among tetraploids.

We consider that the data relating to seeds that did not germinate and to plants that had proceeded to develop, but had perished in the course of the experiment do not permit making clear conclusions (see table). There is, to be sure, no doubt as to the great destruction of diploid plants at the highest dose of radiation (30.3%). But the high percentage of destruction of diploid control plants (19.1%) comes close to the percentage of plant destruction by the first three doses of irradiation. In this respect, the material on tetraploids is also unclear. With the considerably smaller loss among controls (3.6%) and at the first three doses of irradiation (9.1, 10.7 and 10.7%), as compared with diploids, their extremely low mortality under the action of the highest dose of irradiation (5.8%) is astonishing.

After a critical evaluation of all the material outlined, we arrived at the conclusion that it was necessary to repeat a detailed study of the influence exerted by gamma-radiation upon the germination and sprouting of seeds and upon the subsequent destruction of plants.

Besides the need of a simultaneous calculation of the germination of seed of diploid and tetraploid forms, the extreme density in which the plants that we had investigated were growing must be avoided. [Begin p.992]. Experiments must also be conducted under conditions of a more normal, subsoil content of plants that develop during the spring-summer season which is usual for them.

Very distinct differences were detected in the sensitivity of diploid and tetraploid plants to gamma-radiation after the height of the same plants had been measured twice in succession (Sept. 27 and Oct. 4). The number of the measured plants is indicated in the last two colums of the table, all other data of the twice taken measurements are cited in figure 1. The two lower curves reflect the results of the first measuring. Of these the upper one (unbroken) indicates merely a slight (although authentic as compared with controls for the first, third and fourth doses) inhibition of growth in tetraploid plants under the influence of irradiation. The lower (punctated) curve pertaining to diploid plants shows a successive, steadily increasing inhibition of growth under the action of gamma rays, as the irradiation doses are increased. This has been established with full authenticity in all cases, in comparing controls with plants exposed to the action of any dose, as well as in comparing the influence of each successive dose with the influence of the preceding one. A specially sharp inhibition of growth has been noted in the case of the highest dose; in this case the average height of the plants does not reach even half the average height of control plants (4.70 cm against 10.08 cm).



Doses (in kr)

Fig. 1. Inhibition of plant growth in diploid and autotetraploid buckwheat after gamma-irradiation

4 nk - tetraploid, controls; 4 n - tetraploid, experiment; 2 nk - diploid, controls; 2 n - diploid, experiment; I - 1st measuring (Sept. 27); II - 2nd measuring (Oct. 4).

[Words to the left of figure 1]: Average height of plants (in cm)

An even clearer picture is apparent when data of the second measuring, carried out one week after the first one, are examined. This one-week period came at a time of intensive growth of buckwheat plants, and the differences between diploids and tetraploids with regard to their sensitivity to gamma-radiation, noted already during the first measuring, were even more pronounced a week later. On tetraploids the influence of irradiation was considerably less notable than on diploids even during this period; however, at the second measuring the inhibition of their growth became more noticeable. Inhibition of growth noted for the first three doses of irradiation (10, 15 and 20 kr) increased, and all differences with respect to controls were authentic. But the differences in the influence of the three doses referred to proved statistically unauthentic. A statistically authentic difference in growth was obtained only at the highest dose of irradiation, as compared with controls as well as with all other irradiation doses. Plants exposed to a 30 kr dose were on the average almost 3 cm, i.e. 16%, lower than control plants. [Begin p.993].

Side by side with the corresponding curve of the growth of tetraploids, the curve of the second measuring of diploid plants looks very revealing. This curve confirms even more distinctly the findings disclosed at the first measuring. Only the decrease in the average height of plants, as compared to controls, obtained once more for the 10 kr dose was not entirely authentic, for all subsequent doses, however, a gradually increasing, authentic difference in plant height was noted. An especially obvious inhibition of growth was found also here, when the largest dose was used; plants exposed to it failed to reach even half the height of control plants (7.4 cm as compared with 15.8 cm).

Thus, the data on the measurements taken both times of the height of diploid and ~~autoploidx~~ autopolyploid plants permit making the conclusion that diploid plants possess a considerably higher sensitivity to gamma-irradiation. This becomes especially clear when the curves obtained of tetraploid measurements of diploids taken both times. The form of the tetraploid curves obtained on different dates is almost identical, except for the difference in height at which [the curves] proceed. In diploids, however, a sort of convergence was noted, as the irradiation doses were increased; this was due to the more severe inhibition of their growth at the stage [of their development] that followed the first measuring. It seemed that the further the development of diploid plants progressed, the more pronounced were the injuries caused by large doses of gamma-radiation.

Doses (in kr)

Fig. 2. Influence of gamma-irradiation upon the growth of diploid and tetraploid millet plants

The definitions are the same as on fig. 1.

[Words to the left of figure 2]: Average height of plants (in cm)

A comparative investigation similar to the one described above was conducted also with millet -- the Dolinskoe variety, and with autopolyploids obtained by E. N. Volotov from this variety. A season untimely for experimentation and, consequently, the need to maintain the plants in a hot-house have affected millet even more than buckwheat. But data on height measurements of control diploid and tetraploid plants of millet and on the height of plants developed after irradiation of dry seed with the same doses of gamma-radiation (10, 15, 20 and 30 kr) coincide with the picture

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which we have described for buckwheat, hence, we consider their publication interesting.

Let us turn to fig. 2 on which the results of these experiments are represented.

In contrast to buckwheat, the curves obtained in the first and second measurings of millet run on very close levels. This was due to the fact that the second measuring of millet plants was carried out somewhat prematurely, prior to the period of their intensive growth.

Entirely specific and interesting results were obtained from a computation of spots that appeared on the leaves of diploid buckwheat plants developed from irradiated seeds.

Before, however, we proceed to outline the data obtained and to discuss the causes for the appearance of mosaic on the leaves of diploid buckwheat under the influence of irradiation, we shall have to relate about a different type of mosaic that developed in autopolyploid buckwheat exposed neither to irradiation, nor to any other strong factors.

In working with autotetraploid buckwheat, our attention had long since been attracted by peculiar spots that appeared infrequently, but regularly on the blades of leaves of individual plants. These spots stood out on normal tissue by their brighter coloring and often by a sort of depression. They remained on the leaf without changing their outlines. This mosaic appeared on entirely healthy, normally flowering and fruit-bearing plants. We noted similar spots, much more rarely, on the plants of our autopolyploid hemp.

It is important to underscore that the most thorough search for a similar mosaic on diploid buckwheat plants was conducted in vain. Nor were we able to find similar spots either on diploid hemp, or on any other normal diploid plant.

The discovery of a type of mosaic characteristic only of tetraploids led us to substantiate [k obosnovaniiu] the working hypothesis concerning the emergence of individual impregnations consisting of diploid cells in a mass of tetraploid tissue by means of somatic reduction. This hypothesis was based on the following facts:

1) The emergence in tetraploid tissue of the brighter sections which we have described and which approach the color of the leaves of ordinary diploid buckwheat not only by their color, but, in most cases, also by a decreased size of cells, as compared with the cells of tetraploid tissues that surround them. The size of the cells that form a spot correspond with the size of the cells in diploid plants.

2) The emergence in some autotetraploid buckwheat plants of individual and extremely rare "exceptional" diploid seeds impregnated among an overwhelming mass of tetraploid seeds.

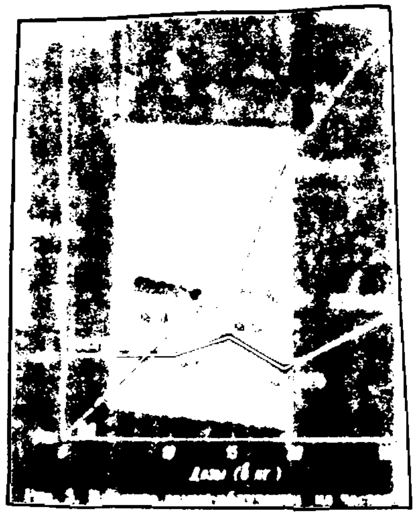
3) The occurrence of cells with a multiple decreased number of chromosomes in preparations of rootlets of autotetraploid buckwheat plants. S. L. Frolova and V. V. Mansurova have noted more than once individual cells with an accurate set of 16 chromosomes, and in one case they have observed even a cell with 8 chromosomes among a multitude of 32-chromosome cells.

These facts published heretofore (Sakharov, 1946) cannot be disregarded when the material of the present work is being discussed.

Let us proceed to examine fig. 3. on which the frequency of the appearance of mosaic sections taken into account only on the first and second real leaves in diploid and tetraploid plants are depicted. Let us begin at the extreme ends of both curves pertaining to non-irradiated material. As should have been anticipated, there was not a single case of similar spots in non-irradiated diploid plants, hence the curve (punctated) for diploids begins at the zero point. But in non-irradiated tetraploid plants 7.8% of the leaves had characteristic, clearly circumscribed spots. This is the peculiar mosaic of tetraploid plants which as a rule [v norme] appears on their leaves. As we study the curve that pertains to tetraploid plants, we are unable to note on it any regular increase in the mosaic percentage in relation to the irradiation dose. It is true that the largest percentage of spotted leaves (11.7%) has been noted at the highest dose (30 kr), but even in this case the difference as compared with controls (7.4%) fails to attain statistical authenticity. On the other hand, as the irradiation dose is increased, the number of mosaic leaves in diploid plants increases in proportion definitely and abruptly attaining 37.9% at the highest dose. Consequently, a greater sensitivity of diploid plants to gamma-radiation has definitely been established also on the [strength] of this character - the emergence of chimerical sections on normal diploid tissue as a result of irradiation. [Begin p.995].

If mosaics in tetraploids are a resultant of somatic reduction, then mosaics in diploids are of a different nature. In the latter case mosaics are undoubtedly due to necrosis of tissues. A preliminary examination of mosaic sections under a microscope has indeed demonstrated that a picture of cell necrosis, or even the absence of protoplast within cell membranes is sometimes observed. Ehrenberg and Nybom (1954) made a study of the appearance of sections on leaves of irradiated barley in which chlorophyll was absent. They established that these sections had a varied structure depending on whether they occurred under action exerted by roentgen rays or neutrons: the spots that developed from roentgen irradiation had a "diffused" character and consisted of necrotic tissues deprived of cellular turgor. On the borderlines of these sections, a gradual transition to more normal cells was observed. After irradiation with neutrons, there were observed more frequently long, more sharply pronounced, white stripes on which plastids were absent, but the cells possessed turgor and were fully viable. These authors consider that cells [observed] in the "diffusion" type sections perish after [exposure to] recentgen irradiation as a result of plasma impairment; the sensitivity of cells to radiation varies strongly in relation to moisture, presence of oxygen etc. It is possible that in treatments with neutrons cell injury is more localised and plastids are injured in particular.

The difference in the number of spots observed in diploid and tetraploid buckwheat after exposure to radiation favors the [theory] that impairment of the nuclei underlies the appearance of necrotic spots, since otherwise it would be difficult to explain the nearly complete absence of an increase in the number of spots on tetraploid leaves when the radiation dose is increased. Obviously, the appearance of necrosis is inhibited when four similar sets of chromosomes are present in the cells of tetraploids.



Doses (in kr)

Fig. 3. Influence of gamma-irradiation upon the frequency of appearance of mosaic leaves in diploid and autotetraploid buckwheat.

Definitions are the same as on fig. 1.

[Words to the left of figure 3]: Percentage of leaves with spots

Discussion of Results

The data obtained in the present work concerning the influence of gamma-radiation upon the growth of buckwheat and millet and upon the number of necrotic spots on leaves have demonstrated once more that autotetraploid plants are morphologically and physiological more resistant to ionizing radiation than diploid plants.

Konzak and Singleton (1952), in a brief report, have pointed out the resistance of autotetraploids to thermal neutrons. They noted that tetraploid oats were more stable than diploid and hexaploid. But in the latter case it concerned polyploid forms in nature [Bogin p.996] - allopolyploids the chromosomes of which are not always represented by four similar chromosome sets.

The relationship between radioresistance and ploidy was studied also

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THE SENSITIVITY OF DIPLOID AND AUTO-TETRAPLOID PLANTS TO GAMMA-RADIATION

By V. V. Mansurova, V.V. Sakharov, and V. V. Khvostova

SUMMARY

The effects of gamma-radiation on diploid and autotetraploid forms of Polygonum and Panicum have been studied. The source of radiation was Co^{60}, and the dosages used were 10, 15, 20 and 30 kr. It has been established that gamma-rays reduce the per cent germination of seeds and retard the growth of plants. Diploids have proven to be more sensitive to the action of gamma-rays. The appearance of mosaic leaves caused by the necrosis of cells has been observed in diploid plants. From the data obtained it is obvious that the nucleus injuries are of decisive importance in the deleterious effect of gamma-radiation and that the duplication of chromosome-sets in autopolyploids increases the resistance of plants to the action of gamma-radiation.

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K izucheniiu peredvizheniia po pasteniiu pitatel'nykh veshchestv.

[Study of the movement of nutritive substances within a plant].

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(In Russian)

As we reported earlier [1], simple organic substances, such as glucose, fructose, and sodium acetate enter into a plant intensively through the root system from soil solutions, and when there is light this entry occurs considerably more rapidly then in darkness. Judgement as to the different rate at which the substances listed enter a plant and move within it was formulated by means of comparing radioautographs taken of plants exposed to light and of shaded plants the roots of which were immersed in solutions of corresponding radioactive compounds.

In the present work we undertook the task of clarifying the reason for the indicated difference. If it were assumed that the movement of nutritive substances within a plant in an ascending direction occurs chiefly with the water current, then the accelerated entry of nutritive substances into leaves exposed to light could be explained by increased transpiration varying in relation to the illumination of the leaves. If, however, the translocation of the nutritive substances occurs independently of the water current, then the change in its rate under illumination should be attributed to the increased photosynthetic activity of the plants and metabolic processes occurring in the cells of various conductive tissues.

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There are in literature contradictory data concerning the relation of the movement of substances from the plant roots into the leaves to the movement of water [2, 3, 4], and, in view of the difficulty involved in conducting direct observations of the movement of water, many conclusions were made on the basis of indirect observations conducive also to another interpretation. We used a direct method of investigation based on a simultaneous study of the entry of tagged organic substances and tagged water into plant leaves.

The experiments were conducted with two-week old bean plants, Phaseolus vulgaris, grown prior to the experiment in a water culture. The plant roots were immersed in a 20% solution of heavy water (D_2O*), containing sodium acetate and tagged C^{14} in carboxyl (100 micron C for the experiment). In each experiment 3-4 two-leaf plants of approximately the same height (15-20 cm) and size of leaves were put in a vessel containing the solution.

At first a study was made of the dynamics of the entry of tagged sodium acetate into the leaves (together with the products of its conversion containing radioactive carbon). For this purpose we used the method of determining the radioactivity of a green leaf during its life-time with an end-window Geiger counter maintaining geometric constancy of the leaf section under observation at the entry opening of the counter. The importance of radioactivity of different sections of the same leaf may, with such a method of determining, vary 1.5-2 times. However, different measurings of the same section of the leaf produce values [znachenia] that differ from one another in no more than 5-10%. In fig. 2, for example, are cited results of measurements taken by the indicated method of the radioactivity of the end sections of leaves of four plants, [Begin p.122] two of which were illuminated and the other two unshaded after they were placed in the solution.

* In some experiments the solution contained 40% D_2O.

In experiments conducted under illumination and in darkness, the plants were placed in similarly humidified chambers. Lighting was produced from two sides with 150 watt incandescent lamps situated at a distance of 30 cm from the plants and separated from them by water filters. To produce darkness the chamber was covered with black paper.

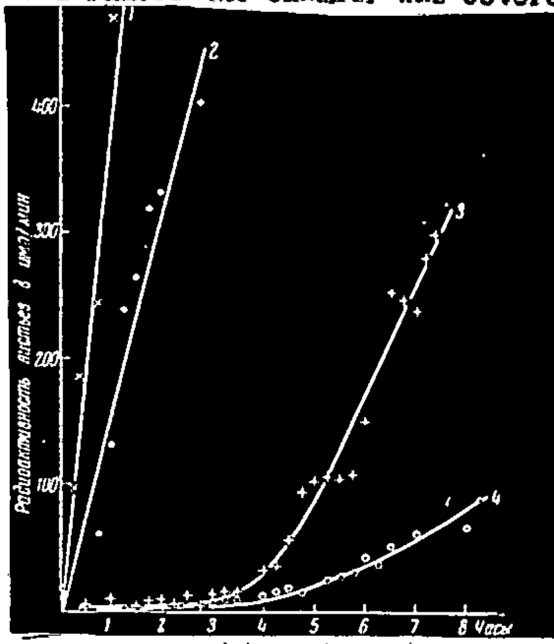

Fig. 1. Dynamics of accumulation of radioactivity in leaves: 1 and 2 in light, 3 and 4 in darkness [Vertical line at left of fig. 1 reads]: Radioactivity of leaves in impulse per minute

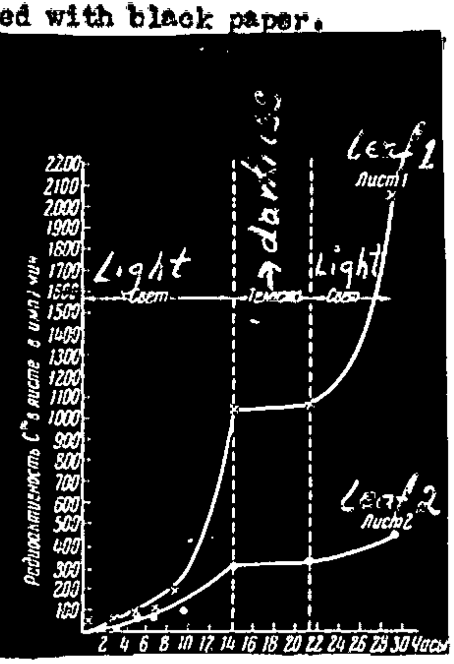

Fig. 2. Dynamics of accumulation of radioactivity in two leaves of the same plant under different conditions of lighting (in light, in darkness, once more in light) [Vertical line at left of fig. 2 reads]: Radioactivity of C^{14} in leaves in impulse per minute

In the leaves of darkened plants radioactivity begins to reveal itself notably only after a stay of several hours in the solution, under light radioactive carbon appears in leaves when the experiment has progressed a few minutes and its content increases sharply as time goes on. This regularity was found in all experiments and in all plants without any exception. It is characteristic not only of the initial period of the manifestation of radioactivity in the plant, but also of any other space of time.

On fig. 2 are cited curves of the accumulation of activity in two leaves of the same plant, belonging to the experiment in which the plant was alternately illuminated and darkened. We can see that in this case also the darkening of the plant immediately slows down the entry of radioactive substances into the leaves. It is known that this type of regularity is characteristic of transpiration of leaf stomata, as well as of photosynthetic processes. In order to make a selection between these two possibilities, we investigated the entry of heavy water into the leaves of plants along with tagged acetate.

Determination of the rate of transposition of tagged compounds throughout the plant by detecting the exact time when isotope registration begins depends in a considerable measure on the sensitivity of the method selected. Special difficulties arise in comparing two tagged compounds one of which has been tagged with a radioactive isotope and the other with a stable one, because the methods used in detecting these isotopes possess an entirely different sensitivity. [Begin p.123]. In our opinion, in order to establish a likeness (or difference) in the movement mechanism of two tagged compounds, it is necessary to study the dynamics of their accumulation in leaves and to demonstrate the presence (or absence) of a direct proportion between the quantities of both substances in a leaf under different experimental conditions.

In establishing such a relation it was necessary to take into consideration the fact that the substances entering a leaf will not only accumulate within it, but will also gradually decrease due to respiration, evaporation etc. In connection with the above, the duration of our experiments did not exceed 25-30 hours in the course of which the total amount of the acetate that entered [the leaves] was negligible as compared with the metabolites available in the leaf, and the concentration of heavy water in the leaves did not exceed 3-4%. As a result of the low content of heavy water in the leaves, as compared with the concentrated solution that entered [into them], the evaporation of heavy water occurring during the experiment could be disregarded.

As indicated above, during the experiment radioactivity in leaves was measured systematically and, at different intervals that fluctuated between 30 minutes and 30 hours, individual leaves were broken off for the purpose of determining the concentration of heavy water within them.

Attention has been attracted by a certain irregularity in the entry of radioactivity into externally identical leaves of the same plant. This irregularity has been observed in many cases and is illustrated by the following data in which the results obtained on many plants are summarized:

Relation of the activities (C^{14}) of two leaves of the same plant at the time one of the leaves was broken off	1	1.5-2	2-4	4-8	9-20
Number of plants	10	5	6	2	2

After the leaves were separated from the plant, they were dehydrated in a vacuum. The distilled water was gathered in a separator [levushka] at 70°, was carefully purified from organic admixtures by the accepted method [5, 6] and after several distillations the content of heavy water in it was determined by the method of the falling drop. Similar to the measuring radioactivity, the concentration values [znacheniia] of heavy water in two leaves broken off of the same plant simultaneously often differed from each other. As a result, a comparison of radioactivity with the content of heavy water was carried out for each leaf separately without neutralization within the whole plant*. Six experiments were carried out, 3 of them under illumina-

* Concomitantly with the measuring of radioactivity in leaves during their lifetime, the activity of dry leaves after water had been distilled from them was also determined. The results obtained by both methods of evaluation of radioactivity were proportional.

tion and 3 with darkened plants. A total of 89 leaves was analyzed. In each experiment the proportion between C^{14} and D was observed, although the absolute content of these isotopes in the different experiments, naturally, varied because of the changed rate at which acetate and water entered the plants depending on conditions of the experiment.

On fig. 3 are summed up the total results of all experiments compared, taking into account the different duration of each. Fig. 3 shows that it is possible to detect parallelism in the movement of tagged acetate and water through a plant, regardless of the proximity of the methods used in determining the isotope content in leaves.

A conclusion concerning the leading role played by transpiration in the translocation of acetate within the plant has been confirmed also by darkened experiments in which a sharp increase in the entry of radioactivity and heavy water into leaves was observed a few hours after the experiment was begun. [Begin p.124].

The use of the method described above holds promise for cases in which a sharp difference in the movement rate of nutritive substances and water within the plant is expected.

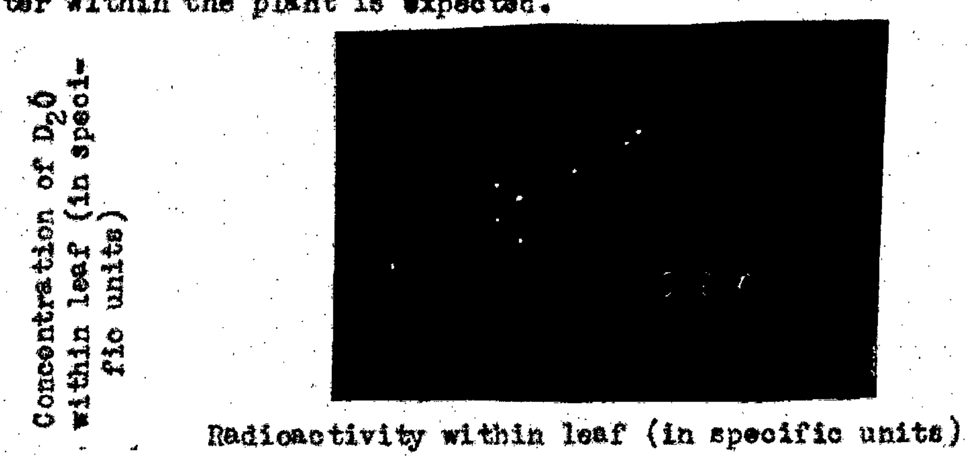

Fig. 3. Relation between the accumulation of C^{14} and D in plant leaves. The asterisk denotes results obtained under illumination, the circle - in darkness. The values of radioactivity in leaves and the concentration of heavy water within them are plotted on the coordinate axes in specific units.

CONCLUSIONS

1. The method of simultaneous utilization of heavy water and tagged organic compounds was used in resolving the problems of the movement of nutritive substances within a plant.

2. It has been demonstrated that by placing the roots of beans (Phaseolus vulgaris) in an acetate I-C^{14} solution the entry of acetate and water into leaves is accelerated under light and slowed down in the dark.

3. Parallelism has been revealed in the entry of water and acetate into the leaves of beans.

4. Irregularity has been established in the entry of nutritive substances into the leaves of the same plant.

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Gause, G. F., Kochetkova, G. V., and Popova, O. L.

Novyi metod selektsii produtsenta al'bomitsina.

[New method for the selection of the albomycin producing organism].

Antibiotiki, vol. 1, no. 1, p.18-20.
Jan./Feb. 1956. 396.8 An84.

(In Russian)

In works aimed toward selection of the antibiotic producing organism [Actinomyces subtropicus] and conducted for the purpose of increasing the productivity of cultures, various active factors widely utilized in recent years, and primarily the action exerted by ultra-violet radiation, have produced positive results. Another effective method proved to be action of a specific antibiotic preparation upon the organism that produces it. Thus, for instance, Japanese researchers have demonstrated that in exerting the action of considerable concentrations of aureomycin upon the culture of Actinomyces aureofaciens which produces this antibiotic, the variants most resistant to "their own" antibiotic were those that produced an increased quantity of aureomycin. This method was used in obtaining variants with increased productivity.

In developing problems of the selection of the albomycin producing Actinomyces subtropicus, we more than once used irradiation of spore suspensions of this fungus with ultra-violet rays with subsequent selection. We did not, however, achieve by this means any considerable increase in albomycin production when submerged fermentation was employed. Afterward we utilized

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the action exerted by "its own" antibiotic, albomycin, upon a culture of A. subtropicus. But in view of the fact that albomycin is deprived of toxic properties and possesses "mild" action, we did not succeed in inhibiting the development of the producing organism with any of the tested albomycin concentrations. [Begin p.19].

The method which we tested further consisted of the following. It is known that the composition of the albomycin molecule includes iron and that Act. subtropicus which produces this antibiotic possesses increased resistance to the iron content within a culture medium as compared with other actinomycetes species related to this one. Hence we studied the problem as to whether or not the individual strains of the organism that produces albomycin possess increased resistance to the iron content in culture media as compared with other strains, and whether it would be possible to establish a relation between the increased resistance to iron and the increased production of albomycin. We tested various concentrations of iron sulfate (0.02-0.08%), but were unable to establish the existence of such a relation.

Then we tested another method that proved very effective. In developing this method we proceeded from the following prerequisites. It is known that the streptomycin-resistant forms of various microorganisms that emerge under the influence of streptomycin possess a large variety of physiological and biochemical characters and are, in this respect, strictly distinct from the original sensitive forms. Would it be possible to obtain new physiological and biochemical variants of the albomycin producing organism by exerting streptomycin action upon an Act. subtropicus culture, and would not some of the variants obtained possess an increased albomycin production? The results of the experiments conducted gave a positive answer to this question.

In working with Act. subtropicus that produces albomycin, the presence of the different variants in the cultures must be taken into account, [since] some of them produce pure albomycin, and others - albomycin mixed with another antibiotic called the "second factor". These cultures can be readily differentiated by means of segmentation of the individual colonies on agarized media with suspensions of staphylococci either resistant or sensitive to albomycin action. The colonies that produce pure albomycin inhibit only the growth of sensitive staphylococci, but do not in the least inhibit the growth of staphylococci resistant to albomycin. Colonies that, along with albomycin, produce also the "second factor" inhibit the growth of albomycin-resistant staphylococci as well. The degree of inhibition depends on the amount of the "second factor" which they produce.

In the experiments described below we used the Act. subtropicus variant that produces pure albomycin without any admixture of the "second factor" and retains firmly this characteristic in multiple reseedings. In cultivating this variant on agarized culture media containing different concentrations of streptomycin, we observed that at a 50 gamma/ml streptomycin concentration one colony out of 1000 survived, at 100 gamma/ml one colony out of 20,000, and at 200 gamma/ml one colony out of 40,000 survived. Streptomycin resistant variants of Act. subtropicus that develop freely at 150 gamma/ml streptomycin concentrations proved extremely diverse as to their morphological and physiological properties. This fact is of great theoretical and practical interest. If the original Act. subtropicus culture had an aerial mycelium of a grayish-white color and a colorless substrate mycelium, then a small quantity of forms possessing yellow colored and yellow-rose colored aerial and substrate mycelia were found among streptomycin-resistant variants. These new forms which we had never observed in Act. subtropicus cultures prior to our use of streptomycin action produced pure albomycin without any admixture of the "second factor", similar to the original culture (see table).

The new variants of Act. subtropicus with a changed coloring of the aerial and substrate mycelia comprise only a small percentage of the total number of streptomycin-resistant cultures which we obtained from this species. [Begin p.20].

Streptomycin-resistant variants of Act. subtropicus with a different coloring of the aerial and substrate mycelia

Origin of strain	Color of aerial mycelium	Color of substrate mycelium	Size of growth inhibition zone on agarized media (in mm)	
			Albomycin-resistant staphylococcus	Staphylococcus sensitive to albomycin
Original strain	Grayish-white	Colorless	0	15
Streptomycin action (150 gamma/ml)	Same	Same	0	15
Same	"	"	0	14
"	"	"	0	17
"	Yellow-rose	Yellow-rose	0	7
"	Yellow	Yellow	0	17
"	Yellow-white	Yellow-white	0	14
"	Same	Yellow	0	12
"	Yellow-olive	"	0	5
"	Yellow-white	"	0	12

Among the 200 streptomycin-resistant forms of Act. subtropicus only 15 cultures, or 1.25%, were found with a changed mycelial coloring. The investigations have demonstrated that variant no. 6 with a yellow mycelial coloring (see table) segregated during further cultivation into colorless and yellow variants which appeared in equal numbers; as regards their characters, the colorless variants matched the original strain. The variant with the yellow-rose coloring (no. 5) also segregated about 10% of the original colorless forms upon further cultivation; the remaining 90% retained their yellow/rose coloring.

Along with the morphological variants, we discovered among streptomycin-resistant forms of Act. subtropicus also essential and authentic differences with regard to albomycin formation. We examined albomycin formation in submerged fermentation in 524 streptomycin-resistant strains of the albomycin producing organism. Among them, a series of forms possessed sharply decreased albomycin production. In a small number of strains albomycin production was 150-200% increased as compared with standards, and this characteristic was firmly retained in a number of generations. On the basis of the data obtained it is possible to conclude that the method described can be used successfully in the selection of the albomycin producing organism.

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Moroz, A. F.

Dinamika obrazovaniia ustoichivykh form bakterii k antibiotiku mitserinu.

[The process of formation of mycerin-resistant bacteria].

Antibiotiki, vol. 1, no. 5, p.26-30. 1956. 396.8 An84.

(In Russian)

The process of emergence of resistant microbe forms under the reaction of chemotherapeutic substances has occupied the attention of scientists for a long time.

Beginning with Kosiakov (1887) and up to recently many researchers conducted experiments which permitted to determine the speed of formation of drug-resistant forms of bacteria; and then morphological and cultural properties were studied in the obtained resistant variants. It is clear now to all, that the presence in bacteria, which originally were sensitive to one or another preparation, of an ability to become adapted to it and produce forms resistant to it, decreases the therapeutic value of a whole series of chemotherapeutic substances to a great degree.

Consequently, when isolating new antibacterial preparations it is very important to study the regularities of development of forms resistant to them.

In connection with the above-mentioned it would be interesting to

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study the dynamics of development of resistant forms of bacteria to the new Soviet antibiotic mycerin, which was obtained in the Institute of Experimental Medicine of AMN [Academy of Medical Sciences] of USSR by Iu. V. Solov'eva.

Antibiotic mycerin represents a dry preparation well soluble in water. The preparation retains the activity during unlimited time in its dry form; the activity of the preparation in dilutions is preserved quite stably.

Preliminary experiments have established that mycerin produced a sharply expressed bactericidal action on all microbes sensitive to its reaction (staphylococci, B. coli, dysenteric bacteria of Shiga and Flexner, typhoid bacillus and others).

Before proceeding with studies of dynamics of growth of resistance in bacteria to mycerin antibiotic it is necessary to check their sensitivity to this last one.

Sensitivity to mycerin was studied on two strains of staphylococci, two strains of B. coli, dysenteric cultures of Shiga and Flexner, and strain Proteus OX_{19}. Hydrochloride of mycerin was utilized in the work. In 1 mg of the substance were contained 25,000 of antibacterial units. Mycerin preparation was dissolved in proportion of 1 mg/ml for the preparation of working solutions.

A method of successive dilutions in test tubes, with an addition of agar was utilized by us for the determination of sensitivity of bacteria to mycerin, as well as for further studies of the process of growth of the resistance to it be bacteria. We marked test tubes with the minimum amount of mycerin, which inhibited the growth of bacteria. [Begin p.27]

Results of studies of sensitivity of bacteria to mycerin are represented in table 1.

Table 1.

Sensitivity of bacteria to mycerin in vitro

Microorganisms	Concentration of mycerin in gamma/ml												Control
	250	125	62.5	31.2	15.6	7.8	3.9	1.8	0.9	0.45	0.22	0.11	
Bact. coli no. 618	-	-	-	-	-	-	-	-	-	+	+	+	++
Bact. coli no. 814	-	-	-	-	-	-	-	-	+	+	+	+	++
Bact. dys. Shiga no. 913	-	-	-	-	-	-	-	-	-	+	+	+	++
Bact. dys. Flexner no. 550	-	-	-	-	-	-	-	-	-	-	+	+	++
Staph. aureus no. 5	-	-	-	-	-	-	-	-	+	+	+	+	++
Staph. Wood	-	-	-	-	-	-	-	-	-	-	-	+	++
Proteus OX_{19}	-	-	-	-	-	-	-	-	-	+	+	+	++

Conventional signs: - inhibiting action of the antibiotic; + absence of action; ++ control without antibiotic.

It is seen from table 1 that the sensitivity to mycerin is dissimilar in different strains.

Then we studied the dynamics of development of resistant forms of bacteria to the mycerin antibiotic.

From test tubes with a minimum concentration of the preparation, which already produced a noticeable inhibiting action on bacteria, we conducted some reseedings of cultures with a loop to a culture medium that contained the same or a higher concentration of mycerin, depending on the intensity of growth of the corresponding strain.

Control reseedings were conducted simultaneously to salt free meat-peptone agar, which did not contain mycerin.

The obtained experimental data on the growth of resistance to mycerin are represented in the cited figure.

Title of figure: Dynamics of obtaining resistance to mycerin by various bacteria. a - along the vertical line - concentration of mycerin in gamma/ml; along the horizontal line - passages : 1 - B. dys. Shiga no. 913; 2 - B. coli no. 613; 3 - Staph. Wood; 4 - B. dys. Flexner. b - along the vertical line - concentration of mycerin in gamma/ml; along the horizontal line - passages: 1 - B. coli no. 844; 2 - Staph. aureus no. 5; 3 - Proteus OX_{19}

Words to the left of the figure: concentration of mycerin, underneath: passages.

It is possible to see from the curves, cited in the figure, that, when cultivating bacteria on media with rising concentrations of mycerin, development of resistant forms of bacteria occurred very slowly. Thus, after 60 passages on media with antibiotics, the resistance to mycerin increased only 8-70 times in all the above cited cultures.

When checking the stability of the obtained resistance of bacteria to mycerin, both after keeping the culture in a columella of agar under vaseline oil, and after a great number of reseedings of cultures on media, that did not contain mycerin, it was established, that in both cases occurred a decrease in resistance to this antibiotic, which was acquired by the bacteria.

[Begin p.28]

Table 2.

Change of biochemical properties of bacteria, which acquired resistance to mycerin

Microorganisms	Growth at concentration of mycerin in gamma/ml	Fermentation of sugars: Glucose	Lactose	Maltose	Mannite	Saccharose	Formation of indole	Formation of ammonia	Formation of hydrogen sulfide	Litmus milk	Reaction of methylene blue	Reduction of nitrates	Catalase test	Pigment formation	Hemolysis	Zone of necrosis in ml^2
Bact. coli no. 613 initial	0.45	KG	KG	KG	KG	KG	+	+	+	K	+++	+				
Bact. coli no. 613 resistant	15.6	Kwk.G	Kwk.G	Kwk.G	Kwk.G	Kwk.G	+	+	+	K	+++	+				
Bact. coli no. 844 initial	0.9	KG	KG	KG	KG	-	+	+	+	K	+++	+				
Bact. coli no. 844 resistant	15.6	KG	KG	KG	KG	-	+ very weak	+	+	SK	+++	-				
Bact. dys. Shiga no. 913 initial	0.45	K	-	-	-	-	-	+	-	K	+++	-	-			
Bact. dys. Shiga no. 913 resistant	15.6	SK	-	-	-	-	-	+	+	K	++++	-	+			
Bact. dys. Flexner no. 550 initial	0.22	K	-	K	K	-	+	+	-	K	++++	+	+			
Bact. dys. Flexner no. 550 resistant	1.8	K	-	SK	SK	-	+ -	Weak	-	K	++++	+	+			
Staph. aureus no. 5 initial	0.9	K	K	K	K	K		+ -						+	+	90
Staph. aureus no. 5 Resistant	7.8	SK	SK	SK	SK	SK								Weak	Weak	70
Staph. Wood initial	0.11	K	K	K	K	K								Weak	+	60
Staph Wood resistant	7.8	K	K	K	K	K								Weak	Weak	55
Proteus OX_{19} initial	0.45	K	-	KG	-	KG	-	-	+	Shch		+				
Proteus OX_{19} resistant	15.6	Kwk.G	-	Kwk.G	-	Kwk.G	-	-	+ -	KShch		+				

Conventional signs: K - acidification; Shch - alkali - formation; KShch - first acid, then alkali; SK - weak acid; wkG - weak gasification

Table 3.

Determination of sensitivity of some bacteria to other antibiotics after acquiring resistance to mycerin.

Microorganisms	Initial concentration of mycerin in gamma/ml	Cross resistance to: Penicillin — Sensitivity in tolerance units/ml	Penicillin — Growth of resistance (number of times)	Streptomycin — Sensitivity in tolerance units/ml	Streptomycin — Growth of resistance (number of times)	Grisemin — Sensitivity in tolerance units/ml	Grisemin — Growth of resistance (number of times)	Levomycetin — Sensitivity in gamma/ml	Levomycetin — Growth of resistance (number of times)	Biomycin — Sensitivity in gamma/ml	Biomycin — Growth of resistance (number of times)
Staph. aureus. no. 5 initial	0.9	0.0145	Without changes	3.12	2	3.1	Without changes	3.1	2	0.19	Without changes
" " no. 5 resistant	7.8	0.0145		6.25		3.1		6.2		0.19	
Staph. Wood initial	0.11	0.0145	Without changes								
" " resistant	7.8	0.0145									
Bact. coli no. 613 initial	0.45			0.25	4	0.97	8	1.95	4	7.8	Same
" " no. 613 resistant	15.6			1.0		7.8		7.8		7.8	
Bact. coli no. 844 initial	[illegible]			0.25	8	0.19	4	1.95	2	3.9	"
" " no. 844 resistant	15.6			2.0		0.78		3.9		3.9	
Bact. dys. Shiga no. 913 initial	0.45			0.25	18	0.97	8	0.48	Without changes	0.9	"
Bact. dys. Shiga no. 913 resistant	15.6			4.5		7.8		0.48		0.9	
Bact. dys. Flexner no. 550 initial	0.22			0.25	9	0.97	8	0.48	Without changes	0.45	"
Bact. dys. Flexner no. 550 resistant	1.8			2.25		7.8		0.48		0.45	
Proteus OX_{19} initial	0.45			0.09	34	3.1	8	0.45	2	1.5	"
" OX_{19} resistant	15.6			3.12		25		0.9		1.5	

[Begin p.30].

When studying biochemical properties in mycerin-resistant bacteria, as compared to initial cultures, it was detected that there occurred but a slight change in some of the indicators of the biochemical activity of these bacteria in a decreasing direction (table 2).

Thus, mycerin-resistant variants, obtained from strains of intestinal rod no. 613 and no. 844, formed gas very weakly during fermentation of sugars of the short variegated series of "Giss" [Hiss].

We were also interested in the problem if a cross resistance to other antibiotics in the mycerin-resistant bacteria took place, as there are many cases cited in literature, when a resistance, developed by bacteria to one of the antibiotics, involves a simultaneous increase in the resistance to many other preparations. We conducted studies of cross-resistance of mycerin-resistant cultures to penicillin, streptomycin, grisemin, levomycetin and biomycin with this aim in mind. They were conducted in parallel with the initial sensitive strains and with mycerin-resistant variants. Results of experiments are cited in table 3.

As it is seen from table 3, the mycerin-resistant bacteria showed an insignificant degree of cross-resistance to streptomycin and grisemin (by 4-34 times); but, in respect to other antibiotics the sensitivity of these variants was similar to the initial sensitive cultures.

CONCLUSIONS

1. When cultivating bacteria on media with an increasing concentration of mycerin, formation of resistant variants proceeded extremely slowly and reached an insignificant degree (during 60 passages the resistance of cultures grew by 8-70 times).

2. When checking the stability of the obtained resistance of bacteria to mycerin it was established, that while keeping these cultures on media that do not contain antibiotics, there occurred a diminution of resistance, which was acquired by bacteria to this antibiotic.

3. When studying biochemical properties in mycerin-resistant variants, compared to initial cultures, it was disclosed that very insignificant changes of some properties occurred in a decreasing direction. This fact gave basis to assume that in the given case no changes of biochemical properties of cultures occurred because a selection of the least sensitive individuals took place, and not an adaptation of culture to the antibiotic.

4. Mycerin-resistant bacteria developed an insignificant degree of cross-resistance to streptomycin and grisemin (from 4 to 34 times); in respect to other antibiotic substances their sensitivity was similar to that of the initial cultures.

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Krasil'nikov, N. A., and Kofanova, N. D.

Deistvie antibiotikov na fagi.

[The effect produced by antibiotics upon phages].

Antibiotiki, vol. 2, no. 1, p.5-10.
Jan.-Feb. 1957. 396.8 An84.

(In Russian)

The problem of antiphage antibiotics is very slightly elucidated in literature. Yet the phages present a certain interest, if one takes into consideration that they (bacteriophages and actinophages) have much in common with certain viruses.

A possibility is not excluded that phage particles will prove to be good test mat rial for detection of antivirus antibiotics.

During our research we tested various actinophages and bacteriophages. Antiphage antibiotics were sought out among the collection of actinomycetes, present in our laboratory.

The method for detecting antiphage antibiotics was such: actinomycetes were seeded, together with a phage, on Petri dishes over an agar culture medium. There and then little cylinders were laid over the seeding material, into which was introduced the antibiotic under observation; chemically pure or in the form of cultural liquid. Sometimes the antibiotic solution was simply applied to the surface of agar in the form of drops.

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Institut Mikrobiologii AN SSSR [Institute of Microbiology of the Academy of Science of USSR].

During the first selection agar blocks of actinomycetes culture, which were grown on different media, were superimposed on the seeded surface. Dishes were placed into the incubator at 25°.

In 1-2 days zones of inhibition of the phage became clearly apparent. They were expressed by the fact that the actinomycetes culture developed quite normally around the agar blocks or cylinders, while there occurred its full lysis on the remaining surface of the medium. If the tested producer of actinophage inhibited the test-culture of actinomycetes also, then two zones resulted. The first-adjoining the block (or cylinders), which was entirely sterile (absence of growth of test-actinomycetes and of the phage), and the second-zone of inhibition of the phage, but not of actinomycetes, owing to which this last one developed normally. In the cases where the antagonists inhibited both the phages and test-cultures, there occurred a general sterile zone around the blocks on the background of slightly developed resistant forms of test-cultures. Both the actinophages and the bacteriophages were investigated as phage test-objects. The following were taken from among actinophages:

actinophage no. 3p, isolated from the Siberian chernozem, it lysates <u>Act. diastaticus</u>

"	no. 15p lysates	<u>Act. ipomea</u>
"	no. 19p "	<u>Act. adorifera</u>
"	no. 23p "	<u>Act. flavivirens</u>
"	no. 31p "	<u>Act. sulfureus</u>
"	no. 36p "	<u>Act. candidus</u>
"	no. 37p "	<u>Act. ipomea</u>
"	no. 26 "	<u>Act. globisporus</u> N 81
"	no. 5 "	<u>Act. globisporus</u> NO-70
"	no. 70, isolated from turf-podzolic soil	<u>Act. globisporus</u> NO-70
"	no. 135 "	<u>Act. globisporus</u> N-135
"	no. 9700 "	<u>Act. violaceus</u> N 9700

From among the bacteriophages, 14 strains were utilized in the experiments: bacteriophage 6 was isolated from Siberian chernozem, it lysates bacteria no. 6 of the type <u>Bac. megatherium</u>.

bacteriophage 14 lysates bacteria no. 14 of type Bac. megathee
" 29 " " no. 29 " Bac. megathee
" 41 " " no. 41 " Bac. agglomeratus
" 52 " " no. 52 " Bac. idosus
" 83 " " no. 83 " Bac. pumilis
" 89 " " no. 89 " Bac. megathee
bacteriophage 102 was isolated from Siberian chernozem to bacteria no. 102 of type Bac. megathee
" 107 was isolated from Siberian chernozém to bacteria no. 107 of type Bac. pumilis.
bacteriophage, museum strain, lysates Staph. aureus 209
" " " " Protéus
" " " " Bact. coli
" " " " Bac. megatherium

Antiphage properties were examined in a large collection of actinomycetes (over 500 cultures), which belonged to various groups and which were isolated from various soils of Soviet Union. Studies of antiphage action of culture of the collection under consideration has shown, that its general regularities basically suggested the rules of manifestation of antimicrobic properties. Antiphage properties appeared almost in all actinomycetes.

In our experiments about 90-98% of actinomycetes from the examined collection inhibited the lytic activity of phages. Some strains or groups of strains inhibited many phages, others - only few, and the third - only solitary or influence [Begin p.6] just one phage. Just as in respect to antimicrobic action, among actinomycetes there, apparently, are no such organisms which would not react upon phages. We tested our actinomycetes on 26 strains of phages and discovered 90-98% antagonists in regard to them. At first we took only 2 phages (no. 26 and 5) as test material. In relation to them only 15% of antagonists were found in the collection. If we were to take not 26, but a larger number of phages, then the percentage of antiphage actinomycetes, apparently, would have been higher. The character of influence of various actinomycetes on phages was different. Some inhibited the phage particles completely, the formed zone of actinomycetes did not have any points of lysis or negative colonies. Other actinomycetes-antagonist depressed the phages partially, the zone of growth of test-actinomycetes had a larger or smaller number of negative colonies (points of lysis). Next, after the reaction of one of the cultures the zones of inhibition would be sharply outlined, and after the reaction of others - the borders of the zone were only slightly outlined, diffused.

The majority of actinomycete-antagonists formed antimicrobic and antiphage antibiotics. Some of them produced antiphage substances and at the same time repressed either both the gram positive and the gram negative bacteria, or only the gram positive bacteria and the cocci. There was a considerable number of actinomycete-antagonists, which inhibited only the phages. Such a subdivision was conditional, it reflected the relation of antagonists only the certain tests-both the microbic and of the phage.

With a specific selection of test-objects among both organisms, all actinomycetes, one may assume, will be antagonists to microbes and phages. Antiphage properties of actinomycetes are quite diverse. Some cultures inhibit a great variety of phages, others inhibit only solitary phages or even a single phage. In other words, the antiphage spectrum of these organisms is very wide in one case, and narrow in another. Here we have a full analogy with the reaction of actinomycetes to bacteria. As a rule, actinomycetes inhibited actinophages more actively than the bacteriophages. From about the total amount of tested actinomycete-antagonists we reckoned 90-98% against actinophages, and 41% against bacteriophages. (table 1).

Table 1.

Display of antiphage activity of actinomycetes when testing on 12 actinophages and 14 bacteriophages

Group of actinomycetes	Number of examined strains	Number of antiphages		Acting against			
				Actinophages		bacteriophages	
		number	%	total	%	total	%
Globisporal	68	68	100	64	94	41	60
Gray	124	122	98	119	96	42	34
Of *A. fradiae* type	18	13	89	14	77	7	38
Pigmented	16	15	94	15	94	4	28
Total	226	221	98	212	94	94	41

A more or less sharply expressed specificity of action was noted while analyzing the antiphage spectrum of actinomycetes.

One can say quite definitely that among some groups of actinomycetes there were more active antiphage cultures than among others. Under conditions of our experiment the greater percent of antiphage actinomycetes was among the large miscellaneous group, designated by a general title globisporal (*Act. globisporus*), then among the group of gray actinomycetes and the smallest among the pigmented (table 1).

A well expressed species' specificity of reaction on phages was noted often.

When examining the globisporal group we found 5 well outlined species. In each of them there were 5-14 strains. In the group of gray actinomycetes there were 23 well expressed subgroups, which virtually represented an isolated species. Then we had strains of well expressed species: *Act. coelicolor*, *Act. aurantiacus*, *Act. roseus*. In most cases, the strains which belonged to one species had a monotypic spectrum, that is, they inhibited the same collection of actinophages and bacteriophages (table 2). In a group of gray actinomycetes from among the 23 examined subgroups (species) only 5 had strains with different antiphage indicators. These groups were not yet sufficiently studied and, possibly, were comprised of representatives of various species.

Conditions and dates of formation of antiphage substances were different, than conditions of formation of antimicrobe antibiotics. It is possible to select conditions of growth of actinomycetes under which mainly the antiphage antibiotics would be produced, or just the antimicrobic

[Begin p.7]

Table 2.

Antiphage spectrum of actinomycetes

Actinomycetes	Actinophages												Bacteriophages												
	3p	15p	19p	23p	31p	36p	37p	26f	135f	70f	5f	9700	14	102	41	89	98	107	113	52	6	29	Staph.	B. coli	Bac. megatherium
A. levoris 8 strains	-	-	-	-	-	+	+ -	+	+	+ -	-		-	-	-	-	-	-	-	-	-	-	-	+ -	-
A. vulgaris 3 strains	-	-	-	-	-	+	-	-	-	-	-		+	+	-	-	-	-	-	-	-	-	-	-	+
A. sp. no. 2302	-	-	-	+	-	+	-	+	-	-	+		+	+	-	-	-	-	-	-	-	+	-	+	+
A. sp. no. 2911	-	-	-	+	-	+	-	+	-	-	+		+	+	-	-	-	-	-	-	-	-	-	+	-
A. fluorescens 2 strains	-	-	+	+	-	+	-	+	+	-	-		-	-	-	-	-	-	-	-	-	-	-	- -	+ -
A. toxicus 2 strains	-	-	- +	+	-	+	-	-	-	-	+		-	-	-	-	-	-	-	-	-	-	-	+	-
A. virosus no. 1609	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. griseus gr. 6 2 strains																									

[Begin p.8]

Antiphage substances were often produced by the culture earlier than antimicrobe antibiotics. For instance, in strain 2738 - Act. globisporus, maximum formation of antiphage substance was on the 2nd day, and of antimicrobic - on the 5th day of growth; in strain 6a (Act. globisporus) correspondingly on the 3rd and 7th day; in strain 2568 - on the 2nd and 6th day, and so on.

Antiphage substances were produced by actinomycetes when cultivated on various nutrient media - on simple synthetic, with mineral sources of nitrogen, and on complex protein ones. They were synthesized on CP no. 1 [Capaldi-Proskauer medium], on CP no. 8, on media with fish broth or corn extract.

Actinomycetes cultures, tested by us, did not synthesize antiphage substances on Czapek medium or on a medium with bean decoction. The antiphage substances also did not form on a medium with potato extract, or were produced in very small amounts. But the antimicrobic substances synthesized and accumulated in sufficient amounts on these media.

Maximum amount of antiphage substances was produced on media with fish decoction, with corn extract, on MPA [meat-peptone-agar] and some other protein media. Their titer differed, depending on the medium, on the composition of the medium and on external conditions. The maximum titer in our experiments was 1:500,000, the minimum - 1:10, 1:100, and more often in the limits of 1:240, 1:1,000.

There are organisms, which produced only the antiphage substance on certain media. The antimicrobic antibiotic either was not formed at all, or was produced in small amounts (table 3).

Table 3.

Formation of antibiotics by actinomycetes

Actinomycetes	Antiphage antibiotic (filtrate)	Antibacterial substances, titer			
		to Staph. aureus 209		to Bac. subtilis	
		liquid culture	filtrate	liquid culture	filtrate
A. griseus N2568	////	243	27	243	27
" N29(?)2	///	0	0	0	0
A. globisporus N2735	//	27	0	81	0
" N115	////	243	9	9	0
" N6a	////	2187	2187	243	243

As it is seen from table 3, the antiphage substances pass through bacterial filters (Berkefeld filters and others) much freer than antimicrobic antibiotics. If in the cultural fluid of strain 115 we detected 243 staphylococcic units than after a filtration through the Berkefeld filter there were only 9 units in a milliliter. Antiphage titer was maintained, approximately, in the same figures - in the cultural fluid 10^6 and in the filtrate 10^6.

It was possible to separate the antiphage antibiotics from the antimicrobic with the aid of specially selected adsorbents. Antiphage antibiotics were dissimilar in stability; heating, in particular, affected them. Many of them became quickly inactivated at a comparatively low temperature. For instance., the substance of strain 2568 became inactive at 60° during the course of 10 minutes, while the substance of strain 6a could withstand heating to 70° during 30 minutes.

As a rule, antiphage substance was less stable to heating than the antimicrobic ones; although among these last ones there was also a great diversity in this respect.

All this pointed to the fact that antiphage and antimicrobic antibiotics represent various compositions, which are produced by the same organisms either simultaneously or at different times, depending on conditions.

Our research has shown that phages vary greatly in their sensitivity to antibiotics. Some of them reacted to almost all the antibiotic substances, which were tested by us; others were repressed by just a few actinomycetes, while the third ones reacted only to single antagonists. There also were phages that did not at all react to actinomycetes tested by us. As it is seen from table 4, actinophages were more sensitive to actinomycetes than bacteriophages.

The most sensitive among actinophages were strains no. 9700 and 26, after that came actinophages no. 38, 3, 15 and so on. Among bacteriophages the first place in sensitivity was occupied by phage Bac. megatherium, it was followed by strains no. 98, 113, Bact. coli, 12, 14 and then the others.

The cited data show how great is the diversity of phages. Among them exist as many distinctions as among microbes and viruses.

Of course, it was necessary to select comparable strains or species when comparing the sensitivity of phages and viruses or microbes to antibiotics. [Begin p.9]

Table 4.

Sensitivity of various phages to actinomycete-antagonists

No. of the actinophage	Amount of actinomycetes which inhibited the actinophage	Bacteriophages	Amount of actinomycetes which inhibited the bacteriophage
3	46	No. 14	11
5	41	No. 102	7
19	33	No. 41	1
23	25	No. 89	7
31	17	No. 98	14
36	85	No. 107	0
37	31	No. 113	13
26	113	No. 52	12
135	27	No. 6	5
70	21	No. 29	14
5	69	Proteus	4
9700	120	Bac. megatherium	42
		Bact. coli	12

In our collection there were four groups, or more accurately, subgroups of actinomycetes in which antivirus properties were detected. The first group, which consisted of gray actinomycetes (strain no. 1609 being a typical representative), inhibited viruses of Russian tick-borne encephalitis, grippe and smallpox. The second subgroup consisted of actinomycetes with white-pale-yellow aerial mycelium (group A. globisporus). The third consisted of actinomycetes with yellow-orange coloration of colonies and pinky-white aerial mycelium. Strain no. 111, its typical representative, produced a depressing action on virus of group A_1. The fourth subgroup, consisting of violet actinomycetes (its representative was strain no. 1212), actively inhibited viruses of Russian tick-borne encephalitis and of smallpox.

The action of antibiotics of these organisms appeared not only in vitro, but also in vivo, directly in the body of experimental animals.

The action of these actinomycetes on phages did not correlate with the action on viruses. Strain no. 1609 inhibited only 2 actinophages (no. 5 and 26) from the 12 tested and not a single bacteriophage. Strain no. 1212, which was also active against the viruses of Russian tick-borne encephalitis and smallpox, had a sufficiently wide antiphage spectrum: it inhibited almost all the tested actinophages. It reacted on bacteriophages very selectively: it inhibited only 2 species among the 14 tested.

A. aureofaciens, A. rimosus, Act. no. 111 and A. roseus have very close antiphage spectra, but their antivirus properties were sharply different. Many actinomycetes, which have sharply expressed antiphage properties, did not at all repress the viruses, tested by us (grippe, smallpox, encephalitis).

It is possible that they produce influence on some other viruses.

We have as yet too few experimental data concerning the antivirus action. A wide range of virus species is required as test-objects in order to compare the specificity of their sensitivity to antiphages with that of various species of phages (actinophages and bacteriophages).

For the present we can say that antiphage qualities are not indicators of antivirus activity in general. If a correlative connection does exist then it is only among individual species of phages and viruses. Nevertheless, this must be established experimentally while comparing vast material.

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English Summary

THE EFFECT PRODUCED BY ANTIBIOTICS UPON PHAGES

A large number of actinomycetes belonging to various groups and species was investigated in order to bring to light their ability to inhibit phages and to produce antibiotics of antiphage activity. As test-objects were chosen phages belonging to 14 strains and actinophages of 12 strains,

obtained from different species of bacteria and actinomycetes.

It was found that the general regularities underlying the anti-phage action of actinomycetes are about the same as those observed in the action upon microbes. Nearly all actinomycetes display anti-phage properties. Some of them are found to inhibit many phage species, while others inhibit but individual species, or a single strain. Antagonists against actinophages are more frequently met with than antagonists against bacteriophages. In actinomycetes a rather outspoken specific anti-phage spectrum of activity could be established.

The action of anti-phage antibiotics is not correlated with that of anti-virus substances. Phages can therefore serve neither as test-objects, nor as models in the search for anti-virus antibiotic.

Trans. A-986
(In full)
vg/M

Borkovskaia, V. A.

Opyt izmeneniia iarovykh zernovykh
kul'tur v ozimye.

[An attempt of experimental transformation
of spring cereals into winter cereals].

Bot. Zhur. [Moskva], vol. 43, no. 1, p.50-60.
Jan. 1958. 451 R923

(In Russian)

Discussion of problems of the formation of species has shown, on the one hand, the presence of sufficient reasons for doubt in the authenticity of separate facts about the appearance of sharp changes or "conversion" of species, and on the other hand, during the course of discussion there was pointed out the absence of experiments, based on more precise methods, which would not arouse doubts of their authenticity.

We think it necessary, in connection with this, to share our seven-year experience in work in this direction.

Our experiments in studies of conditions of the arising of new forms were begun in 1949-1950 in connection with the spreading of an idea about the possibility of breeding new species, which was expressed by Academician T. D. Lysenko at the August session of VASKhNIL [All-Union Academy of Agricultural Sciences imeni V. I. Lenin] in 1948. According to data available at that time, sharp changes and "conversion" of species were observed

Vsesoiuznyi institut rastenievodstva. Leningrad. [All-Union Institute of Plant Industry. Leningrad].

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mainly when transforming spring cereals into winter cereals. Therefore we took this course as a basis of our reasearch, the more so because there were very few such experiments conducted at that time. We can only mention as the most well-known works those of N. K. Shimanskii (1949) and V. K. Karapetian (1948, 1950a, 1950b).

In experiments of N. K. Shimanskii spring wheat 1160, when sown in the fall under conditions of Odessa, increased its winterhardiness already after one year of overwintering (43.7% of those which overwintered as compared to the control - 9.7%) and were converted into a winter cereal in the second and third generations (97.7 and 98.7% of overwintering). Moreover, only the changes of varietal characteristics were noted.

In the experiments of V. K. Karapetian four varieties were involved; they were sown at different dates in the fall under conditions of Moscow oblast'. Here, too, was observed a noticeable increase of winterhardiness from generation to generation, especially in soft wheats. For instance, in Liutestsens 062 the control had 12.3% of survived plants; one year of overwintering gave 19.0%, two years of overwintering - 36.1%. In hard wheats the increase of winterhardiness was lower, but, as was established by the author, they were then "converted" into soft wheat.

According to data of the above-mentioned authors, one can assume that the emergence and fixation of the overwintering characteristic can be brought about comparatively easy - during 2-3 generations when planting spring crops in the fall both in various geographical points (Moscow and Odessa) and at most diverse times. In Odessa all the October planting dates gave an increase in winterhardiness, and in Moscow - all the September planting dates. [Begin p.51].

One could say the same thing also with respect to the formation of soft wheats from hard, which appeared after all dates of plantings, and, as it was ascertained by later works, in various geographical points, among them also in Odessa (Mokrov, 1953).

In our work we tried to detect all the possibilities for obtaining new species, to make more precise the conditions of accumulation and fixation of the overwintering characteristic in spring crops, as well as to trace the changeability of the composition of populations of the varieties and species under investigation.

Our basic experiments proceeded under conditions of the foot hill zone of north-western Caucasus at the Maikop Experiment Station of VIR [All-Union Institute of Plant Industry], as well as in Krasnodar city at the experimental base of the All-Union Scientific Research Institute of Oil and Essential Oil Crops [VNIIMSMK].

The works at the Maikop Station were conducted in parallel at two points: in the valley of the river Belaia (300 m above sea level) and at a foot hill section "Shestak" (600 m above sea level). Beginning with the year 1952 the basic variants were planted annually: in the steppe zone of the Krasnodar krai at the Kuban Experimental Station of VIR, where the winters were very severe, and for two years at the mountain section of Teberdinsk State Game Reservation (1330 m above sea level) and in Leningrad oblast' (Pushkin city).

All the work was conducted under the direction of Doctor of Biological and Agricultural Sciences, Professor E. N. Sinskaia.

For experiments on the change of spring crops into winter those species were first utilized for which no real winter forms were known. Such were the Persian wheat (Triticum persicum Vav.), oats, hulless barley, partly hard wheat; for the last one semi-winter forms were known only. List of crops and varieties, which were included in the experiments, are cited in table 1.

It was required, for the solution of the raised problems, in the first place to ensure clearness and authenticity of the experiment. In this respect we immediately encountered certain difficulties. These difficulties were met at once while ensuring the purity of the initial material. One should mention, that both in the above-mentioned works about the transformation of spring cereals into winter and in those published later, the authors, as a rule, did not preliminarily study the initial material, that is with selection of typical plants and checking of their offspring. We too did not preliminarily do this because at least two years would be required for such a work: one year for selection, another for checking of the offspring. Such a checking of the initial material was conducted by us during the process of the experiments proper. For this purpose during the first year all the plants, which were preserved after the winter, were carefully inspected and all the admixtures removed. Since during the usual dense plantings different plants can easily grow together by their roots, we took only one spike from each plant for the next seeding. During the second year each spike was planted in a separate row and, after checking the offspring, all similar families were united. With such a work, undoubtedly, there was danger that under the form of admixtures it was possible to remove the already changed plants. But, firstly, according to already existing data, the sharply changed forms do not emerge, as a rule, during the first year, and, secondly, we carefully studied all the admixtures up to checking their offspring. Besides, there were but few of these admixtures and their origin did not cause any doubts.

In order to prevent the possibility of repollination, varieties of similar crops were grown on isolated sections, and the soil for planting was prepared yet during the fall of the preceding year.

The greatest difficulties were met during the removal of possibilities of mechanical contamination of the material. With a large volume of work (500-700 of registration plots) it was almost impossible to provide a guarantee against all possible cases [Begin p.52] of mechanical contamination and the more so because it was much more than just one year. Nevertheless, we took all possible precautions, introducing special rules for planting, harvesting, transportation and stacking up of sheaves, threshing, and so on. (Text continued after table 1)

Table 1.

Crops and varieties, involved in the experiment

Varieties	Origin	Year, since which it was included in the experiment
	A. Wheat	
	1. Hard (T. durum Desf.)	
Arandany	Azerbaijan GSS (State Selection Station)	1949
Gordeiforme 10	Dnepropetrovsk GSS	1949
Gordeiforme 27	Krasnodar GSS	1949
Melianopus 69	Krasnokutsk GSS	1949-1952
Khoranka 711/1	Azerbaijan GSS	1949-1952
	2) Soft (T. aestivum L.)	
Al'bidum 3700	Omsk, SIBNIZKHOZ [Siberian Grain Scientific Research Institute]	1952
Ostka Khlopitska	L'vov oblast'	1952
Surkhak 194	Tadzhik GSS	1952
Grekum 289	Krasnovodopadskaia GSS	1952

Table 1 (continued)

Varieties	Origin	Year, since which it was included in the experiment
	3) Persian (*T. persicum* Vav.)	
Dika 9/14 v. *stramineum*	Gruzinskaia GSS	1949-1952
Dika 9/14 v. *fuliginosum*	Gruzinskaia GSS	1952
	4) Turgidnaia (*T. turgidum* L.)	
Ramose Kakhetinskaia	Georgian SSR, Akhaltsikhe city	1950
Ramose akad. Lysenko	Moscow, Gorki Leninskie	1949
Ramose akad. Tumanian	Erevan, laboratory of species formation	1950
Ramose opytnika Stepaniana	Georgian SSR, Akhaltsikhe city	1950
	5) Spelt (*T. dicoccum* Schübl.)	
Mestnaia	Armenian SSR, N. Akhta	1950
	B. Barley (*H. sativum* L.)	
Nudum maloaziatskii	Kuban Station of VIR	1949
Viner	Falensk GSS	1952
	C. Oats (*A. sativa* L.)	
Aristata 7	Alma-Atinskaia GSS	1949
	D. Rye (*S. cereale* L.)	
Onokhoiskaia	Onokhoiskaia GSS	1949

In order to ascertain which of the fall-winter dates of planting will produce the best effect, we planted all the varieties every 5 days, beginning with the 1st of September and up to the freezing through of the ground (December- January). Later on we conducted repeated reseedings of crops of each date and again on the same date. Such repeated reseedings "on the same date" were conducted [Begin p.53] at both points of the Maikop Experiment Station during the course of three years - 1949 to 1951 inclusive. During these years the first winter (1949/50) was severe. We observed considerable loss of plants of spring crops at the earlier (September) dates of planting. The next two winters were mild, and the plants of spring crops were preserved almost in all the variants, but to a different stage, depending on the variety and date of planting.

In 1952 we already conducted comparative studies of the offspring of different variants, which during this year were planted simultaneously - 2 dates in the fall (September 25 and October 14) and in spring. Besides this, part of seeds of the basic variants, together with the control (from spring sowings) were planted at the Kuban Experiment Station, where the winters were extremely severe. This year's winter in the region of Maikop Station was favorable for overwintering of plants of most spring varieties. Calculation of the percent of overwintered plants, according to variants of the experiment, has shown that there were no differences among the offspring of different fall dates of planting. The spring reproductions, that is the controls, overwintered in like manner for both dates.

At the Kuban Station, where the conditions of overwintering were more severe, differences appeared only among varieties. In the limits of a variety there also were no differences among the offspring of different fall dates and the control (spring reproduction) and later on there took place full loss of both, these and the others. Plants of reproductions of all dates of planting, without exception, of Persian wheat, spelt, barley and oats fully perished towards spring. The fall reproduction of semi-winter hard wheat of the variety Arandany (66-93%) survived somewhat better compared to the spring reproduction (60%). In the remaining varieties (the ramose and hard wheats) individual plants in different variants, which survived towards spring were highly weakened and all were lost towards the time of harvesting.

Spring planting of all fall reproductions, together with the control (from the spring planting), was conducted late - April 10 - in order to avoid the influence of low temperatures and on this background to more successfully detect the accumulation of the winterhardiness property. But in this planting also differences were observed only among varieties, but not among the variants. After such a late planting the semi-winter wheat Arandany, as well as the ramose varieties of nachitschevanicum (opytnika Stepaniana and akad. Tumaniana)(1) did not form spikes and behaved like winter crops in all their variants, including the control. After an early planting in spring they usually formed spikes, which took place during former years. A great diversity of forms appeared in the spring rye, Onokhoiskaia, after a spring planting; they varied from the typical spring to semi-winter and real winter. But, as long as before the beginning of our work it was grown together with winter varieties, it was natural that many plants here represented heterozygote forms. We excluded it from our further experiments for this reason. The remaining crops and varieties behaved like the usual spring crops after a spring planting. Offspring of the two and three-year reseedings of various fall dates formed spikes unanimously and at the same time with the control.

During the fall of 1953 the offspring of the fall reproductions were united in the limits of each month and were again planted at the best time for the sowing of winter crops at the Maikop and Kuban Experimental Stations,

(1) Translator's note: named after a city in Caucasus and also after the men who developed them.

as well as at the mountain point at Teberda and in Leningrad oblast'. The size of plots varied from 4 to 10 sq. m.

The winter of 1953/54 was quite severe and caused considerable loss of plants at all points. Nevertheless, as in the preceding years, there were no considerable changes observed among the reproductions of various dates of plantings. [Begin p.54].

At Maikop a very insignificant advantage of fall reproductions has appeared in three varieties, when compared with the spring reproductions in the percentage of overwintered plants: in hard wheats - Arandany, which had 75% of plants in the fall reproductions and 63% in the spring, and Gordeiforme 10 where there were respectively 41 and 34%, and in barley - Nudum malcasiatskii, where there also respectively were 64 and 40%.

At the Kuban Station the Kuban reproduction of Arandany stood out markedly, having a total of 665 survived plants when compared to the Maikop Station which had only 256 plants under similar conditions of planting. There were no differences in winterhardiness of different reproductions of the other remaining varieties.

Conditions of overwintering in Teberda, at an altitude of 1330 m, and in Leningrad oblast (Pushkin city) proved to be too unfavorable, and all the reproductions of the Persian and of the hard winter wheats, spelts, barley and oats, which were planted both on the fall and on the spring dates, were fully lost. Only single plants survived towards the spring, among semi-winter wheats of the Arandany variety and among the ramose in individual variants of the fall reproductions; but they were so weak, that they were lost before the formation of seeds.

During subsequent years the fall reproductions were continued to be planted at the best times for sowing winter crops at the Maikop and Kuban Experimental Stations; nevertheless, up to the year 1957 there were no substantial changes seen in their winterhardiness as compared to the control (spring reproductions) (table 2).

Table 2. (p.57)

Overwintering of fall and spring reproductions of spring varieties at the Maikop Experiment Station (Plantings on September 28, 1956)

Varieties	Number of years of fall reproductions	Plants remaining by June 1, 1957 after planting of 1,500 seeds	
		from the fall reproduction	from the spring reproduction
A. Wheat:			
1) Hard (T. durum Desf.)			
Arandany	7	90	130
Gordeiforme 10	7	67	109
Melianopus 69	5	5	3
Khoranka 711/1	7	0	22
2) Persian (T. persicum Vav.)			
Dika 9/14 v. stramineum	7	3	1
Dika 9/14 v. fuliginosum	4	25	16
3) Spelt (T. dicoccum Schübl.)			
Spelt from Armenia	6	14	2
4) Soft (T. aestivum L.)			
Surkhak 194	4	76	139
Ostka Khlopitska	4	44	65
Al'bidum 3700	4	36	67
B. Barley			
Nudum maloaziatskii	6	1	0
Viner	4	12	4
C. Oats			
Sovetskii	3	1	2
Aristata 7	7	1	0

Footnote: Data on ramose wheats are not cited as the spring reproductions were not planted because of lack of seeds.

(Text continued from page 54)

We conducted studies of many other biological, morphological and economic (quantitative) characteristics, during the whole course of our experiments, besides the winterhardiness. We are citing here some data concerning these observations.

In order to track down the influence of dates of planting on the progress of development of the following during 1952-1953 we conducted observations on the formation of the apical tip [zone of growth] in offspring of all the variants of fall and spring dates of planting. These observations have shown that differentiation of the apical tip in plants from reproductions of different dates of plantings proceeded approximately at the same time. Phenologic observations of the stages of heading and ripening have shown that the passage of these stages corresponded to the alternateness of differentiation of the apical tip and in the limits of the variety also has no differences among the variants.

Follow-up of the dynamics of heading, after planting fall reproductions in spring, has shown that differences, which were observed on the day of calculation, between the fall and spring reproductions were expressed in a very slight lag in the heading of the fall reproductions of two varieties. In the Arandany variety the fall reproduction had 23 plants which formed spikes, and the spring - 54; in the variety Gordeiforme 10 respectively 25 and 62 plants. In all the rest of cases the character of heading of the fall and spring reproductions was similar.

Detailed survey of morphological features has shown that during the first year of work plants of strange forms were detected in three varieties. Thus, single plants of soft wheat were found in almost all fall-winter dates of plantings of Persian wheat Dika 9/14, as well as in individual dates (without any regularity) in hard wheat Gordeiforme 10. In both cases single plants of soft wheat were met also in spring plantings, but in a considerably smaller percentage (in both cases - in one date of planting among ten). Subsequently it was found out that a small number of these plants in the control was explained by their belonging to the winter forms, which do not head in spring. There was no doubt that these forms were present yet in the initial material. [Begin p.65]

The ramose wheats - Kakhetinskaia and opytnika Stepaniana, which were taken from production plantings, were clearly contaminated with barley and nonramose forms of soft and hard wheat. After removal of all these admixtures during the first year of work, they did not appear any more. In the rest of varieties there were no admixtures of other forms,

After removing all the contamination during the first year and checking the offspring through selected spikes, we repeatedly had cases of appearance of new forms and species of plants both in the fall and in the control (spring) plantings. But we did not have such cases where the cause of their origin was unclear to us during the course of the whole seven years. We shall briefly describe these cases.

In two cases the offspring of individual spikes of Persian wheat consisted 100% of similar variety of the soft. In this case the mistake during selection was beyond doubt, because these species are very similar to each other, and at the beginning we even resorted to a cytological analysis, in order to distinguish the overlapping forms.

In 1952, during two periods of planting (September 30 and October 30) in the variety Gordeiforme 10 several plants with a white spike of the intermediate type between the hard and the soft wheats were discovered. Checking of their offspring has shown, that these were hybrids of the hard and the Persian wheat Dika 9/14, which then evolved during the following generations.

In plantings of spelt we detected in the same year its natural hybrids with hard wheat, which fact was confirmed by the character of segregation of the offspring of these plants.

Appearance of natural hybrids in both cases could have happened during the fall planting in 1949, which was conducted without space isolation. Individual plants F_1, in virtue of domination of characteristics of the mother species could have remained unnoticed during the checking of offspring of individual spikes.

We also found absolutely sterile hybrids among Persian wheat and rye, ramose wheat and rye, Persian wheat and spelt in those cases when they were grown on the same sections. Inasmuch as since the fall of 1952 the plantings at all the points were conducted on general sections without space isolation, we repeatedly observed cases of the appearance of natural interspecific hybrids; in particular, fertile hybrids were found between the Persian wheat and the hard; ramose and hard, and others. Their hybrid nature was confirmed by the external appearance and the character of segregation in the offspring.

Besides the above-mentioned natural hybrids, no other visible changes of morphological characteristics were observed by us.

Studies of such quantitative features as the height of plants, bushiness, length of spikes and awns, density and the amount of grams in a spike, and weight of 1,000 grains have shown that after a fall planting the spring crops approximate the winter forms of corresponding varieties in all these features, and differ considerably from control plants sown in spring. Nevertheless, when planting simultaneously fall and spring reproduction of several years' standing, these differences smoothed out almost entirely both in the fall and the spring sowings. Even if they were retained, then it was in very insignificant amounts; and for ascertaining it through analysis we needed a larger amount of plants than we had at our disposal.

An article of Academician T. D. Lysenko was published in 1952, where precise methodical instructions were given on conversion of spring crops to winter. In particular he wrote: "A method for liquidating the spring heredity and producing a winter heredity is now defined so accurately that on this basis an agricultural procedure has been developed, which permits to convert winter crops into any variety of spring wheat, barley or other plants of these species, that [Begin p.56] have both the spring and the winter form in any region". (Lysenko, 1952a : 6).

According to directions contained in the cited article, of T. D. Lysenko, a near-winter planting was carried out during the fall of 1952 (November 25) of nine new varieties of cereal crops which in the general list were marked as of 1952. As in the preceding experiment the planting was conducted with unchecked seeds. Most of the plants survived after the winter. We did not detect any admixtures of other species.

For a subsequent planting 2 spikes were selected from each plant, which were threshed separately. During the spring of 1953, the seeds of one of the pair of selected spikes were planted during the best time for sowing the winter crops (October 8), and the seeds of the other spike at a later time (October 27). In all 100 spikes were selected from each variety. Seeds of every spike were sown in a separate row.

Winter of 1953/54 was severe. Loss in both the spring and the winter crops was observed, but the plantings of both dates survived, although individual varieties were thinned out. A detailed checking of each family has shown an absence of any marked morphological changes which went beyond the limits of the variety. The best families were harvested separately, and the rest united into the limits of each date.

During the fall of 1954 all this material, together with the initial seeds from spring reproductions was sown on October 7. Area of plots was 2 sq. m. Winter of 1954/55 was mild and there were no differences in overwintering of the fall and spring reproductions. According to such indicators as the phases of development, disease infection, lodging, as well as the height of plants and their general appearance, weight of 1,000 grains, and others, the fall reproductions of I and II dates did not differ from those of spring reproductions in anything during this experiment. There also was no difference among these variants during spring plantings. They all formed spikes simultaneously and all together and did not differ in any way among themselves. Henceforward, as in the preceding experiment, this material has continued to be sown at the Maikop and the Kuban Experimental Stations on the best dates for planting the winter crops. Nevertheless, up to the present time no marked shifts in the increase of winterhardiness of the tested varieties were obtained. Data of the last overwintering (1956/57) of the available material at the Maikop Experimental Station are cited in table 2. The conditions of winter of that year were very unfavorable on account of the unusually early frosts (November 8), the absence of the snow covering and retarded sprouts, which appeared only on October 24 due to conditions of a dry fall.

From data in table 2 it is seen that even those differences smoothed out which were observed between the fall and the spring reproductions during the preceding years. We explain this by an extremely early loss of plants which even could not start to become hardy; of course, no peculiarities of more winterhardy varieties and forms could be expressed under such circumstances. But on the whole here was reflected the true picture of the seven year work on changing spring cereals into winter.

Let us cite data of one more experiment which was conducted in Krasnodar at the Experimental Base of the All-Union Scientific Research Institute of Oil and Essential Oil Crops [VNIIEMK]. Hard wheat Gordeiforme 27 and the Persian wheat Dika 9/14 were utilized here. The initial material was the same and it also was not preliminarily studied and checked.

During the first year of work (1949) the plantings were conducted, beginning with September 10, every 5 days up to February 10. In 1950 the plants were harvested according to the dates of planting without any preliminary survey on account of absence of the specialist. Only the remnants of chaff after harvesting were kept for the control. During the fall of the same year seeds of each date were sown at the following dates: Gordeiforme 27 - October 13 and 21, November 15 and 27, December 22, January 5, 15 and 25, [Begin p.57] February 2, 12 and 22, and March 3; Dika 9/14 on October 18 and 26, November 15 and 25, December 22, January 5, 18 and 25, February 2 and 12.

In 1951, after a detailed survey, it was found out that in the variety Gordeiforme 27 in the offspring of 2 variants of plantings of 1949 (October 5 and November 10) soft wheat was met everywhere. Survey of the pellicle in the chaff confirmed the presence of soft wheat in these variants during the year of planting. Consequently it was present yet in the initial material.

In Persian wheat Dika 9/14 soft wheat predominated in all variants.

Plants of Persian wheat survived only in plantings of winter and spring dates. Presence of soft wheat in the initial material was established at the Maikop Station. Under conditions of Krasnodar, where winters are more severe the Persian wheat [Begin p.58] after fall dates was all destroyed by frost, and only those plants of soft wheat survived which were winter crops in the biology of their development.

In 1951, after removing all admixtures, typical plants of these two varieties were again planted at the following dates: November 3, 13 and 23, December 3, February 13 and 26. Subsequently all families were of the same kind and typical for their species.

In 1952 families of each kind were united in the limits of variants and were planted on three dates: the best - September 23 and near-winter - December 1, as well as in spring of 1953, April 2. Winter of that year was unfavorable and most of plants of the September planting were lost. Of the Dika 9/14 variety 4 plants survived, and of Gordeiforme 27 - 54 plants. Most plants survived from the near-winter planting (December 1), but no visible changes were recorded among the experimental plants in both cases.

In 1953 both varieties were planted on a date which was near to the best for winter crops in that zone, namely October 13. Winter was extremely severe and towards spring only a few remained in all variants and even single plants, but they all retained features of their species and variety. The same was observed in 1954 after a sowing on October 17, when the winter was favorable and both the experimental and the control plants survived well. In 1955 the plantings were again heavily thinned out without noticeable differences between the sixth generation, obtained from fall sowings, and the control, that is the spring reproductions of the same varieties. It is possible to say, that after separation of all admixtures, the remaining material underwent the effect of three very severe winters after plantings at most diverse dates; but still we did not succeed in finding any changes of morphological characteristics, nor any marked increase in the property of winterhardiness of the tested varieties. At the same time this experiment has shown that with insufficient purity of the initial material it is easy to accept a semblance of conversion of one species into another as a reality.

On the whole our experiments on changes of spring crops into winter, which were conducted with twenty varieties that belonged to eight species of cereals, have shown that this question is not as easily solved as it seemed judging from the published works. The obtained experimental data do not correspond to directions of Academician T. D. Lysenko.

The conducted works have shown that with a careful preparation of the initial material by means of selection and checking of selected plants by the offspring we did not succeed in obtaining not only any changes of morphological properties, but also any marked shift in the direction of acquiring the property of winterhardiness. One should point out that if during the first year of work we did not remove all admixtures from the initial material, in particular of the winter soft wheat, then we would have before us a semblance of "conversion" of some species into others, and Persian wheat "would be changed" in our experiments into soft, the hard into soft and into spelt, and the ramose wheat into soft wheat and barley, and so on.

Some may object stating that during the course of the whole 7 years we did not have a complex of such conditions which contribute to the origination of sharp changes. Indeed, most of the winters under conditions of the Maikop Station were favorable for overwintering of spring cultures. Yet, 3 winters (1949/50, 1953/54 and 1955/56) were severe enough and caused the loss of a great number of spring crop plants and even of winter crops. Besides this the fractional dates of plantings every 5 days during the course of 3 months, which during the course of 3 years were conducted at two points, also formed a very great variety of conditions. Here too one should add the repeated plantings during the course of 4 years at the Kuban Experimental Station, and 3 of these years were characterized by extremely severe weather conditions, [Begin p.59] when most plants of spring crops were lost. Material of different dates of plantings was also sown for 2 years under mountain conditions at an altitude of 1,300 m (Teberda) and in Leningrad oblast'. To this should be added that since 1952 the experiments were conducted according to the specific method of the Academician T. D. Lysenko, as well as to remember those experiments which during 7 years were conducted in the city of Krasnodar according to a complex scheme, which also included variants of plantings, that were recommended by Academician T. D. Lysenko. And yet not in a single case did we have one authentic fact of mutability [leap-like variability] of morphological or biological properties of plants. Taking into consideration that we tested 20 varieties of most diverse origins, from southern to northern, which belonged to different ecotypes, we must make a conclusion that the possibility of mutations [leap-like changes] and "conversions" of species in our experiments was not confirmed and the proposed methodical directions did not justify themselves in this respect.

In contrast to the condlusions of Academician T. D. Lysenko and of other authors, which think that it is easier to change a typically spring form into a winter one, than to increase the winterhardiness of the winter crop, our experiments have shown quite opposite results; we have obtained a marked shift in the increase of winterhardiness first of all in the semi-winter hard wheat Arandany; after that in a somewhat smaller degree these differences appeared in the medium variety Gordeiforme 10 and had no shifts in direction of winterhardiness in early-ripening varieties of southern origin, such as Melianopus 69, Khoranka 711/1, Persian wheat, spelt and others.

If, in reality, the property of winterhardiness arises gradually, accumulating from generation to generation under conditions of constantly acting selection in this direction, then it becomes apparent that all forms, in the first place late-ripening, then semi-winter crops and the slightly winterhardy represent gradual stages of this evolution of winterhardiness. That is why it is easier to obtain a real winter form from a semi-winter and it takes less time to increase winterhardiness in the already available winter crop, than to take for this purpose spring and non-winterhardy varieties.

In this respect there already exists a rich experience of the whole selection work where, for the formation of winterhardy varieties, the available winterhardy forms - either wild or cultivated were always used as initial material.

Our experience has also shown that without a preliminary selection of plants in the initial material and checking of their offspring one cannot have a guarantee of non appearance in the experimental material of any admixtures, and in any amount. Appearance of single plants of other genera, species or varieties, after all the precautions were taken, also cannot serve as proof of mutability of species. A proof for this last one can be only the appearance of those conditions, which regularly every time will cause one and the same variability. At the present stage the appearance of unusual forms in the population can only serve as a reason for conducting a series of repeated experiments in order to check this fact and for detecting specific conditions which cause such a variability.

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O primenenii ul'trafioletovoi radiatsii dlia sterilizatsii nekotorykh ob"ektov na pishchevom proizvodstve.

[About the utilization of ultraviolet radiation for sterilization of certain objects in food industry].

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(In Russian)

With the development of the technique of construction of apparatus for artificial ultraviolet radiation many experimental observations have been accumulated about their utilization. Ultraviolet rays have been used for sterilising the air, water, environment and for affecting men (N. F. Galanin, N. M. Dantsig, 1950; L. I. Mats, 1950; G. M. Frank, 1939, A. I. Shafir, 1951, and others).

Yet the wide practical use of artificial ultraviolet radiation was begun only lately; it began to be used for disinfection of air in children's and medical institutions, as well as for the purpose of sterilization of certain food products. I. A. Golovkin noticed that, after a daily irradiation of sausages, the preservation of full high quality continued during the course of 24 days while the control pieces were covered with mould and slime already on the 11th day. Meat quarters, according to data of the same author, were preserved for 13 days after daily 3-hour irradiation, while the control specimens kept well only 6 days.

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Before us a problem was raised to find out the possibility of utilizing ultraviolet radiation for the sterilization of certain objects in fish canning industry. Considering the demands of the industry, we took the following objects: a vegetable oil, which was utilized for the preparation of canned fish, smoked sprats (intermediate products for canned sprats), the surface of the equipment and the workers' hands.

Irradiation was conducted with bactericidal lamps of 15 W capacity, which proved to be the most effective in their sterilizing effect. A line with the length of the wave 253.7 m μ enters into the ultraviolet spectrum of these lamps, which produced the maximum bactericidal effect.

Irradiation of fats is used widely for the obtaining of vitamin D. Sterilization of fats by ultraviolet rays was not utilized in practice because intensive irradiation of animal fats causes their oxidation and changes the flavor (G. M. Frank, 1939; A. V. Reisler, 1952, and others).

After conducting experiments on irradiation of vegetable oil it became clear that for a sterilizing effect the thickness of the layer of oil, the exposure (from 10 minutes to 1 hour), massiveness of microbe seedings and the state of rest or movement of the irradiated oil were of importance. [Begin p.40]. According to literary data (N. F. Galanin, 1952; G. M. Frank, 1939; M. G. Kichenko, 1950, and others), the bactericidal part of the spectrum of ultraviolet rays penetrates liquid opaque media to an insignificant depth; we began irradiating with a layer 0.5 mm thick and further on proceeded to 1, 2, 4 and 5 mm.

The work was conducted with sunflower oil, which is used for the preparation of canned fish. The distance from the source of irradiation was always equal to 20 cm. Before irradiation the oil was inoculated with one of the following microorganisms: staphylococcus, intestinal, and sporogenous bacilli (of mesenterious type, consisting of spores up to 90%) and the Aspergillus fungus.

In all, 50 series of experiments were conducted on the irradiation of oil. A noticeable effect, in regard to oil which was at rest, appeared after irradiation of an oil layer 1 mm thick and less, and, basically, depended on the length of the exposure and degree of seeding of oil.

We present, as an example, data on irradiation of oil, infected with staphylococci (table 1).

Table 1.

Dependence of the sterilizing effect of irradiation with ultraviolet lamps of sunflower oil (without stirring), which was inoculated with staphylococci, on the length of exposure and on the degree of seeding

Number of microbes in a drop of oil before irradiation	Exposure (in min)	Number of microbes in a drop of oil in a layer (in mm)		
		0.5	1	2
5,900	30	160	308	400
150	30	2	70	125
26	30	0	0	26
5,300	60	150	800	2,700
112	60	0	4	47

We also utilized irradiation of oil, which was in motion, in order to increase the bactericidal effect, considering that, thus, the upper layer, which was affected by ultraviolet rays, would change constantly (table 2).

Table 2.

Difference in bactericidal effect of irradiation of sunflower oil, inoculated with staphylococci, depending on the state of oil.

Number of microbes in a drop of oil before irradiation	The state of oil	The thickness of the irradiated layer of oil (in mm)	Number of microbes in a drop of oil after irradiation with and exposure (in min.)	
			20	30
Tens of thousand	Rest	2	Without change	Thousands
" " "	Movement	2	Thousands	640
Thousands	Rest	2	560	240
"	Movement	2	200	40
1,200	Rest	2	620	440
1,200	Movement	2	50	7
640	Rest	2	140	120
640	Movement	2	11	5

It became apparent, as a result of these experiments, that the movement sharply increased the bactericidal effect - this gave a possibility to decrease the length of exposure of irradiation of oil to 20 minutes. [Begin p.41].

The resistance of various species of bacteria to ultraviolet rays is dissimilar. B. coli die very quickly in the irradiated oil; the staphylococci die almost just as fast; bacterial spores are more resistant.

It was ascertained, that nonsporal microflora disappeared altogether during the course of the first 24 hours of keeping. In the nonirradiated oil (control) dying off of introduced microbes took place also but considerably slower (in the course of one month and longer). In order to explain the cause of dying off of the remaining microbes, experiments were conducted by inoculating the oil after irradiation. Observations have shown that microbes introduced into the oil after its irradiation died as quickly as the remaining irradiated ones (table 3).

Table 3.

Speed of dying off of staphylococci in oil, inoculated after irradiation

State of oil	Number of microbes right after inoculation	The number of microbes in a drop of oil after inoculation in (in hours)					
		24	30	48	72	120	168
Inoculated after irradiation	480	0	0	0	0	0	0
Inoculated 7 days after irradiation	1,100	640	0	0	0	0	0
Nonirradiated	220	200	200	35	36	39	24

I. A. Golovkin and T. B. Chizhov (1951) point out that irradiated products acquire bactericidal properties and, after their second seeding with bacteria and storing, they show, in a reseeding two times less microbes than the control specimens.

After irradiation during the course of 20-60 minutes, the oil changed somewhat in its organoleptic properties: there appeared a slight taste and smell of an aging oil; canned fish, prepared with irradiated oil did not differ in their organoleptic properties from the control specimens.

According to data of F. I. Ukhtomskaia iodine and acidic number changed in oil only after prolonged irradiation (not less than one hour), whereas the peroxide number increased even after a 20 minute exposure.

The next step in our work was the irradiation of smoked sprats in order to prolong the period of their preservation. According to conditions of production we could conduct only a single, short (3 minute) irradiation. An increase of 2-3 days was noted in the time of preservation of smoked sprats, when compared with the nonirradiated.

For experiments on sterilization of tare and of workbenches, we took wooden planks, with a slight roughness, and galvanized iron. The tested surface was contaminated ~~with [illegible]~~ with one of the cultures

(B. coli, staphylococci, mesentericus spores and mould spores) before irradiations. Irradiation was conducted at a distance of 20 cm from the object. It was ascertained that the sterilizing effect depended on the character of the material, of the massiveness of seeding and species of microorganism. When irradiating galvanized iron full sterility of its surface was achieved in 10-20 seconds after seedings with nonsporogenous and vegetative forms of microbes and in 1-3 minutes after seeding with mould spores (table 4).

Somewhat different results were observed when sterilizing wooden surfaces. Unevenness and roughness of the irradiated surface protected the microbe cell from the destructive action of bactericidal rays. (Text continued after tables). [Begin p.42].

Table 4.

Bactericidal effect of irradiation of galvanized iron, contaminated with microbes

Number of microbes on the imprint before irradiation	Number of microbes on the imprint after irradiation at an exposure of								
	10	20	30	1	1.5	2	3	5	10
	Seconds			minutes					
				B. coli					
Massive growth	140	1	1						
Difficult to count	120	0	0						
2,000	34	0	0						
539	13	0	0						
				Staphylococci					
Massive growth	120	0	0						
1,750	56	0	0						
700	14	0	0						
Difficult to count	10	0	0						
1,900	200	2	0						
400	0	0	0						
				Mould					
1,050	-	-	700	18	-	14	2	1	1
280	-	-	90	4	-	0	0	0	
160	-	-	25	0	-	0	0		

Table 5

Bactericidal effect of irradiation of a wooden plank, contaminated with microorganisms

Number of microbes on the imprint before irradiation	Number of microbes on the imprint after exposure (in min.) 0.5	1	1.5	2	3	5	8	10	12	15
					Staphylococci					
Massive growth	5,225	1,200	700	420	200	87	19	15		
5,600	700	375	220	160	96	24	4	0		
1,500	190	86	42	38	15	0	0	0		
120	11	0	0	0						
				B. coli						
Massive growth	5,250	1,150	150	140						
5,700	240	69	29	11						
1,030	30	6	1	2						
109	3	1	0	0						
				Sporogenous rod						
Massive growth	Massive growth	5,000	2,500	1,500						
Difficult to count	350	140	60	44						
1,400	140	23	7	4						
350	18	12	2	5						
				Mould						
Massive growth	-	4,210	-	2,600	2,050	1,400	725	525		
Difficult to count	-	3,500	-	1,050	875	520	155	65		
4,200	-	420	-	210	144	104	85	40	-	45
700	-	170	-	61	41	27	18	10	-	1

[Begin p.43]

The wooden surfaces, irradiated by us, which were freed from all visible impurities, had a slight roughness, usual for the tare (boxes) or for planks on the workbenches. Their sterility was attained much slower than that of metal surfaces. The majority of microbes (85-98%) died during the first 30 seconds, but the remaining number of them died off slowly -- during the course of 15 minutes and more from the moment of irradiation, depending on the massiveness of seeding and the species of microbes (table 5).

And in the experiments under consideration B. coli and Staphylococci proved to be the least resistant. The spores of moulds were far more resistant: after a heavy seeding of a wooden surface with them full sterility was not achieved even after an hour's irradiation, although 80% of cells died during the first minute. When a wooden surface was visibly soiled the number of perished B. coli and Staphylococci on it came up to not more than 75% after irradiation during the first 30 seconds, while under the same circumstances, up to 95% of microbes died off on a clean plank.

Data, obtained by us, were sufficiently convincing, and this method can be recommended for sterilization of tare, of workbenches and equipment of the food industry.

There is information in literature that short wave ultraviolet rays are practically harmless to the skin (G. M. Frank, 1939; Meier, E. Zeitts, 1952). We decided to use ultraviolet irradiation on the skin of hands. Before irradiation we contaminated the skin of the hands with microbes (Staphylococci and B. coli), one hand was irradiated and the other served for comparison. Irradiation was conducted at a distance of 5 cm with two bactericidal lamps, equipped with hoods (in order to prevent irritation of eyes), during the course of 1,2 and 3 minutes. Doses taken for seedings were known to be great. Death of microbes during the first minute of irradiation comprised 80-90% (table 6).

Table 6

Bactericidal effect of irradiation of hands, contaminated with Staphylococci and B. coli

Exposure (in min.)	Number of microbes on the imprint of the palm of hand: Before irradiation	After irradiation
	Staphylococci	
1	400	40
2	400	26
3	400	1
1	160	1
2	160	0
	B. coli	
1	Massive growth	61
1	250	40
1	196	6
1	100	10
2	100	0
1	80	10
1	15	0

When the seeding is small, such as usually takes place after washing the hands with soap, one minute irradiation will be virtually quite sufficient.

Experiments, conducted along with the above, on disinfecting the hands using chlorine water have shown that this method does not give better results when compared with irradiation, and in certain cases is even less effective. Besides this [Begin p.44] the use of chlorine water requires systematic control for its correct concentration, not to mention the unpleasant smell after washing the hands with chlorine water and possible irritation of the skin.

Before introducing this method into practice it is necessary to conduct a longer observation of irradiation of hands with bactericidal lamps under conditions of production.

Conclusions

1. Sterilization of vegetable oil by ultraviolet rays gives a positive effect only when irradiating a moving layer not more than 0.5 cm high. Nonsporal flora (B. coli, staphylococci) are less resistant during irradiation of oil, than the bacterial spores.

2. The irradiated oil acquires bactericidal properties and the microflora remaining after irradiation in any amount perishes during the first 24-hour day. But the irradiated oil acquires a weakly expressed taste and smell of an aging oil.

3. Irradiation with bactericidal lamps of metal and wood surfaces produces a great bactericidal effect and can be recommended as a quick method for decontamination of tare, workbenches and other objects of equipment.

4. The length of exposure, the character of the material its visible soiling, massiveness of the seeding with microbes and their species, influence the bactericidal effect during irradiation of surfaces.

5. Irradiation of contaminated hands with bactericidal lamps during the course of one minute is just as effective in decontamination as washing the hands in chlorine water.

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Trans. A-988
(In full)
VG/M

Mardzhanian, G. M.

Pis'mo uchenogo soveta sektora zashchity rastenii AN Armianskoi SSR v redaktsiiu "Botanicheskogo Zhurnala".

[Letter of the Scientific Council of the Department of Plant Protection of the Academy of Sciences of the Armenian SSR to the editor of the "Botanical Journal"].

Bot. Zhur. [Moskva], vol. 43, no. 1, p.156-157.
Jan. 1958. 451 R923.

(In Russian)

The Scientific Council of the Department of Plant Protection of the Academy of Sciences of the Armenian SSR discussed the critical memorandum of P. N. Golovin [Trans. A-792], which was printed in the "Botanical Journal", no. 1, 1956, about the article of the Senior Scientific Co-worker of the Department, M. A. Mkhitarian, "On the variability of species of rust of cereals", which was published in "Izvestiia of Academy of Science of Armenian SSR" (vol. 5, no. 12, 1952, p.13-18), and found it necessary to express its opinion about some of the questions touched upon there.

The basic motive, which prompted P. N. Golovin to criticize Mkhitarian's article, is, apparently, a difference in the points of view of Mkhitarian and Golovin concerning the same problems (variability of rust species, role of the intermediate host, and others). Nevertheless, as it seems to us, this does not give any right to P. N. Golovin to come forward with such a clearly biased criticism.

Having this circumstance in view, the Scientific Council thought it to be its duty to give an explanation as regards some of the questions touched

Sektor Zashchity Rastenii AN Arm SSR [Department of Plant Protection of the Academy of Sciences of the Armenian SSR].

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upon in the memorandum of P. N. Golovin.

M. A. Mkhitarian has been working in the Department of Plant Protection since 1934, and during this time he showed himself to be a modest worker, who is far removed from a tendency to make "discoveries" in science. The Scientific Council, who is well acquainted with the methods of work of M. A. Mkhitarian, knows that all his conclusions were made on the basis of factual material, which was accumulated by him during the course of 22 years.

The basic omission of Mkhitarian must be considered to be that he did not describe in his article methods of his field and laboratory experiments more fully; but this was caused by the necessity to limit himself to the frame of a journal article, which was too narrow for the material that he had to present.

Mkhitarian's experiments of several years' standing, as well as observations, led to a conclusion about the absence of sexual reproduction in rust fungi of wheat, and, in particular, in yellow rust.

Concerning the question, as to what species of rust on barberry Mkhitarian worked with, one can say the following. Phytopathologists of Armenia know, and this is also mentioned in the monograph of P. N. Tetorevnikova-Babaian "Rust Parasites of Cultivated and Wild Plants of the Armenian SSR" (1952), that on barberry there is only one species of rust - Puccinia graminis under conditions of the Armenian SSR; therefore, the accusation of P. N. Golovin, that Mkhitarian may have worked with another species of rust, is incorrect, and the doubts, which he developed in connection with this, were unfounded.

In his article, Mkhitarian expressed an opinion that the aeciospores of barberry "for the most part" infect the leaves of barberry itself; that is, they rarely infect the cereals. This demonstrates, that the intermediate hosts do not play any special role in the cycle of development of species of rusts of cereals. But, as it follows from Mkhitarian's data, he also succeeded to infect cereals with aeciospores of the barberry rust; this then again confirms that the rust on barberry is Puccinia graminis, and not some other species, and that P. graminis under conditions of Armenian SSR has a wintering mycelium.

It seems to us that facts, which were established under certain ecological conditions (the presence on barberry of five species of rust and the absence in P. graminis of the wintering mycelium), cannot be transferred to other localities, as it is known, that changes in the environment bring about biological changes in living organisms.

The Scientific Council, on the basis of extensive data, which existed in reports on this problem, knows well that Mkhitarian has demonstrated by his numerous experiments and, in the course of 20 years, annually confirmed by his observations, that on wheat the rust has a full cycle of development and can develop without an intermediate host. Besides this, he also demonstrated, and the later experiments and observations confirmed it, that on barberry, without being transferred to cereals, rust also completes the cycle of its development. Thus, the doubts of Golovin in this problem are unfounded. Besides that, one has to take into consideration, that Mkhitarian does not exclude the well-known fact of passing over [Begin p.157] of rust from barberry to wheat and back, but he considers that this phenomenon is only of secondary importance under conditions of Armenia.

Concerning the question about the conversion of P. graminis to P. triticina, and of this last one to P. glumarum and vice versa, one should say that the opinion of the author was built on the basis of results of numerous experiments, which were conducted under isolators, with the observance of accurate methods for the course of many years. He took the infectious material from one rust pustule and even infected with one spore; this, in our opinion, is sufficient in order to consider the methods convincing, and the results accurate.

On the basis of research by the author, a serious question arises how to treat the established phenomena: to accept the representattion, available in systematics, about the existence of three species of rust and to think, that they can pass over from one to another with a change in the conditions of existence, or should one revise the systematics of these three rust fungi and to consider that there exists but one species of rust, which assumes one or another form, depending on various conditions, of existence.

The Scientific Council finds, as Golovin himself pointed it out, that the question, set up by Mkhitarian, was one of the most complicated and, at the same time, is an especially interesting and important problem of modern biology; therefore, all the materials, which pertain to its solving, must be elucidated in the modern scientific press even in that case if they were solved by a somewhat different interpretation, which is contrary to the firmly established opinions of the authorities; this then explains why this article was published in the "Izvestia" of the Academy of Science of the Armenian SSR; it is desirable, that more data be printed concerning this question.

We think it appropirate to mention, that no matter how high an authority P. N. Golovin is, nevertheless, when criticising scientific works, he should use expressions which are more fitting in such cases. Besides that, it is surprising that P. N. Golovin came out with his criticism 4 years after Mkhitarian's article was published.

We request to include the reply of the Scientific Council on the critical memorandum of P. N. Golovin about the article of M. A. Mchitarian "On the variability of species of rust of cereals" in one of the next issues of your journal.

Received July 10, 1956.

See also translation no. A-989 "Reply of the Committee of the Mycological Section of the All-Union Botanical Society".

Trans. A-959
(In full)
vg/W

Bondartsev, A. S., Rashevskaia, V. F.,
Stepanova, K. M., and Khokhriakov, M. K.

Otvet komissii mikologicheskoi sektsii vsesoiuznogo botanicheskogo obshchestva.

[Reply of the Committee of the Mycological Section of the All-Union Botanical Society].

Bot. Zhur. [Moskva], vol. 43, no. 1, p.157-158.
Jan. 1958. 451 R923

(In Russian)

At the request of the editor of the "Botanical Journal", the Mycological Section of the All-Union Botanical Society at its 140th session on January 25, 1957, after a careful acquaintance with the letter of the Scientific Council of the Department of Plant Protection of the Academy of Sciences of the Armenian SSR, in connection with the criticism by Professor P. N. Golovin of the article of M. A. Mkhitarian "On the variability of species of rust of cereals", has formed a competent committee, which was entrusted with compiling a reply to this letter.

At the 141st session, on February 15, 1957, the Mycological Section of the All-Union Botanical Society discussed the conclusion, which was drawn up by the committee and is asking the editor's office of the "Botanical Journal" to publish it as the reply of the Mycological Section to the cited letter of the Scientific Council of the Department of Plant Protection of the Academy of Science of the Armenian SSR.

The text of the Committee's conclusions is cited below:

"The Committee, after familiarizing itself with all the data (the cited article, its review and letter), considers that each researcher has a right to his own opinion on any problem. But if this point of view is

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brought to the general knowledge without any proper grounds and convincing proofs for others, then this gives the right to other researchers to express their discontent or to speak out critical remarks.

"M. A. Mkhitarian, in his article, advances the following erroneous ideas: 1) sexual process is in general absent in rust fungi; 2)aeciospores of the stem rust of cereals cannot infect cereals, in connection with this the aecidial stage of rust on barberry is an independent species, and the uredio - and teliostages are another species, which are not connected with barberry; and 3)the stem, brown [leaf] and yellow [stripe] rusts of cereals are forms of existence of one species and, depending on conditions, are converted one to another.

"The Committee thinks, that even if one takes into consideration the zonal specificity during development of rust fungi, all these ideas are the result of M. A. Mkhitarian's fallacy in connection with his insufficient knowledge of immutable facts. We admit that under conditions of Armenia, as in certain other zones of the Soviet Union, all the cited species of rust fungi develop on cereals, bypassing the aecidial hosts, that is they are in a diploid state. This first of all refers to stripe rust. [Begin p.158] Nevertheless, it would be incorrect to make from here a conclusion about a full absence of the sexual process in these fungi, especially in the stem and leaf rust. Under conditions of certain regions of Soviet Union the role of an intermediate host is indisputable. It is known, for instance, that under the condition of Eastern Siberia, where plantings of winter wheat are absent and on which the brown rust could overwinter in the uredostage, it is annually restored through an aecidial host - "leshchitsa" (Leptopyrum fumarioides). M. A. Mkhitarian, for some incomprehensible reason disregards the data, that a sexual process occurs during the development of rust on aecidial hosts; this fact is known as a result of classical research of L. I. Kursanov and of foreign scientists - "Kredzhi [Craigie], Allen, Stackman, Brown, Cotter. This was also confirmed by the results of careful investigations of the Aspirant, I. A. Shifman, accomplished by him at the laboratory of mycology imeni Professor A. A. Iachevskii at VIZR [All-Union Scientific Research Institute for the Protection of Plants] in recent years on sexual hybridization of forms of brown [leaf] rust of wheat, couch grass, brome grass and other cereals, with the development of wholly viable fungi which were, in some cases, more pathogenic in reference to wheat, than the initial parent forms. Thus, a denial of a sexual process in rust fungi, which infect cereals, must be recognized as incompetent.

"On the question of inability of aeciospores from barberry to infect cereals, M. A. Mkhitarian should have had in view that *Puccinia pygmaea* Eriks., *P. arrhenatheri* Eriks., and other species form their own aecidia on barberry, as well as the fact that *P. graminis*, as it is known, consists of many specialized forms, among which some cannot infect cereal plants, although they develop their aecidia on barberry; such are: f. sp. *agrostis*, f. sp. *poae*, f. sp. *aperae*, f. sp *arrhenatheri*, and others. Meanwhile, as it is seen from the article, M. A. Mkhitarian did not conduct any biological analyses of aeciospores for their belonging precisely to the specialized forms of *P. graminis*, which infect cereal plants.

"Reference of the Scientific Council of the Department of Plant Protection to the work of Teterevnikova-Babaian in this case cannot serve as a proof. Mkhitarian did not take the trouble to explain how he treated the data of foreign and Russian researchers, who many times experimentally have established a direct connection of rust on barberry with rust on wheat. Apparently, M. A. Mkhitarian did not conduct experiments on infecting barberry with aeciospores, because in his article there are no data about the fate of these aeciospores, as well as on what kinds of spore bearers arise on barberry, if they really are able to infect it. Therefore, the affirmation of Mkhitarian about the presence in this case of two species of rust also is beneath criticism.

"Concerning the conversion of species of rust to other species, this question, from our point of view, in general is beyond discussion because it is stated by Mkhitarian without indicating the methods of research or any experimental data. The drawings of uredospores, which he brought forward, as a proof of his idea, are so carelessly executed that it is impossible to judge about the belonging of uredospores of even the initial forms to one or another species. Meanwhile, it is known that, for instance, uredospores of P. graminis are easily distinguished according to the exceedingly characteristic equatorial bulging in the capsule. Incidentally, aeciospores of P. graminis also are easily distinguished from aeciospores of other species of rust, which infect barberry, by the bulging of the capsule at the crown of the spore.

"Evaluating the article of M. A. Mkhitarian as a whole, the Committee must comply with the essence of the basic ideas of the criticism of Professor P. N. Colovin. The matter here is, of course not in the form, but in the contents. Therefore, we consider to be biased not the review of Professor Golovin, but the letter of the Scientific Council of the Department of Plant Protection of the Armenian SSR, who, without looking into the essence of the questions touched upon, took under protection the erroneous statement of Mkhitarian, and as a basis for their opinion simply repeat these erroneous statements in their letter. The reference that Mkhitarian could not elucidate the methods of his research more fully on account of the brief length of the article is not convincin since instead of describing the methods he preferred to make unfounded attacks for the space of more then two pages on N. A. Naumov, V. G. Transhel' and other authoritative researchers. It would have been far better, if the Scientific Council had provided Mkhitarian in good time with proper leadership in his work and had given him the possibility to publish the methodical part of his work in more detail.

"The insufficient knowledge of M. A. Mkhitarian in questions about the variability of rust fungi is already seen from the list of the cited literature that ... utilised, which must be considered to be clearly insufficient. However, he did not utilize properly even the cited literature.

"In conclusion it would be interesting to knows who it was among the phytopathologist-reviewers who permitted Mkhitarian's work to be published, and who among the phytopathologists took part in the session of the Council, which decided about the unfairness of the criticism of Professor Golovin.

"February 14, 1957,

Leningrad".

"Members of the Committee:

Doctor of Biolog. Science A. A. Bondartsev,
Candidate of Agric. Science V. F. Rashevskaia
Candidate of Agric. Science K. M. Stepanov,
Doctor of Biolog. Science M. K. Khokhriakov."

See also Trans. A-988; Letter of the Scientific Council of the Dept. of Plant Protection of the Acad. of Sciences of the Armenian SSR.

Trans. A-990
(In full)
VG/M

Bakhteev, F. Kh.

O sostoianii prepodavaniia botaniki v srednei shkole.

[On the status of teaching botany in secondary schools](1)

Bot. Zhur. [Moskva], vol. 43, no. 1, p.146-153.
Jan. 1958. 461 R923.

(In Russian)

Naturally, the question about the proper training, education, preparation for independent social-productive activity of our descendants, our children disturbs us deeply. The Party, the Young Communist League, the Soviet organizations, the specially formed Academy of Pedagogic Sciences of the RSFSR have been always occupied with these problems and continue to be occupied with them.

Nevertheless, as practice shows it, the addition of specific aid of the scientific society to the endeavors of the cited organizations can in no way be regarded as an undesirable phenomenon, as a hindrance. Rather quite the opposite: insufficient public attention to the organization of education of our children helped, to a certain extent, in the accumulation of many scandalous shortcomings in the teaching of fundamentals of biology in the secondary school, particularly of fundamentals of botany. The fact itself about the special discussion, at the present convention of the All-Union

(1) A report delivered on May 6, 1957 to the 2nd Delegates Conference of the Botanical Society of the USSR.

Botanicheskii Institut im. V. L. Komarova Akademii Nauk SSSR, Leningrad [Botanical Institute imeni V. L. Komarov of the Academy of Science of USSR, Leningrad].

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Botanical Society, of the report "On the status of teaching botany in secondary schools" is unprecedented in the history of the Societies forty-year activity.

At the request of many members of VBO [All-Union Botanical Society] at the end of 1955 the permanently acting Board on critical evaluation of textbooks and of school equipment for higher institutes of learning was compelled to discuss, contrary to the formed custom, at one of its open sessions, the textbook of M. I. Mel'nikov "Fundamentals of Darwinism "for the secondary schools, and about a year later (November 30, 1956) the same Board discussed the botanical textbook for the 5th and 6th classes by B. V. Vsesviatskii, which is being currently used. Materials of these discussions, which were conducted with the participation of scientific workers-biologists, methodists, teachers, and other interested persons, disclosed the existence of very serious defects in teaching of fundamentals of biology in the secondary school.

The basic and main defect is rooted in the contents of compulsory programs on the fundamentals of biology, in the present case in the contents of the program on botany. The serious flaws of the school textbook on botany, which, as it is known, was compiled strictly according to the official program, approved by the Ministry of Education, are connected precisely to this. Under this "brand" of botany the students are not being taught the fundamentals of botany as a theoretical base for farming, but mainly, and first of all, the applied problems of plant industry and agrotechnics. Under the banner of polytechnicalizing the school, the teaching of fundamentals of botany was transformed into the teaching of fundamentals of agriculture with some elements of botany. The still intensifying tendency to agronomize the school course of botany is also reflected in the training of biology-teachers in pedagogical institutes where quite a substantial time is given over to the so-called fundamentals of agriculture, which include agrotechnical problems exclusively, up to studying agricultural machinery, implements, and so on.

V. I. Lenin said, as it is known, that a polytechnical principle of instruction requires wide general education; without the existence of such wide general training, without mastering the fundamentals of science there also cannot be any effective polytechnicalizing.

Serious defects in teaching botany to students became so dangerous that graduates of secondary schools have at best a very simplified idea about botany, which by no means arouses in them either the interest to know the flora and vegetation surrounding them, or all the more, the wish to deepen the obtained knowledge by means of independent reading of botanical literature, organization of excursions or in any other ways. Almost all the participants of the cited conferences of the Board [Begin p.147] of VBO have pointed to a sharp fall in the interest of young people in botany and in nature in general, as well as to its intelligent protection.

Stenographic reports of discussions of the above-mentioned textbooks were sent, at the proper time, to the higher organizations in Moscow, and their brief contents were published in part in the "Botanical Journal" (1956, no. 5), and will be again published there in part in the near future (1).

Fortunately, these materials were not left without notice: at the end of January of the current year the Academy of Pedagogic Sciences of RSFSR called a special meeting for a discussion of the question "Fundamentals of science in the school course of biology", to which representative of VBO

(1) Materials on discussions of the report of B. V. Vsesviatskii will be published in no. 6 of the "Botanical Journal" in 1957. (Editor's note)

and BIN (Botanical Institute) of AN SSSR were also invited.

Nevertheless, the Ministry of Education remains deaf to the opinion of the scientific society and as yet did not show any signs of paying attention to the comments, which were directed immediately to its address. I venture to tell, precisely in this connection, about certain facts, which relate to the discussion in the Botanical Society of the school textbook "Fundamentals of Darwinism" by M. I. Mel'nikov. Biologists of different specialties, who spoke during the discussion of this textbook, mentioned its many defects. The general conclusion was that the textbook on fundamentals of Darwinism cannot be recognized, to any extent, to be a valuable manual for the pupils and it is necessary to radically reorganize the existing program on Darwinism, taking into consideration the critical comments and to revise the textbook. It was also emphasized that the striving of the Ministry of Education to reduce the time of teaching of fundamentals of Darwinism to students from two hours per week to only one hour was also injustified.

How then did the Ministry of Education of RSFSR react to the public comments? It is true, they, it appears, stopped the introduction of M. I. Mel'nikov's textbook in schools, but they shortened the time given over to Darwinism from two hours to one per week and they entrusted Professor E. A. Veselov with compiling a textbook on Darwinism for the students, which would be designed for the reduced time, without taking into consideration the serious criticism, that was expressed by many besides the Botanical Society. Meanwhile, one should point out, that the published textbook "Darwinism", which was compiled by Professor Veselov for the higher institutions of education, had been already sharply criticized on the printed pages (Botanical Journal, no. 4, 1957). One could hardly expect from this author a better composition on the fundamentals of Darwinism for school children, than what he wrote for undergraduates.

As you see, the steps, which were undertaken, are yet far from sufficient. Gross defects in teachings of botany and in fundamentals of Darwinism are still far from being removed; for this reason the efforts, which were started by the public in this respect, should not be slackened. All the more, under the circumstances the VBO cannot limit its problem to just certain critical remarks, which relate to the contents of the program, textbooks and teaching of botany in schools. It is important and necessary to strive for the removal of all these defects and at the same time to think seriously on the matter how our Botanical Society could render special help to schools for the increase of botanical knowledge of pupils, for stimulating their interest in the flora, vegetation and in nature in general, in its rational utilization as a productive power and in its protection. Such problems, connected with the propaganda of botanical knowledge, as it is known, ensue directly from the statute of VBO.

This is the reason why the Presidium and the Council of the All-Union Botanical Society came to the conclusion about the necessity of a special discussion, at our Convention, of the report "About the status of teaching botany in secondary schools".

Passing over to the specific review of programs and textbooks of botany for the 5th and 6th classes of the secondary school, one should point out, first of all, that the school course of biology, as a whole, undergoes almost constant changes. During the last 8 years it was subjected to "reorganization" now on "Michurin's" now on "Pavlov's" fundamentals; the teacher and the author of textbooks sought something new, often "untested material, subject to discussions, but which was "modern". For instance, in the program on botany for the school year 1953/54 for the 5th class, which was estimated for 66 hours, one sixth of the time was given over to studying the "life and activity" of I. V. Michurin "and of "works of Academician T. D. Lysenko-successor in the work of I. V. Michurin". At the present time a reorganization of schedules proceeds in connection with polytechnicalizing and professionalizing of the secondary school.

It is obvious that under such circumstances there is no possibility to teach biology normally, neither to compile a good textbook, nor a methodical manual. In the almost yearly changing of programs sometimes one or another element, one or another object are left out. For instance in 1934, biology of cultivated plants was studied; in 1935 - 11 families of flowering plants, but later on, from year to year the number of studied families decreased: first to 10, 7, 6, then to 5, 3 families and in the year 1954 none was left. In 1949 a study of 24 cultivated plants was introduced, but 4 years later their number was reduced to 6, leaving the potatoes, cabbage, corn, wheat, flax and apple trees. [Begin p.148].

The presently operating course in botany for the school year 1956/57 for the 5th class specified 2 hours per week, in all 66 hours per year; among them:

Introduction	1 hour
I. Plants in nature and in agriculture	4 hours
II. Cellular structure of plants	3 "
III. Seeds, planting, Germination of seeds	14 "
IV. Roots. Soil nutrition of plants	10 "
V. A leaf. Formation of organic substance in plants	8 "
VI. Stem. Movement and precipitation of substances in the plant	9 "
VII. Propagation of plants	14 "
VIII. Plant - a living organism	3 "

For the 6th class the same amount of time is provided for botany as in the 5th. It is divided in the following order:

Summing up the summer work of the students	2 hours
I. Conditions for growing cultivated plants	9 "
II. Cultivated plants and their growing	21 "
III. Development by I. V. Michurin of new varieties of fruit plants	5 "

IV. Basic groups of plants 28 hours
V. General picture of development of vegetation on earth 5 "

Besides this it is written in the program:

"In the 6th class (as in the 5th) during the school year 1955/56 are introduced compulsory practical studies at the training-experimental plot according to a special program.

"Practical lessons at the training-experimental plot for the 5-- 6th classes are built in close connection with the studies of the botany course and help to inculcate in students the necessary knowledge and skills in agricultural work on the growing of plants on the basis of modern agrotechnics"; we read this on page 6 of the "Program for the school year 1956/57".

In the cited special program are provided: sowing of seeds of carrots and parsley, growing of tomato seedlings and their pruning, planting and selection of vegetable seeds, planting of cuttings of currants and strawberries, thinning of carrots and beets, watering the cucumbers. It is interesting to point out, that none of the ennumerated cultivated plants were studied in the botany course. The main thing to which the attention is drawn at the training-experiment plot is digging and redigging the soil with a following cultivation of the soil. Cultivation of the soil is mentioned 7 times in this program. The thematics of experiments, which are cited at the end of the botany course are limited to three subjects: on vernalization, influence of fertilizers and growing of valuable field crops (corn and others).

Unfortunately, it is impossible in a report to subject the above cited program on botany, for the 5th and 6th classes, to a more detailed critical analysis; therefore I will dwell only on some of the most important remarks.

Firstly, the existing defective approach to teaching botany to 11-13 year old children is very alarming, as this approach is not in accord with children's psychology and, thus, is little understood by them. This feature is confirmed by the absence of lively interest in botany and nature in our children and youth.

Secondly, here there is no proper system of rudiments of fundamentals of botany; there is no succession in knowledge, no gradually and logically consecutive development of ideas. It seems as if almost all rudiments of fundamentals of botanical science are included in the program, but they are taught entirely inadequately and in a chaotic disorder without satisfying the requirements of common sense and convenience of teaching.

Thirdly, even a simple review of the program shows its supersaturation with questions of farming practice to the detriment of the very fundamentals of botany, to the detriment of the development of an interest in children to plants in nature, to the richness and diversity of flora and vegetation; it pushes in children the development of only the utilitarian, superficial approach to the surrounding nature. Systematic excursions into nature are entirely absent; they are completely replaced by work on the so-called training-experiment plot.

A certain conclusion ensues from the above said that the program on botany for secondary schools must be seriously reasoned out and revised. In this responsible work must take part not only and not so much the official institutions as our respected teachers acknowledged by everyone, methodists, pediatrists and our leading botanical scientists.

If a superficial acquaintance with the program uncovers such an unhappy state in the teaching of botany which arouses disappointment and perplexity, then the direct reading of the textbook for school children in the 5th and 6th classes, which was compiled on the basis of this program, provokes new bewilderment and strengthens the uneasiness about such reduced fundamentals of botany. This refers especially to the textbook of V. A. Tetiurev, which was compiled on the basis of the program of 1948; this last one was partly replaced during the past school year by the new textbook of B. V. Vsesviatskii, that corresponded to the program with which we just now became acquainted. [Begin p.149].

The critical review and discussion of this textbook on November 30, 1956, by the Board of the Botanical Society permits me to bring to the knowledge of the Convention if not all, then at least part of the critical remarks, which were made at this conference, where over 50 persons were present, including botanists, teachers, methodists and biologists in general.

Compared to the textbook of Tetiurev, from which the school children studied botany after the year 1948, the textbook of B. V. Vsesviatskii, which now, partially has replaced the former, is undoubtedly better.

First of all this textbook, in the opinion of many, is written in a comparatively good language, understandable to school children, although one meets some unfortunate expressions. But on the whole the exposition is not bad. From the textbook were excluded many ideas of very doubtful or questionable scientific value, which, as it is known, were taught during a course of years and, unfortunately, in most cases continue to be taught in the secondary schools under the guise of latest scientific achievements. The rest of the contents of the textbook are fully up to the requirements of the program, which was approved by the Ministry of Education. For this reason the further critical remarks, with the exception of some specific author's slips and mistakes, must be addressed not alone to the author but also to the compilers of the program.

Passing over to the defects of the textbook, it is necessary, first of all, to pause on the correlation between the botanical information proper and the production material. This last one is presented in too large, immoderate amount to the detriment of acquaintance with fundamentals of botany. From among the 206 pages of the textbook over 60 pages, that is about 1/3 of its volume are filled with purely agrotechnical and plant industry problems, as for instance: cleaning of seeds, sorting the seeds, determination of the germination ability of seeds; dates for plantings, methods of planting, depth to which the seeds should be covered up; fertilizer, top dressing for plants, watering, cultivation of soil; increase of the yielding ability of plants, fertility and structure of soil; planting of grasses, crop rotation, soil tillage, implements for soil tillage, planting of shelter belts, growing wheat, corn, flax, potatoes, cabbage, apple trees; grafting apple trees with eyes, planting apple trees, nursing apple trees; raising the Bere winter Michurin's variety of pears, crossbreeding, raising Renet bergamot apple trees and others. If to these one should add that during out-of-class studies no systematic excursions into nature were provided for and that the whole work of school children at the training-experiment plot, as it was already mentioned above, consisted wholly of work bearing a purely productive character, then the overloading of the school course of botany with agrotechnical and plant cultivation problems will become quite apparent.

We all understand very well the general problems on the polytechnicalizing of the school, they do not arouse any doubt in any one. But in the given case the correlation between the fundamentals of botany proper and the production material is so unbalanced that this fact becomes a demonstration of the incorrect, distorted use of directions about polytechnicalizing the school in botany. And this basic mistake must be eliminated, since without the knowledge of fundamentals of biology a correct conception about the surrounding nature, about its diversity, wealth, and usefulness, rendered to men, is impossible. Finally, it is impossible to understand and enrich the very methods of the production activity of man, with which the requirements of polytechnicalizing are connected.

Further, one should also think that after all, in the secondary schools are trained for the future production activity not only people of the agricultural profile, but also future specialists of many other branches of our national economy. It is sufficiently clear, that in time out of our school children will be developed not alone agriculturists, tractor drivers, brigadiers, zootechnicians, leaders and workers in kolkhozes, sovkhozes and other agricultural institutions, but also workers of other profession, engineers, technicians, doctors, teachers, scientists - physicists, chemists, electricians, metallurgists, mechanical engineers, and so on.

The question arises - on what grounds do we foist on all, without exception, such hyperbolized portions of fundamentals of agricultural production? Why, say, when teaching the school children the fundamentals of mathematics are not taught some of the methods of bookkeeping or statistical computation, which, undoubtedly, with such an approach to polytechnicalizing, as it was made in regard to botany, could have been tried to explain by the requirements of polytechnicalizing?

Would this not mainly explain the fact that young men, who later on in life become participants of different branches of nonagricultural production, have a very slight idea about flora and vegetation, and very often treat them in a barbarous way. But very likely also those, who after the secondary school go to work on farming even if they have independently enriched their knowledge will, hardly, stand higher in their botanical knowledge than their comrades, who went into other branches of production.

This is the main, the most decisive defect in the status of teaching botany in secondary schools and I think, that our convention must determine its specific attitude to such an arrangement of the problem. The remaining defects, although they are numerous, are, as it seems to me, connected to a considerable degree with the first, basic defect. [Begin p.150]

Nevertheless, I would like to be understood correctly. To no extent do I repudiate the necessity of teaching the fundamentals of agriculture to school children, but not at the expense of pinching the fundamentals of botany. The production material, which is connected to agriculture, in my opinion should be offered only after the botany course and better in senior classes.

In this respect, of great value is the suggestion of the Secretary of TsK VLKSM [Central Committee of the All-Union Lenin's Young Communist League] Comrade Shelepin, which was made by him quite recently at the Session of the Supreme Soviet of the USSR, about the introduction of production specialization of students in the three last classes of the secondary school on the basis of the obtained uniform and general seven-year education.

Now, permit me please to pass over to some other specific critical instances from the botany textbook for school children.

Let us start at once with the first page - the introduction. It consists of but one page and a half, but the matter is not in its volume. If it were written in keeping with the children's understanding, if it could arouse interest, entice the student with prospects for studying botany, then the basic purpose in the given case would have been achieved. But, as it was mentioned, quite correctly, by the Board of VBO at the meeting on the critical review of the B. V. Vsesviatskii's textbook, 11-12th year age in children is the time when they are interested in Mayne Reid, when they want to become flyers, submarine captains, they dream about a romantic profession. That is why, in order to interest children in botany right from the first lesson, it is necessary to elaborate the introduction carefully. Botany material provides much for an interesting and entertaining introduction, which would throw light upon the role of plants in the development of life on earth and could disclose the manifold importance of botany. Much can be done here. But, unfortunately, the introduction is very boring in the textbook of B. V. Vsesviatskii: a definition of botany is given, then there is explained what the terms "wild growing and "cultivated" plants mean, and that from rye one makes rye flour and bakes the dark bread, and from wheat - wheat flour is made and white bread is baked; that corn is a remarkable plant, that the unplowed lands are tilled new and sown to seeds of cultivated plants, and, finally, that studying of botany will help the school children to get acquainted with the life of plants and take part in the general work of growing cultivated plants. Such an introduction is hardly capable of interesting a school child.

The first chapter "Plants in nature and in agriculture" is comprised of three paragraphs: 1) forest plants, 2) cultivated plants of the garden and vegetable patch, and 3) plant organs.

If "forest plants" in this chapter were supposed to give an idea about plants in nature in general, then this experiment has clearly failed. Firstly, the plants in nature are represented, as it is known, not alone by the forest vegetation, but also by meadow, steppe, desert, swamp, water and others. Besides this, the idea "plants" in nature surely includes not only the green, but the nongreen plants, including the microorganisms. The idea about all this was not given, and the forest plants are limited to birch and oak among trees, haselnut among bushes, and pansy and lily of the valley among grasses. In conclusion, the paragraph relating to plants in nature contains such a deduction: "There are three forms of plants: trees, bushes and grasses. Trees and bushes are perennial plants with woody stems. Grasses have thin, green grassy stalks. Grasses happen to be perennial, biennial and annual" (page 11).

You can judge yourselves how much this conclusion responds to reality, concerning the plants of the whole nature. It is clear that fixing in children's minds of such an idea, which is connected to the wealth of plant forms in nature cannot help in a valuable mastering of fundamentals of botany.

Examining the botany textbook chapter by chapter, unfortunately, one could acquaint the Convention members not just with single serious defects; but there is hardly a necessity in doing this because any botanist, even after just turning over the pages of the textbook will find there much that is unexpected.

For instance, why is it that the whole systematics is limited to the description of three families: cereals, mustard family and leguminous plants. If only cultivated plants were compared then in this case such families as rose family, the umbellate, and the lily family should have been added. Such a subject as "Development of the plant world on earth" is limited to three pages; scanty, impoverished material on biology of flowering does not lead the students to the fundamentals of Darwinism in senior classes, and so on. It is obvious, if the time, which was reserved for botany, is spent on teaching agrotechnical material, then, naturally, there is no time left for studying the fundamentals of botany.

The textbook also has several serious factual mistakes, which sharply reduces its scientific level. I shall pause on some instances.

On pages 102-103, under paragraph 39, a description is given of the process of fertilization in angiospermae. Almost every sentence of this paragraph contains one or another mistake.

The textbook does not at all give any idea about the embryo sac, neither about the contents of the embryo sac, nor about double fertilization. Passed by in silence is also the fact [Begin p.151] about the process of double fertilization - one of the most wonderful discoveries in the history of botany, which is connected with the name of S. G. Navashin.

It is likely that teacher-methodists would cite many reasons in defending the simple, practicable presentation of the process of fertilization which is none too easy to communicate to children 11-12 years old. I quite agree with them, but in the exposition of B. V. Vsesviatskii the wish to be understood was achieved at the expense of direct distortion of the fundamentals of science, and this is not permitted to anyone.

On page 9, where information is given about the cultivated plants of garden and of truck garden, it is emphasized that "fruits are especially good, which grow on apple and pear trees, which were developed by I. V. Michurin and his students". Meanwhile we all know that good fruits are produced also on varieties developed by many other selectioners - fruit-growers. Why was it necessary to write an untruth in a textbook?

On page 100, where it is spoken about cross-pollinating plants, oats is also presented as cross-pollinating, while, as it is known, oats is a typical self-pollinating plant.

On page 203, in the second paragraph of chapter 13, which is given over to "Development of the plant kingdom on earth" we read: "The most ancient organisms were unicellular. They differed from modern one-celled plants by a still simpler structure: they had a form of a lump of slime. These lumps were alive. Ancient plants originated from these primary living organisms".

It turns out then, that the first living beings, which originated on earth, had already a cellular structure. Yet we should not forget (and in his time Engels wrote about this!), that the cell proved to be a product of a long evolution. The author, of course, knows this very well but, apparently, wishing to be better understood by children, he, instead of an accurate exposition of the fundamentals of science, fell into an inadmissible vulgarisation.

On page 182, concerning the way of life of lichens, we read: "Combined existence of two organisms in one body of lichens proved to be very profitable for it. The mycelium absorbs water and mineral salts; algae form organic substance from carbon dioxide and water". Meanwhile it was ascertained a long time ago in botany, and, more over, by Russian scientists, in particular by A. A. Elenkin, that the theory of symbiosis, according to which fungi and algae in lichens are in reciprocally profitable relations, is not valid. And it was shown that the fungus parasitizes and saprophytes on alga. Why then write about lichens that which was erroneously written 30-40 years ago?

Permit me to limit myself by the cited instances, which pertain to the characteristic of the scientific level of the school textbook on botany. Unfortunately, such instances were by far not exhausted by me, and anyone who would like to satisfy himself could do it easily by reading the botany textbook page after page.

This textbook has an almost two million circulation; our children study it. After the critical remarks, made just now, it is, apparently, quite clear, that the accepted botany textbook for secondary schools must be revised as soon as possible so that no serious errors of principle and no blunder would have any place in it.

One should also think about the matter, to what extent is justified a condition when for the whole Soviet Union only one textbook on botany is officially recommended. Would it not be more expedient to have regional botany textbooks, say for republics of Central Asia, for Baltic republics, for Transcaucasia, and so on, written by qualified botany-pedogogues or by their collectives?

Such regional textbooks, obviously, should be written according to a single standard program; but in their purely botanical material these textbooks must correspond to the natural-geographic, floristic, geobotanical and other peculiarities of those regions for which they are destined.

Besides that, in order to increase the quality of the school course of botany when compiling new botany textbooks one should free them from any casual, new ideas. The textbook must be based on strictly tested, established data of botanical science and, at the same time, must be adapted in every way to the children's age, to children's psychology; it must arouse in our growing generation an interest in flora, vegetation, and in nature in general. In connection with this one should acknowledge, that the practice, used by the Ministry of Education, for compiling and approval of projects of programs and authors' manuscripts on botany textbooks is defective, because only a very narrow and closed circle of people, unfortunately not always sufficiently competent, are concerned with this question. This practice, by no means, helps in removing those big defects in the teaching of botany in school, which were uncovered by the botanical society. It is necessary to continue the efforts, begun by the Botanical Society, on helping with cardinal improvement of botany teaching in secondary schools and to attain the elimination of all the defects in this work.

That is why, it seems to me, VBO cannot and should not limit its participation in this very important matter to only critical remarks, which pertain to school programs, textbooks and requests addressed to the Ministry of Education and to other organisations, that supervise the school education. Many members of the Society, [Begin p.152] in accordance with their specialty and personal aptitude, could take direct part in the development of school programs and in the compiling of textbooks and manuals, write in the pedagogical press, in particular, on pages of the journal "Natural Science in School", which was renamed lately to "Biology in School"; write popular botanical articles, stories, books for children and do many other useful deeds for the uplift of the quality of studies of fundamentals of botany in school and out of it.

Unfortunately, during the last 2-3 decades our leading botanists have almost not taken any part in such a popular scientific-methodical journal for biology-teachers as the "Biology in School". But it was comparatively recently only that such outstanding scientists biologists wrote in the press, appeared at conferences and meetings on various scientific-methodical problems as: A. A. Elenkin, V. L. Komarov, V. N. Lubimenko, N. A. Maksimov, N. A. Monteverde, V. I. Palladin, I. I. Polianskii, V. I. Taliev, K. A. Timiriazev, V. M. Shimkevich, and among those in good health now P. A. Baranov, M. M. Gellerbakh, Iu. I. Polianskii, V. I. Polianskii, B. E. Raikov, V. N. Sukachev, and others. The Botanical Society must considerably accelerate its activity in this respect. On the other hand the proper editorial offices of scientific-pedagogical, methodical and other popular journals on the subjects of biology must, at last, go to meet the wishes of the society, and invite to take part in their journals, besides the selected narrow circle of staff authors, also the most worthy biological scientists, in particular botanical-scientists, including also the members of VBO. In any case, the Botanical

Society, on its part, must, in every way possible, encourage and stimulate this part of the activity of its members.

The publishing of popular books and journals will be of exclusively great importance for the propaganda of botanical science. This is, of course, indisputable. Many of those present, probably, remember yet to the present time, what a lasting impression was produced on them during the children's years the reading of the masterfully written books, although containing some mistakes, of D. N. Knigorodov, N. A. Kholodkovskii, N. D. Skalozubov, S. P. Arzhanov, K. K. Serebriakov, B. E. Vasil'kovskii, I. I. Polianskii, A. V. Tsinger, and others. Of course, now too books are published for reading on botany, but there are very few of them and they appear on the book market only rarely. There almost are no books about the organization and conducting of independent excursions for school-children to the forest, swamp, meadow, steppe, tree nurseries, botanical gardens, museums, and so on. There are no portable, richly illustrated pocket botanical guide books, or many other things.

Yet, look what convenient, attractive, well illustrated, rich in color, botanical publications for school children are published by our friends in the German Democratic Republic, Czechoslovakia, and in other countries. We have a great demand for good botanical popular books.

Therefore there is no wonder, that as soon as a good book is published, it cannot be found: the whole edition is immediately sold out. Try, for instance, to buy popular-scientific or scientific-art books on botany, which were published last year, such as books by N. M. Verzitin, A. V. Kozhevnikov, V. M. Korsunskaia, V. D. Aleksandrova, reissued books by I. I. Polianskii, A. V. Tsinger, and you will not be able to find them. The demand for a good, scientifically reliable popular botanical book for children is great, and it would be regrettable if our Botanical Society would not pay any attention to it and would not increase its activity in this direction.

Permit me now to concisely sum up those basic thoughts, which I consider as certain suggestions, which follow from the just completed report.

Firstly, one should apply to the Ministry of Education with a request about an immediate and basic revision of the existing program on botany for secondary schools with a direct participation in this responsible work of representatives of the Botanical Society, as well as with the following wide discussion by the botanical society of the new project of the program.

Secondly, one should bring to the attention of the Ministry of Education that the present textbook on botany for the secondary school does not correspond to its purpose in many respects; it must be immediately revised and can be permitted for the use of secondary schools only temporarily, until a new textbook on botany will be compiled on the basis of the newly revised program. One should also suggest that the textbooks on botany must give a well written, interestingly presented, absolutely scientifically proven complex of fundamental information in sections, taking into consideration the age peculiarities of the students.

Thirdly, the out-of-school lessons of the school children must not be concentrated only on the work at the training-experiment section, but to a considerable extent on studies of natural flora, vegetation, on becoming acquainted with plantings of parks, botanical gardens and hothouses. One should widely encourage the work of associations of young naturalists in this respect. During the lessons proper a necessary amount of time must be set aside for excursions into nature and not to be limited only [Begin p.153] to the production objects, as it is practiced now at best.

Fourthly, one should bring to the most serious attention of the agencies of public education the completely unsatisfactory status of teaching of fundamentals of Darwinism in secondary schools, where the biological education is being completed for the greater mass of Soviet youth and which is of great importance for the formation of their world outlook.

Fifthly, it is necessary to revise the organizational forms of work in the Botanical Society proper, which would permit to considerably increase the activity of members of the Society not only in regard to the public control of the course and status of teaching of botany in secondary schools, but also concerning the propaganda of botanical science among school children by means of organising active help to publishing houses Detgiz [State Children's Literature Publishing House], Molodaia Gvardiia [Young Guards], to the Publishing House of the Academy of Science of USSR, Sel'khozgiz, and others in the business of a considerable increase in issuing pertinent scientific-popular botanical literature, as well as by means of organisation of reading of popular lectures for school children, youth and the adult population.

For the start such an activity in the Botanical Society could be centered in the already existing, permanent Commission of the critical review of textbooks and school equipment, but in the future there must be organized a special, say, School Commission of VBO.

For the conclusion of the report I shall take the liberty to appeal to all the delegates of the Convention, to all the members of the Botanical Society, to all those present with a request to express their attitude to the report given by me and to introduce any suggestions, which are directed to the increase of quality, to the improvement of the contents of teaching of botany in the secondary schools, as well as to the intensification of the activity of the Society in the business of popularization of botanical science, especially among the young people.

For the Conference's resolution on Bakhteev's report, see Trans. A-991

(In full)
VS/M

Resolution on the report of F. Kh. Bakhteev
"On the status of teaching botany in secondary schools".

(Approved at the Plenary Session of the Second Delegates Conference of the Botanical Society of the USSR [VBO] on May 17, 1957).

Bot. Zhur. [Moskva], vol. 43, no. 1, p.153-155.
Jan. 1958. 451 R923.

(In Russian)

The All-Union Delegates Conference of the Botanical Society, having heard and discussed the report "On the status of teaching botany in secondary schools" [Trans. A-990], considered its bringing to the attention of the Conference quite welltimed; this was confirmed by the active and lively discussion of it by the participants of the Conference.

The basic aspects of the report, which characterise the unsatisfactory status of teaching botany in secondary schools, namely, non-correspondence of the program and of textbooks on botany for the school to the basic requirements of correct training of the future builders of communism, who should possess solid dialectic-materialistic world outlook and the purely conventional accomplishment of polytechnicalizing the school, are considered sufficiently proved and have found full support from the Conference.

In conformity with this, the Conference resolved:

1. To recognize as necessary an immediate radical revision of the existing program for botany for secondary schools, reestablishment of teaching there of fundamentals of botany (morphology, systematics, anatomy and physiology of plants), which were substituted, to a considerable degree, by agrotechnical material, with a direct participation in this work of representatives of the Botanical Society and with the following wide discussion of

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the new project of the program by the pedagogic and botanical community.

2. To mention that neither the newly published textbook on botany by B. V. Vsesviatskii, nor, the more so, the textbook by V. A. Tetiurov for the secondary school in many respects do not answer their purpose. Among them, only the textbook of B. V. Vsesviatskii, after its proper revision, can be temporarily, until the compiling of new textbooks, permitted as a manual for the secondary school.

Textbooks on botany must present a well written, interestingly conveyed, and absolutely scientifically proved complex of information on the stated divisions of botany, taking into consideration the age peculiarities of the school children.

3. To uphold the suggestion about the centering of teaching of fundamentals of agriculture in the senior (8-10th) classes of the secondary school, in which a specialization should be organized for the purpose of preparing the students for their future practical activities. [Begin p.154]

Such a solution of the problem will provide a real polytechnicalizing of our school as regards the teaching of botany which proves to be a required basis for understanding the processes of agricultural production, as well as for the perception of natural flora and vegetation.

4. The Conference of Delegates of the Botanical Society considers it expedient, in conformity with peculiarities of natural-geographic conditions of various parts of the Soviet Union, to have not one, but several textbooks for botany in secondary schools. For instance, such textbooks could be published, besides the European part of the RSFSR, for Siberia, as well as for Ukraine, Belorussia and Baltic Soviet republics, Caucasus, Transcaucasus, Central Asia and others. For the compiling of such textbooks the most prominent botany-pedagogues and botanical-scientists of the cor-

responding geographical zones should be engaged first and foremost.

5. Out-of-school studies of the school children must be centered not alone at the training-experimental plot, but, to a considerable degree, on studies of natural flora, vegetation, on the acquaintanse with the planting of parks, botanical gardens, hothouses, and so on. In this respect, one should encourage the activity of societies of young naturalists. More attention should be given during the school studies to excursions into nature, which matter should be reflected in the school plans. Particularly, to utilize the time of the sojourn of the students in the pioneer-camps for their acquaintance with the natural vegetation and flora; for this purpose to request the TsK VLKSM [Central Committee of the All-Union Lenin's Young Communist League] and the Ministry of Education to send qualified - botany-teachers and biologists to pioneer-camps.

6. To draw the most serious attention of the agencies of public education to the fully unsatisfactory status of teaching of fundamentals of Darwinism in secondary schools, where the biological education is being completed for the greater mass of Soviet youth and which is of great importance for the formation of their world outlook. To consider erroneous the reduction of the course of fundamentals of Darwinism to 1 hour per week instead of 2 hours.

7. To intensify the activity of the Botanical Society on popularization of botanical knowledge among school children and students by means of encouragement of efforts of members of VBO [All-Union Botanical Society] in publishing for the school botanical keys and botanical atlases, popular-scientific, scientific-artistic botanical books and by other menas; in every way to assist in the intensification of the publishing activity in the cited direction of Detgiz [State Children's Literature Publishing House],

"Molodaia Gvardiia" [Young Guards], the Publishing House of the Academy of Science of USSR, of Uchpedgis [State Training and Pedagogical Literature Publishing House], Sel'khozgiz and other publishing houses.

8. In every way to widen and intensify the activity of the Society, which is directed to the improvement of teaching botany in the secondary school, to the popularization of botanical knowledge, protection of green plantings and nature. To recommend to the Presidium and the Council of VBO to discuss and solve specific organizational forms for the intensification of this work, taking into consideration the suggestions, made at the Conference, about the formation of a special school or pedagogic section in VBO for the purpose of extensive attraction of biology-teachers to its work.

9. To have the report and materials of the Conference on the status of teaching botany in secondary schools extensively published not alone in the publications of the central organization of the VBO, but also, if possible, in publications of its branches and sections, as well as in the central newspapers.

To especially appeal, in the name of the Conference, to editorial offices of pedagogic publications, in particular to the journal "Biology in School", about the full publication of the report and of all the materials of the Conference, which are connected with its discussion, on the pages of this journal.

10. In order to attain the most effective realization of the resolutions of the Conference about the problem in question, to commission the Presidium and the Council of VBO to form, in the immediate future, and direct an authoritative delegation from among the members, competent in this respect, to the Central Committee of the Communist Party of the Soviet Union and to TsK VLKSM, as well as to the Ministry of Education of RSFSR.

EDITORIAL (pages 154-155)

According to the report of F. Kh. Bakhteev during the session of the Conference lively discussions developed in which 15 persons took part. The greater part of the speakers (P. A. Baranov, N. M. Versilin, V. M. Korsunskaia, N. S. Kamyshev, V. V. Sakharov, G. G. Bosse, L. A. Utkin, A. G. Giller, Tkachenko, V. N. Beliaeva, A. K. Efeikin and A. A. Semenova-Tian-Shanskaia) upheld the basic aspects of the report. They were opposed only by the chief editor of the journal "Biology in School" V. M. Fedorova, by the author of the textbook "Botany", B. V. Vsesviatskii, and, partly, by V. Chukreev.

The resolutions of the Conference on this question were included into the previously printed general resolution, which was unanimously adapted on May 17, 1957 and which was by the Bureau of the Section of Biological Sciences of the Academy of Science on September 5, 1957. (See "Botanical Journal", vol. 42, no. 11, 1957, p.1727-1734).

On the pages of the "Botanical Journal" the status of the teaching of botany and of Darwinism in the secondary school has been elucidated upon many times. Nevertheless, the agencies of public education did not react to criticism, coming from the scientific society. [Begin p.155].

Unfortunately, the new textbook on Darwinism for the secondary school, which was compiled by E. A. Veselov, cannot, by any means, be recognized as satisfactory, it repeats the mistakes of past textbooks, which were already previously critisized in print(1).

(1) On December 27, 1957, a discussion took place about the textbook of E. A. Veselov at a joint session of the Committee on critical revision of textbooks and of school equipment of the VBO, of the Leningrad Society of Naturalists and of the Chair of Biology of the Leningrad Municipal Institute for the Improvement of Teachers. The materials of discussion will be published in the "Botanical Journal".

Attaching great importance to the questions which were touched upon in the report of F. Kh. Bakhteev, the Editor's office publishes it and expresses hope that now at last the Ministry of Education of RSFSR will settle this question, which troubles our whole scientific society.

(In full)

Information requested of all geneticists of USSR.

Zhurnal Obshchei Biologii, vol. 19, no. 4, p.[312].
1958, 442.8 Z6.

(In Russian)

The International Union of Biological Sciences is preparing a list of all the geneticists of the world.

The National Committee of Soviet Biologists, entering into this work, requests all geneticists in USSR to send in the following information concerning themselves; this information will be later on included into the International list of geneticists.

We ask you to send this information on an ordinary post card arranging it as follows;

1. Family name, name and patronymic. (If there are works, published in foreign languages, indicate, in brackets, the accepted Latin transcription of the surname and of the initials).

2. Learned degree and rank.

3. Year of birth.

4. Place of work (in full) and the position occupied.

5. Business address.

6. Scientific specialty (problems which interest you especially).

In order to avoid mistakes, it is requested that this information be typed or written very legibly (please, write the surname in printed letters).

Please send the information to: Moskva, K-9, Mokhovaia ul. (street) no. 9. Moscow Society of Naturalists, Genetics Section.

It is requested that the post cards be registered.

Presidium of the National Committe
of Soviet Biologists.

Trans. A-950
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VE/A

Timofeev-Resovskii, N. V.

Mikroevoliutsiia. Elementarnye iavleniia, materialy i faktory mikroevoliutsionnogo protsessa[1].

[Microevolution. Elementary phenomena, material and factors of the microevolutionary process[1]].

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(In Russian)

INTRODUCTION

1. The classical methods of the study of evolution amount to a comparative treatment of the morphological, physiological, embryological, biogeographical and paleontological material; to an analysis of the results obtained from the viewpoint of some general principles; and to the establishment of fundamentally important phenomena, regularities and means of evolutionary processes. This tendency may be called "macroevolutionary". Macroevolution amounts to the "major" phenomena and processes occurring on large areas in the course of extensive (geological) divisions [otrezkov] of time and concerning chiefly the higher systematic categories. Along these

1 On the basis of reports read at the cybernetics seminar of the Mechanico-Mathematical Faculty, Moscow State University [MGU] and at the seminar on evolutionary problems in the Biological Institute [BIN], Academy of Sciences USSR, in February of 1957. Received [for publication] Oct. 27, 1957. [Inscribed to]: Sergei Sergeevich Chetverikov, dear teacher and friend.

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lines have been described the basic phenomena of phylogenetic differentiation (with the formation of the natural, phylogenetic general system of organisms), evolutionary adaptations and ontogenetic differentiations (of the evolutionary process).

2. At the present time these classical methods are inadequate for the study of the evolutionary process. In the first place, they have to a considerable extent been exhausted: the principal stages, phenomena and phenomenological regularities of macroevolution have been described in general outline, and for the time being work remains to be done on details and on minor changes in the existing schemes. In the second place, and most important, the classical methods used in macroevolutionary study are purely phenomenological and, hence, do not permit resolving singularly [odnoznachno] the problem concerning the real mechanisms of the evolutionary process and the paths [na putiakh] over which the formation of evolutionary phenomena occurs. Many evolutionists, having forgotten the limits of phenomenological methods and also the possibility of the extensive use of the principle of natural selection discovered by Darwin, often pronounce categorical judgment concerning "mechanisms" of the evolutionary process that they have accepted, but that have never been substantiated; this leads to the development of evolutionary "theories" that in essence do not belong in the methodology of natural history. The latter was aggravated by a long gap existing between the specific course of evolutionary biology and the development of present-day genetics. By means of countless genetic and cytogenetic experiments [Begin p.318] and accurate quantitative treatment of their results, genetics has clarified the basic features of genotype structure, the mechanism of hereditary characters and the nature of variation. Yet, many geneticists were scarcely, or only superficially interested in essential evolutionary problems. For the

last decade, however, an intensive unification of classical evolutionary biology and experimental and theoretical genetics has taken place.

An especially important stage in the course of the creation of a new trend in the study of evolutionary processes was the appearance of S. S. Chetverikov's classical work [entitled] "About some moments of the evolutionary process from the viewpoint of contemporary genetics" (1926).

At the close of the 20-ties there began to develop a new trend in the study of evolutionary mechanisms that was based on an experimental and theoretical analysis of genetic phenomena occurring in populations that underlie the formation of the lower systematic categories and species. This trend can be called "microevolutionary". Microevolution amounts to "minor" phenomena and processess occurring on relatively small areas and in comparatively short segments of time leading to the formation of elementary evolutionary phenomena and to the formation of lower taxonomic units, and, hence, is conducive to a direct and accurate experimental and theoretical analysis.

3. The theoretical analysis of microevolutionary phenomena must be based on the sum total of our contemporary, explicit knowledge of hereditary and variation phenomena and make use of precise definitions and accurate mathematical methods for analysis and for the establishment of ultimate conditions for the systems under study. In this sense the study of microevolution is of special interest also to mathematicians who in their analysis require the use of contemporary methods of mathematical logic, theory of probability and mathematical statistics; the fundamental principles of such mathematical analysis of microevolutionary phenomena were laid in the works of S. S. Chetverikov (1915, 1926), V. Volterra (1931), G. F. Gause (1934), A. N. Kolmogorova (1935), V. Ludwig (1933, 1939, 1940, 1943),

K. Patau, (1939), S. Wright, (1931, 1932, 1935, 1938, 1940), R. A. Fisher (1932, 1936, 1939) and Haldane (1924-1934, 1932, 1936, 1939). Apart from this, however, accurate concepts of the evolutionary mechanisms and of the structure of evolving [evoliuiruiushchikh] systems can, as types of the governing systems of a higher order, be of interest to cybernatics. In connection with the above, in the present brief report an attempt is being made from the biological point of view, to give a sufficiently accurate definition and formulation of the basic concepts with which one must operate in making a study of microevolutionary processes. A definition and brief description of elementary phenomena, evolutionary material and factors which must be taken into consideration in any serious discussion of the course of evolutionary processes will be given in a further statement.

Definition of concepts of the evolutionary process and elementary evolutionary phenomena

4. C. Darwin demonstrated that at the foundation of a grandiose, directed and regular evolutionary process of living organisms on our planet lie statistical, non-directional and "fortuitous" variation phenomena; under the influence of the principles of the struggle for existence and natural selection which he discovered, a fortuitous and nondirectional variation [Begin p.519] is directed into a definite channel of the evolutionary process that occurs on Earth (Darwin, 1895).

Hence, in evolutionary discussions and in plotting [postroenie] of evolutionary schemes, elementary errors in mixing of plans must not be permitted: [to wit] in proceeding from the nondirectivity of elementary variation processes and from a series of evolutionary mechanisms, to forget about the general directivity and regularity of the evolutionary process as a whole or, even worse, to impart direction and regularity discerned in the course of the evolutionary process into discussions of all elementary phenomena and mechanisms of evolution. As in a study of the role played by microphysical phenomena in biology, the macrophysical objects in which they proceed must not be forgotten (Timofeev-Resovskii and Rompe, 1958), so in making a study of evolution and, in particular, of the elementary phenomena and processes that underlie it; two plans must not be forgotten: the quantitative-statistical elementary phenomena and mechanisms on the one hand, and the historically directed macroevolutionary process on the other hand. Hence, first of all, it is essential to define the macroevolutionary process.

5. In the briefest possible formulation, the fundamental characteristics of the macroevolutionary process can be defined as follows: on our planet we call evolution the historical change occurring in living organisms that is characterized by the process of phylogenetic differentiation, evolutionary adaptation and ontogenetic differentiation upon which evolutionary progress is based. A description of the individual stages, special phenomena, and also of the trend and the phenomenological regularities of the entire process as a whole comprise the subject of macroevolutionary investigations. However, a creative study of evolutionary mechanisms requires, first of all, that an attempt be made to elucidate what type of elementary phenomena underlie the evolutionary process, or, which amounts to the same, to establish necessarily what phenomenon comprises the prerequisite essential to the occurrance of the evolutionary process. Such an essential prerequisite also will be the "elementary evolutionary phenomenon".

6. Before an exact definition of the concept of an elementary evolutionary phenomenon is formulated, it is necessary to remember the fundamental

characteristics of the actual existence of living organisms on Earth. The most characteristic and interesting feature of life on Earth is its quantum state, or discontinuity of forms. On our planet all living organisms are actually represented by species, i.e. by discrete morphophysiological groups of individuals and geographo-ecological forms possessing general characteristics and a definite realm of distribution, potentially capable of crossing with each other and of intermingling, yet under natural conditions completely, or almost completely biologically isolated from other similar groups.

The morphophysiological meaning of the conception of species can be very different in various large, taxonomic subdivisions of living organisms. All species are united in a taxonomic-hierarchic system of higher categories reflecting various stages of phylogenetic differentiation. Further on the great evolutionary importance of the formation of species will be emphasized as the most essential phase in the process of the evolution of organisms and of their adaptation of a biosphere. The formation of species is, however, a complex and conclusive level of microevolution and, therefore, the formation of a new species cannot be regarded as an elementary evolutionary phenomenon. All species of living organisms occupy on the Earth's surface specific areas, but the individuals of any species are never distributed evenly within the boundaries of their realm. In some species (in most of them) the individuals [Begin p.520] form separate, territorially dissociated groups of various sizes; in others, with a more or less continually populated area, the population density is never uniform, there develop individual areas of concentration of individuals that are divided by considerably less densely populated areas. Such individual, territorially separated groups or concentrations of individuals among which a more or less sudden crossing and intermingling actually occur (i.e. panmixia is really accomplished to a certain degree) are called populations. Populations are the lowest and the elementary form of group existence of the individuals of each species; the sum total of the individual populations and the areas which they occupy form the general biomass and the realm of species distribution. Thus, populations are elementary groups of the historical existence of the individuals of a species in nature. Each population (with the exception of specific cases in which the population was formed by one clon or one pure line) is very heterogenious as regards its genetic composition because it consists of a mixture of different genotypes; in addition, the different populations within the limits of a species always, to some degree or other, differ statistically from each other as regards their genotypic composition.

7. Proceeding from the above statement, an elementary evolutionary phenomenon, without which the course of the evolutionary process is unthinkable, can be defined as follows. We call a more or less long-range alteration in the genotypic composition of an individual population within the limits of a species the elementary evolutionary phenomenon. Such definition satisfies two fundamental conditions: it is scarcely possible that on the basis of the sum total of our present knowledge a more elementary evolutionary phenomenon could be found and, on the other hand, it is impossible to imagine an evolutionary process not connected with changes occurring in the genotypic composition of a population. To realize an elementary evolutionary phenomenon, it is essential to have material in the form of hereditary variation and to have factors under the influence of which changes in the genotypic composition of a population are produced. We shall consider below the individual problems concerning elementary evolutionary material and elementary evolutionary factors.

Elementary Evolutionary Material

8. C Darwin believed quite correctly that the material, bricks of a kind, that are used in constructing the evolutionary process, are hereditary variations emerging constantly and always present in all populations of living organisms. But in his time practically nothing was known of the nature and the elementary units of hereditary variation. At present, experimental genetics has accumulated a great deal of material on hereditary variation for a whole series of species of animals, plants and microorganisms. We know that elementary units of hereditary variation are mutations that emerge discretely and singly, and after their emergence are inherited in accordance with the well investigated mechanism of the transmission of inherited elementary characters. We know also the nature of mutations that can be subdivided into three basic types: a) gene mutations, i.e. changes occurring in the structure of a specific individual gene, b) chromosome mutations, i.e. changes occurring in the structure of one or several chromosomes based on original ruptures or breaking of chromosomes and not necessarily accompanied by changes in any individual genes, and c) genome mutations, i.e. changes in the number of one, several (heteroploidy), or all (polyploidy) chromosomes of a specific selection. [Begin p.521]

Even though there is relatively little probability in each individual mutative act, in view of the large number of genes and of the capacity of breaking intergenic connections within the genotype of each species, the total number of mutations emerging in the gametes of one generation is relatively large in all species of living organisms, numbering from single percentages up to a couple of tens of percentages containing some kind of gamete mutation per generation. Such mutative process occurs in all living organisms, spontaneously, i.e. without any specific experimental influences from without; under the influence of some chemical and physical factors, particularly ionizing radiation, the percentage of the emerging mutations can be notably increased. Besides these mutations which are a resultant of chromosomes found in cell nuclei and of the genes located within them, we know of only one more type of hereditary change - the so-called plastid mutations in green plants; plastids having in a considerable measure autonomy and developing independently by means of extranuclear formation can, similar to genes, endure structural alterations that are transmitted further through inheritance to a chain of progeny of the changed plastid. Any other type of extranuclear, long-term hereditary changes or real non-Mendelian heredity have not as yet been established with any certainly, regardless of a huge amount of experimental material (perhaps, with the exception of a few individual interesting cases of cytoplasmic virus transmission). Some cases of cytoplasmic inheritance of a series of properties observed in distant hybridization upon exact and long analysis carried out by the method of crossing were, found to be a resultant of temporary disharmony between a genotype and cytoplasm that were alien to each other; in the course of time the disharmony was eliminated as a result of changes occurring in the cytoplasm under the influence of a genotype that was new to it.

From the above statements it follows that the well known mutative process is, if not the only one, then in any case the principal one, quantitatively absolutely dominant source of elementary hereditary changes (Dobrzhanskii, 1937; Möller [Müller], 1929, 1940; Melchers, 1939; Morgan, 1932; Timofeev-Resovskii, 1937, 1940, 1943; Schwanitz, 1943; Stubbe, 1937, 1938).

9. Elementary hereditary changes must serve as elementary evolutionary material. Such changes, as has been said above, are mutations. Consequently,

we must recognise that, the mutations well known to us are elementary evolutionary material.

Certain demands must be made of the sum total of elementary evolutionary material that it must satisfy. These demands include the following: a) evolutionary material must include variations of any characteristics of a given species of organisms emerging in different directions and with various degree of pronounced deviations from the original type; b) variants must, at least in part, have positive or negative selection value, i.e. they must influence such general biological properties of organisms as relative viability under specific conditions, potential reproduction, sexual selection and biological isolation etc.; c) variations must occur under natural conditions and, consequently, must be contained in various concentrations in natural populations of organisms; d) differences between historically arranged lower taxonomic units must be reduced to various combinations of the same variations, while some of the latter must come out upon an independent evolutionary arena having occupied a specific area. [Begin p.322].

If it were taken into consideration that elementary evolutionary material is represented practically in its entirety by various types of mutations which we know from experimental genetics, then the demands listed above should be made of the latter. Further we shall consider the extent to which the mutative process satisfies these demands.

10. A large quantity of mutations found and studied in various species of animals, plants and microorganisms has demonstrated that the latter could affect any morphological,physiological and chemical characteristics that generally are present and vary in a given species. Besides, mutation characteristics could deviate very strongly from the original type and cause clearly pathological conditions (often lethal for homozygotes), or

properties characteristic of supra-specific differences, as well as scarcely notable, frequently discernible only with the aid of special methods, quantitative deviations from the original type. They, consequently, satisfy fully the first demand. It was demonstrated in a whole series of special investigations that various mutations can to a noticeable degree exert influence upon a relative viability (in a homozygous state more often decreasing it, and in a heterozygous state increasing it), upon productivity and upon any other general biological property in organisms; at the same time, their action may vary under different external conditions and in combination with various other mutations. This explains the possibility of carrying out selection for the purpose of increasing or decreasing the degree of profoundness of any characteristics or combinations in cultural plants under conditions of artificial selection. Thus, mutations satisfy the second of the above-mentioned requirements as well.

Two more general properties of the mutative process found in all living organisms must be emphasized. The first one of these is that the majority of mutations occurring in a homozygous state decreases viability, or produces even a lethal effect; this is not surprising, since in a harmoniuous system of any organism, well arranged by natural selection, sudden changes tend sooner to decrease than to increase its property. This, however, by no means deprives the sum total of mutations of the possibility of representing material for the evolutionary process, but merely decreases the percentage of mutations that could have been caught up by the flow of natural selection. The second one, a specially important property of the mutative process found in all organism is contained in its "suddenness", or, in C. Darwin's terminology, "indeterminism". Mutations cause deviations from the original type in any character, in various degrees and in any direction without showing any "orthogenicity" or purposeful directivity; nor does hereditary variation possess any characters of "adequate relations with environment", despite the fact that, as mentioned above, some chemical and physical factors are capable of influencing quantitatively the percentage of emerging mutations, sometimes even selectively.

11. At the beginning of the current century, some biologists advanced an argument against the evolutionary importance of mutations to the effect that mutations really are the artificial product of domestication and laboratory conditions, and that they play no role whatever under natural conditions; even their emergence and presence in natural populations became a subject of doubt. With the development of genetics and the experimental use of an increasing number of natural, wild species and forms of animals and plants, data multiplied on the high degree of the heterozygous nature of individuals from natural populations on a whole series of mutations known from laboratory experiments. Since the middle 20-ties, as a result of the classical work by S. S. Chetverikov (1926) mentioned earlier, special investigations have been conducted (by the method of inbreeding of a large number of individual specimens from natural populations) first with Drosophila and then with a series of other objects [Begin p.323] [for the purpose of] determining the genetic composition and the degree of heterozygosity of natural populations by the different mutations. It soon became clear that all natural populations contained the most varied mutations in different concentrations, in most cases low ones; In species gentically well investigated, most of these mutations were already known due to their emergence in the laboratory or in field experiments.

At present, the analysis of the genetic composition of the different natural populations under various conditions and at different times - in relation to their size, territorial dissociation, physico-geographical and ecological conditions - comprises a special genetics division - population genetics. Population-genetic experiments accompanied by an exact mathematical analysis of border-line conditions of population-dynamics systems are a very important part of the work involved in the study of microevolutionary processes. At present, in any case, there is no doubt whatever that the mutative process takes place in nature the same as in a laboratory and that all, especially amphimiotic [amfimiktichoskie], populations contain a large number of the most diverse mutations. This demonstrates that mutations meet fully the third demand made of evolutionary material (variations must arise under natural conditions - page 321, point "c").

12. During the last half-century, for the purpose of genetic analysis, very many crossings were carried out between different natural forms, subspecies and even species of a series of animals and plants; in some cases (mice, gypsy moth, Epilachna [genus of ladybugs (?)], snapdragon [Antirrhinum], tricolor violet, thorn apple and others) a detailed monographic analysis of the genetic nature of the entire subspecies, and the geographical variation within the limits of a certain species was conducted by entire laboratories or groups of investigators. In all cases in which a sufficiently careful genetic analysis was conducted, it was clarified that among all natural intraspecific forms and related species, i.e. in all cases in which a genetic analysis could be conducted by the method of crossing, the genetic differences between various forms were reduced to combinations of known types of gene, chromosome and genome mutations. It is true that in most cases the external phenotypic differences between various natural forms proved to be of a polyhybrid nature based on the differences found in a few or even in many genes, which rendered the experimental analysis somewhat difficult; in some

cases the analysis is also complicated by the presence, in various forms, of different chromosome or even genome (in plants) mutations. But, in any case, an exact analysis failed to disclose any differences not connected with combinations of types of mutations known to us; this demonstrates that mutations actually take part and, obviously, serve as the only material in the process of natural evolutionary differentiation. Finally, in some cases (although vast material on natural variation of organisms has not yet been sufficiently studied) it has been possible under natural conditions to disclose distribution of specific mutations in high concentrations in one or in several mixed populations; these cases demonstrate that even individual mutations may serve as a basis for the formation of subspecies differences in nature. Consequently, mutations meet also the fourth and last demand made of elementary evolutionary material (some variations must come out upon an independent evolutionary arena - p1521, point "d").

13. Thus, the results of a large number of various genetic experiments have demonstrated that mutations satisfy all demands that can be made of evolutionary material. Consequently, we are able to assert that elementary evolutionary material [Begin p.324] is represented in all species of living organisms by mutations which we know by their nature and properties. Besides, these mutations emerge without being directed and without environmental adequacy, i.e. they are "indeterminate variations" in the classical Darwin sense; they are capable of exerting influence in various degrees and in various directions upon the most varied characters and properties of organisms, including such as relative viability and fertility, potentials for crossing with other forms, etc. The mutative process occurs spontaneously in all organisms under natural conditions, mutations in various concentrations are prevalent in all natural populations and they take part in the historical evolutionary

process in serving as material for the emergence of subspecies and species groups.

Elementary Factors of Evolution

14. In the preceding paragraphs it was demonstrated that mutations meet all demands that must be made of elementary evolutionary material, and represent the only known type of elementary, hereditary changes occurring in all living organisms and, hence, serve as elementary material for the evolutionary process occurring in living organisms on Earth. However, in order to render evolutionary material conducive to the formation of elementary evolutionary phenomena and, later, also the evolutionary process, it is necessary that action of a series of factors be exerted upon this material.

Proceeding from the sum total of our knowledge of the nature of heredity and variation, of the structure of natural populations and of their dynamics, we pick four elementary evolutionary factors: a) the mutation process (namely, the process, and not the emergence of mutations which serve as evolutionary material), b) population waves, or "waves of life", c) isolation and d) natural selection. The degree of action of all of these factors varies and, theoretically, can be expressed quantitatively. The quantitative aspect of the action of evolutionary factors we shall henceforth, for the sake of brevity, call "pressure" of one factor or another. The elementary evolutionary factors listed above will be described separately below, and each of them will be assigned a relative position within the general system of influences exerted upon the formation of the evolutionary process.

15. The mutation process. The mutations arising in all living organisms are, as indicated above, elementary evolutionary material. But their emer-

genes, a timeless, spontaneously occurring mutation process is, as such, naturally, a constantly active evolutionary factor that produces genotype alterations. In relation to its own intensity, i.e. to the total percentage of arising mutations per generation of the given organisms, it possesses one or another type of specific pressure upon the population. Various Lamarckian and orthogenetic evolutionary statements, when their nebulous ideas are translated into a more specific and clear genetics language, indicate that [the opinions voiced] in these statements attribute the exclusive, or, at any rate, the leading role of the fundamental factor, determining the trend and character of the evolutionary process, to the mutation process.

Proceeding from the general properties of the evolutionary process described in the preceding chapter, we shall try to determine the real position of the mutation process among evolutionary factors. The decisive characteristics of the mutation process are its two fundamental characters: its non-directivity and relatively low pressure. It was said above that mutations are "indeterminate variations" [Begin p.325] in the classical Darwin sense. Because of this characteristic alone, the mutation process cannot be a directive factor governing the general properties and regularities of the evolutionary process; if the mutation process were to be such, then the emergence of mutations would have to be directed, teleological, adequate to environment, adaptive and in accord with the trend of the evolutionary progress, which would require an entirely unthinkable reversible relation from the following generations to the preceding ones. Apart from this, the second of its basic characters also contradicts such role of the mutation process: the pressure of the mutation process is too low and usually is superseded [perekryvaetsia] by the pressures of other factors. This, in turn, is connected with a certain average or model [modal'nyi] degree of the stability of genetic structures required for the occurrence of an orderly and regular evolutionary process. Such a process would have been impossible in the absence of sufficient stability of the genotypes and during their adequate variation, and the whole picture of life on Earth would have been a different one: instead of an orderly system of forms reflecting the stages of phylogenesis, adaptation and evolutionary progress, the living stratum of Earth would have represented a poorly differentiated jelly.

In the case of adequate reactions of the mutation process to environment and high lability of genotypes, not even a sufficient evolutionary tempo could have been realized; with considerable fluctuations in the habitat, changes in organisms on Earth would have amounted chiefly to fluctuating treading at the [same] place. The general, relatively high, model [modal'nyi] degree of the stability of genotypes, as well as of a series of other properties of the mutation process have definitely been regulated by the action of some sort of stabilizing selection (Shmal'gausen, 1946) constantly active since the beginning of the evolutionary process on Earth. Naturally, a series of individual physical and chemical factors, as indicated earlier, are, obviously, capably of selectively influencing to a certain degree the mutation process. Apart from this, as a result of the evolutionary changes occurring in species, the structure and variation of genotypes also undergo changes (Berg and Timofeev-Resovskii, 1958). In connection with the changes occurring in the structure of genotypes and in the character of ontogenetic differentiation, there may arise various types of genomes, genetic and phenotypic "masking" and "unmaskings" of a portion of mutations leading to corresponding changes and displacement in the manifestation of mutability in various forms. The above mentioned properties of mutability are classically generally reflected in phenomena of a very high degree of parallelism with hereditary variation in related species and subspecies which diminishes, as the phylogenetic relationship of forms decreases; this phenomenon of parallelism with hereditary variation was noted way back by C. Darwin and was generalized by N. I. Vavilov (1922, 1935) in the ground-work of his processing of a huge quantity of material.

16. Thus, the mutation process is characterized by fortuity, non-directivity or indeterminism (in the Darwin sense) of arising mutations and a relatively low pressure; hence it is not a directive factor of evolution, does not, as such, bring about phenomena of differentiation or evolutionary progress, but serves merely as a supplier of evolutionary material. Consequently, the <u>mutation process</u> is the first elementary evolutionary factor supplying elementary evolutionary material.

17. <u>Population waves</u>. The elementary form of real, historical group existence of individuals of a species in nature are, as indicated earlier (# 6), populations. In all species of living organisms the number of individuals that produce populations and the areas occupied by populations [Begin p.326] are never constant for a long period and fluctuate more or less all the time. The scope and frequency of these quantitative fluctuations in the different populations and in various groups of living organisms are likely to be very diverse, but there are no absolutely stable populations. It suffices to cite a few examples. Colossal fluctuations are known to take place in the number of a whole series of insects (for instance, flies or mosquitos) in relation to the season [of the year], or changes just as great in the number of the individuals of a series of pests (insects or rodents) in different years; in these cases, the relation between the minimum and maximum number of individuals could be [prevyshat'] one to a million.

In other organisms, such numerical fluctuations, in relation to the rapid shift of generations and a series of ecological conditions, could occur more frequently or more rarely and could also manifest themselves in various degrees of change in the number of individuals.

Usually, numerical fluctuations are accompanied by expansion or reduction of the population area and, sometimes, also by the emergence of new and disappearance of existing populations. And comparatively rapid expansions of the general species area have been observed as a result of migrations in one or several directions with the formation of new populations, or just as rapid a reduction of the species area with the disappearance of a series of populations; in these processes, the individual populations experience an especially large number of fluctuations. The great evolutionary importance of quantitative fluctuations of all populations of living organisms was first pointed out by S. S. Chetverikov (1915) who called them "Waves of life"; for purely practical reasons (considerations of style in translating into a number of foreign languages), we prefer to call them population waves.

Let us examine briefly the actions to which populations are likely to be subjected (from the viewpoint of their genotypical composition) under the influence of quantitative fluctuations. After a sharp reduction of their quantity, only a small number of individuals start a new wave of life. This small number of individuals, naturally, cannot reproduce accurately the genotypic mixture characterising the entire original population. Only a portion of the many mutations contained in small concentrations and in a heterozygous state in the original population will be represented among the individuals that give rise to a new wave of life; these mutation will quite suddenly, in jumps, increase their concentration and will, thereby, considerably increase also their potentiality to survive subsequent waves of life, and the rest will just as suddenly disappear from the population. Consequently, population waves are a most important factor, in the first place, in the sudden elimination of rare mutations from populations and, in the second place, in the just as sudden sharp rise in their concentration.

This purely statistical process is of great importance in "Bringing out mutations upon the evolutionary arena": those mutations which as a result of such a sudden jump have achieved a relatively high concentration have, in the first place, an increased potentiality to remain in the population for a relatively long time (having escaped sudden, complete extinction), and, in the second place, they fall under the relatively rapid influence of positive or negative natural selection which (under a similar pressure determining the biological value of a given genotype and population-dynamics conditions) acts very slowly in the case of small concentrations and very rapidly in the case of average concentrations of a given genotype within the population. Furthermore, on the ascending branch of the wave of life, pressure of natural selection decreases more or less (due to the progressive increase in the number of individuals and to the decrease in the severity of the struggle for existence connected with it, yet on the descending branch it correspondingly increases. [Begin p.327]. Finally, fluctuations and changes in the borders of population areas and considerable fluctuations in population density place a portion of the individuals in a different habitat, changing thereby the pressure and direction of the action of natural selection; the latter is especially pronounced in long waves of life and in the expansion of species realms.

18. Thus, population waves represent the second elementary, evolutionary factor. They, the same as the mutation process, are sudden and nondirective and, principally, also serve as a supplier of evolutionary material. Yet, distinct from the mutation process, they do not influence the emergence of the mutations themselves, but their "bringing out" upon the evolutionary arena by means of a sudden increase in the concentrations of a portion of them within the populations.

19. Isolation. If each species were represented by a single, very large, in a considerable measure panmictic population, then the differentiation phenomena occurring in such a population would have been constantly, partly or entirely levelled out by means of crossing and intermingling; this would have greatly retarded the evolutionary process. Already Darwin, and a whole series of other researchers after him have, therefore, paid special attention to instances of action of an intensely pronounced isolation upon form-formation; a most detailed study was made of the form-formation of fauna and flora; the formation of surface flora and fauna was studied in great detail on islands, of fresh water - in such ancient lakes as the Baikal and Tanganika, of oceanic litterals - at the opposite shores of continents (for example, at the Atlantic and Pacific coasts of America); a study was made also of the influence of long geological isolation of such continents as Australia and South America upon the general character and original characteristics of their fauna and flora. In all of these cases the great influence exerted by long isolation upon the form formation process was clearly evident. However, even isolation on a small scale pronounced in any degree, i.e. disturbance of complete panmixia, is of great importance as an evolutionary factor. If there occur some kind of mechanical or bio-

logical "barriers" that to some degree or other decrease the crossing or mingling of individuals among various sections of a population or among different populations, then in such population sections, though partly isolated, there is an increased possibility of an independent occurrence of variously directed natural selection processes, or retention of differences determined by sudden phenomena, for example, by population waves. The degree of isolation, i.e. the degree of panmixia disturbance, may vary from an absolute one to a barely perceptible one; as a result, in various cases one can speak of a different isolation pressure. Isolation may be determined by the influence of very different external as well as biological causes. In connection with this, we shall give here a brief, schematic classification of the different forms of isolation.

20. Individual, concrete causes and forms of some degree of isolation or other can be listed in countless numbers among the separate groups of individuals within the limits of a species, but they can all be broken up into two basic groups: a) territorial or mechanical isolation and b) biological isolation.

Territorial or mechanical isolation includes all cases of existing external barriers, or the formation of any kind of external barriers between population sections (Timofeev-Resovskii, 1938, 1939, 1940; Bauer and Timofeev-Resovskii [or Timofeeff-Ressowsky] 1943). For dry land organisms, depending on the animal, plant and microorganism species, such barriers can be formed by any water area and obstacle from a brook to an ocean, and for aquatic organisms, any dry land area [Begin p.328] from a narrow strip to a continent. Such obstacles can be formed by areas for some reason or other not inhabited or sparsely inhabited by a given species, for example, mountain ranges and elevations for lowland organisms, and lowlands for mountain organisms, forests for steppe species, and open spaces for forest species, or areas lacking inhabited places, or having the worst kind of habitations, thanks to which there form sections among the populations that are not inhabited or are sparsely inhabited by individuals of a given species. According to the space-scale and the degree of isolation effectiveness (degree of isolation pressure), territorially-mechanical isolation is likely to vary within a wide range, from absolute isolation of far removed sections of disjunctive, island or lake regions to scarcely perceptible obstacles reducing panmixia only negligibly. The isolation degree is, naturally, determined not only by one expressed [vyrazhennost'] obstacle, but also by the degree of mobility and settling of the individuals of each generation; the combination of both of these will determine the isolation pressure.

The biological isolation is contained in the reduction of the potentiality of effective crossing of individuals not determined by any external barriers. There can also be a large number of individual, rigid forms of biological isolation; but they all can be reduced to three main forms: a) ecological, b) physiological and c) strictly genetic isolation (Timofeev-Resovskii, 1938, 1940, 1941; Bauer and Timofeev-Resovskii [or Timofeeff-Ressowsky], 1943).

Ecological isolation unifies all cases in which different individuals of some species possess a decreased potentiality for crossing as a result of some ecological difference, for instance: different reproduction dates, different nest, spawning, or generally unproductive biotypes due to various forage plants or edaphic resources etc. In essence, a decrease in the crossing potentials is here also, in the final reckoning, determined by a dissociation of individuals in space or during the reproduction period; it is not, however, determined by external-mechanical factors, but by instinct and the biological characteristics of the organisms themselves.

Physiological isolation includes all cases of decreased crossing potentiality between various individuals and groups of individuals due to decreased copulation potentiality between them, determined by decreased sexual attraction or by a change in the copulation organs. In the case of pure forms of ecological and physiological isolation, the progeny obtained after accomplished crossing is entirely normal and productive; consequently, one degree of biological isolation or another is prompted here merely by a biologically determined decrease in the crossing potentiality. Undoubtedly, in the final analysis, the fundamental [pinciples] underlying such biological specificity are genetic reasons: genetic differences between forms manifesting some degree or other of ecological or physiological isolation.

In contrast to those referred to above, in a strictly genetic form of isolation [the characteristic] of decisive importance is not a change occurring in the copulation potentiality, but a decrease in viability or productivity of the hybrid progeny obtained as a result of crossing. It has been demonstrated in genetically well investigated animal and plant species that one degree or another of genetic isolation (from a scarcely perceptible one to an absolute one) may, in different cases, be determined by different combinations of gene, as well as of chromosome or genome mutations.

In an evolutionary sense, all isolation forms act similarly: thanks to a long disurbance of complete panmixia and intermingling, they (in proportion to isolation pressure) increase the potentialities of the divergence of isolated population sections. [Begin p.329]. But a more important, conclusive step is, of course, the attainment of a high degree of biological and, in particular, genetic isolation; biological isolation is difficult to reverse, but a truly genetic one (pronounced to a sufficiently high degree) is the final form of isolation creating a further possibility for a corresponding group of organisms to proceed to a considerable extent with [their] autonomous evolutionary development not infringed upon by a leveling intermixture.

21. Thus, isolation is represented by two principal types - the territorial-mechanical isolation and the biological isolation of which the latter is subdivided into three basic forms: the ecological, physiological and strictly genetic isolation. All forms of isolation can be pronounced in various degrees of intensity and, consequently, they can exert different pressures upon the processes occurring in populations, having determined the increased potentialities of intrapopulation and interpopulation differentiation of organisms. Isolation is the third elementary, evolutionary factor determining fundamentally the increased potentialities of the emergence of processes of phylogenetic differentiation and also of accelerating their tempo.

22. Natural selection. The first three elementary evolutionary factors which we have examined up to now (mutation process, population waves and isolation) can within their own reciprocal action bring about the elementary evolutionary phenomena which we have formulated above (para 7): alteration of the genotypic composition of a population. It is possible to realize phylogenetic differentiation under their action, i.e. formation of two or more new forms from one original form. It is, however, quite impossible to imagine that adaptations can develop and evolutionary progress can be realized only with their participation. This explains also why the evolutionary process cannot take place in the form developed earlier (para 5) and concurrently also the formation of an orderly phylogenetic system of organisms under the influence of merely these three factors. The ingenious merit of C. Darwin

was his discovery in nature of the factor of natural selection which is the main force determining the form and direction of the evolutionary process occurring on Earth. In natural history, C. Darwin's discovery of the principle of the struggle for existence and natural selection is comparable only to I. Newton's discovery of the principle of universal gravity. At present, on the basis of contemporary knowledge of nature and the properties of hereditary variation, we can evaluate the action and pressure of natural selection in a considerably more solid and detailed form. A great deal of literature has been devoted to natural selection, but we can limit ourselves here to a brief examination of the possible effects of selection in connection with the properties of elementary evolutionary material of which we have adequate knowledge.

23. Earlier, we considered (paras 9-12) the most important mutation properties as elementary evolutionary material. At that time it was mentioned that mutations were capable of influencing all fundamental biological properties of organisms, such as relative viability in various habitats, fertility, potentialities of crossing with other forms etc. As indicated by the results of a large number of precise genetic experiments, it is especially important that most mutations possess pleiotropic action, i.e. that they influence not only one, but several characteristics and properties of an organism; we know also that each individual character of an organism is likely to undergo changes under the influence of a large number of different mutations possessing now and then very different complexes of other pleiotropic actions. [Begin p.330].

The degree of manifestation, form of expression and the general biological properties of each individual mutation can be influenced by many other mutations; this, in particular, concerns the relative viability and other general biological properties of organisms containing some or other mutations. In general outline, it can be said that most individual mutations possess different relative viability and different expressiveness [vyrazhennost'] of a series of characteristics under various conditions of external and genotypic environment (Timofeev-Resovskii, 1934, 1940). All of these mutation properties create a possibility of an extremely varied and effective action of artificial selection in breeding [otbora v selektsii] and of an infinitely differentiated, delicate and powerful influence of natural selection upon living organisms in nature. There is no need to attribute selection importance, always somewhat anthropomorphically, to each individual morphological or physiological characteristic, for it may be a resultant either of a specific morpho-biological combination of characteristics, or of a pleiotropic influence of the same mutations exerted upon the general reproduction potentialities of a given form. On the other hand, each individual character possessing, as such, positive selection importance can with the aid of natural selection, comparatively rapidly, "select for itself" an optimal genotypic environment. The pressure of selection, as of all other factors, can be very different quantitatively and can act differently upon homozygotes and heterozygotes.

The rate of selection action for various border cases (assuming specific pressures of selection and of other factors) yields to precise mathematical calculation (Volterra, 1926; Gause, 1934; Fisher, 1930, 1932; Holdane, 1924-1934, 1932). Even the most insignificant selection pressures may prove effective, during a sufficiently long well-defined directivity toward some of the more general properties of living organisms (for instance, such as formation of the basic structural type, some properties of metabolism, mechanism of cell division, general properties of structure and genotype variation, etc.);

well-defined, directed, standardising and stabilizing selection has, undoubtedly, remained active during whole geological periods and epochs, or even since the beginning of evolution on Earth. In a word, we today, on the basis of contemporary knowledge of the mechanism of heredity and of the nature of hereditary variation, can see in natural selection an even more powerful and, at the same time, delicate and differentiated factor exerting action upon living organisms, than was possible in Darwin's time.

In addition, we now visualize much more clearly than heretofore the "aid" rendered to natural selection by the other elementary evolutionary factors listed above, especially by population waves and isolation that have produced the possibility of accelerating considerably the rate of selection action in the formation of adaptive and differentiation phenomena.

24. Thus, natural selection is the last and fourth elementary evolutionary factor. Only this factor makes the occurrence of the evolutionary process possible in the form in which we have observed it on Earth; for only natural selection creates the possibility for the formation of adaptation to a habitat, genuine phylogenetic and ontogenetic differentiation, and evolutionary progress based on all of these phenomena. Consequently, natural selection is the fourth and most important elementary evolutionary factor which determines the formation of evolutionary adaptations and differentiation, and which determines the direction and fundamental regularities of the evolutionary process. [Begin p.331].

Formation of the elementary evolutionary phenomenon and the origin of species

25. All basic elementary [phenomena] comprising the evolutionary process were briefly defined and described above. Now, it is necessary to visualize

briefly the scheme of the elementary evolutionary phenomenon developed from elementary evolutionary material under the influence of elementary evolutionary factors and, to dwell, just as briefly, upon the characteristics of the formation of species as the conclusive stage of microevolution.

28. The mutation process contributes at all times toward the genotypic changes occurring in a population in the form of a continued and repeated emergence of various mutations. If, however, a species would have been represented by a single, very large, constant population that would not have been affected by any factor except the mutation process, then there soon would have been established some equilibrium in the species population that would have been displaced only very slowly depending on the possible shifts of the quantitative relationships [involved] in the emergence of various forms of mutations. Generally, thanks to the large number of lethals and mutations with a decreased viability, the species would have gradually degenerated. Actually, however, as we have seen above, the total population of each species was broken down into a large number of individual populations limited and often very small in size [chislennosti]; besides, all populations fluctuate quantitatively, sometimes with very great amplitude, and there are between them, and within the larger ones of them, the most varied and in various degrees pronounced territorially-mechanical and biological barriers. Finally, thanks to the biological heterodynamics [neravnetsennosti] of the different genotypes at each given constellation of conditions (and to the change in their relative viability with a change in conditions), and also to the excessive production of progeny inherent in all species of living organisms (for in species that for a long time do not markedly either increase or decrease the number of individuals, there remains of each pair in each following generation only 1 pair!), natural selection is always active in all populations.

In such a situation, elementary evolutionary phenomena, i.e., according to the definition given earlier, more or less long-term changes must unavoidably and repeatedly occur in the genotypic composition of individual populations (as compared with neighboring or original ones) within the limits of each species. Naturally, not by far all of them will stand out morphologically so as to qualify as material for a systematic-taxonomic description, and not by far all will continue their differentiation progressively and well-defined. In relation to the degree of isolation and, particularly, to the direction of selection action, the further evolutionary fate of such populations, or parts of populations, will be very diverse; some will come out on the "great evolutionary arena", yet others will disappear in the course of time through assimilation with neighboring populations. In a word, the same as mutations represent material for the formation of these elementary evolutionary phenomena, so do the latter serve as some sort of material (however, within the limits of group variation and not individual variation) for the process of evolutionary adaptation and differentiation. In the formation of <u>elementary evolutionary phenomena</u> the main role is played by population waves and isolation, but in their further destiny, the decisive role is played by natural selection.

27. <u>Species formation.</u> The sum total of the individuals of a species, or a more or less considerable part of it can endure two fundamental types of changes: those occurring in time and in area. If there arise populations with a notably better adaptability to habitat, then they, in the absence of intensively pronounced [Begin p.332]isolation barriers (or during the disappearance of such barriers in the course of time), can gradually force out the original forms from a considerable portion of the species area; such processes of gradual substitution of "better forms for inferior ones", at

a different rate, on a different scale, and accompanied by morpho-physiological differentiations of various degrees of manifestation, occur in all species of living organisms. This comprises the process of evolutionary adaptation occurring everywhere in various degrees and forms.

If adaptation is not narrowly specialized and if the area of a species is not very large, or barriers with a sufficiently strong isolation pressure, do not arise within its limits, then such adaptation processes can proceed without any marked differentiation of the original form into two or several new ones; in the given case we shall deal with gradual evolutionary changes in time. More often, however, are observed more narrowly localized intraspecific adaptation and differentiation processes accompanied, in the presence of sufficiently pronounced isolation barriers, by the formation of intraspecific geographical or ecological races or subspecies. Such geographo-ecological development of forms is likely to be an important step on the road to species formation, which was also the opinion of C. Darwin; the further fate of subspecies forms depends on their biological and geographo-geological history and can be very diverse. In any case, division of an original species into two or several new ones requires the formation of a practically complete biological isolation between the corresponding sub-specific forms; after this their further destinies, including the settling of some areas or other, are in a considerable measure independent of each other. Yet the means and the form of achieving a high degree of biological isolation can be very different. In a whole series of cases it, undoubtedly, is preceded by territorially-mechanical isolation to some degree or other, i.e. the formation of a sufficiently pronounced biological isolation proceeds through geographo-ecological variations; obviously an independent development of a high degree of biological isolation of intrapopulation subspecies or species is also possible with the participation of only the "usual" weak forms of interpopulation or intrapopulation territorially-mechanical isolation.

28. Thus, species formation, having begun with the formation of some intraspecific group from an elementary evolutionary phenomenon, can proceed by different means in relation to the historical destiny of species populations and the area they populate. However, most of the different means of species formation can be reduced to two principal types: the geographical one proceeding through the formation of ever more differentiated geographical subspecies, and the nongeographic or biological one proceeding through the formation of an intrasubspecies or species area of a biologically isolated form. Adaptation to localized geographical conditions and gradual development of sufficiently pronounced biological isolation, as a result of a long territorially-mechanical isolation, underlie the first type; a localized formation of a biologically isolated group of individuals or populations, in which, under the action of natural selection, there develop special ecological adaptations facilitating a progressive increase in the degree of biological isolation of a new form from the original one, and its independent settlement, underlie the second type.

29. What, then, is the importance of species formation in evolution? An exact definition of the species concept was given above (para 6); in accordance with this definition, the principal and fundamental characteristic of a species is its practically complete or almost complete biological isolation under natural conditions from all other such species. [Begin p. 33]. This circumstance comprises the prime importance of species formation between the stages of evolutionary phylogenetic differentiation. Discontinuance of crossing and intermingling with neighboring forms permits the emerging new

species to proceed henceforth to a considerable extent by independent paths. One of the most important of such paths is the pursuit of interspecific competition with related forms that opens up new possibilities and trends in the activity of natural selection. Thanks to the inability to mix with individuals of other species, the new species can begin adopting new ecological niches and developing new specialised adaptations (including such surprising ones as mimicry and mimetism) without slowing down these processes by leveling crossings and intermixing. Species formation leads to an increase in the general plasticity of a corresponding, larger, phylogenetic group (genus, family); as a result, species formation increases the general intensity of the utilisation of Earth's surface by organisms in raising the differentiation degree of biomass within the biosphere. Naturally, a complete cessation of crossing with other species reduces variation possibilities, having excluded a large number of possible recombinations of hereditary characteristics and properties that emerge as a result of segragation after various forms have crossed with each other. But crossing between sufficiently remote forms occurs prior to the attainment of complete biological isolation in nature, this takes place especially often in plants; in connection with this there has been observed an emergence and settling of subspecies (in plants, probably, also of species) of a clearly hybrid origin. The importance of species formation in the hybridization of individual forms in nature is, however, often greatly exaggerated. Obviously, the destruction of forms, occurri g as a result of crossing and segregation, after they had developed under the long influence of natural selection and had been well-adapted to a habitat, proved in most cases biologically disadventageous; this probably explains the presence of comparatively narrow hybrid transition zones at the boderline of realms of many well differentiated subspecies.

Finally, this, probably, explains also the relatively long (sometimes even very long) existence of species and subspecies in a phenotypically almost unaltered form, regardless of the comparatively great variability and heterozygousness of the populations; a stabilizing selection (Shmal'gausen, 1946) maintains the preservation of a historically developed (under the influence of other forms of natural selection) favorable combination of characteristics and properties the partial changes of which may prove less advantageous for a species, than the preservation of a harmonious type of organization already achieved. Naturally, similar to the paths of species formation, the destiny and evolutionary importance of the products of distant hybridization in nature can, in individual cases, be very different. Species formation, the most important stage of evolutionary differentiation, may at the same time be regarded as the final, conclusive link in the chain of strictly microevolutionary processes.

CONCLUSION

30. C. Darwin, having discovered and formulated the principle of natural selection, laid the foundation of the theory of natural history for the evolutionary process of living organisms on Earth. In the course of the first 60 years following the appearance of C. Darwin's classical work, scientific study of the evolutionary process amounted mainly to comparative morpho-physiological, embryological, biogeographical and paleontological investigations, to their treatment from Darwin's evolutionary point of view, to the establishment, [Begin p.334] as a result of such investigations, of general phylogenetic schemes and important stages and phenomena of the evolutionary process, and to an elucidation of phenomenological evolutionary regularities; this trend can be called macroevolutionary. At the present time,

thanks to the brilliant development of experimental genetics during the last fifty years and to the enrichment of our knowledge of the nature of heredity and variation connected with it, the study of microevolution has been made possible. The problem of this trend of investigation is the establishment and precise definition of the concepts of elementary phenomena that underlie the evolutionary process, and the study of the concrete mechanisms of species formation. The concepts of the evolutionary process, the elementary evolutionary phenomena, population and species were formulated above (paras 5-7), the nature of elementary evolutionary material comprised of mutations has been elucidated (paras 9-13), the presence of the four elementary evolutionary factors has been established and their action has been demonstrated, [they are]: the mutation process (paras 15-16), population waves (paras 17-18), isolation (paras 19-21) and natural selection (paras 22-24). Finally, the most general scheme of the formation of the elementary evolutionary phenomenon under the influence of the action of various factors upon evolutionary material has been given (para 26), and the basic, most probable mechanisms of species formation have also been described (paras 27-29).

31. The study of microevolution originated about 30 years ago as a result of a revival of active interest of a number of experimental geneticists in evolutionary problems, after a period of dissociation of the basic developmental channels of classical evolutionary teaching and of the new science - genetics. Thanks to the intensive experimental work done in rapidly developing disciplines in evolutionary and population genetics, the boundaries and fundamental content of the teaching of microevolution have been fully defined. At present it can be asserted that the theoretical achievements in this sphere (formulation and definition of fundamental concepts, elucidation of genetic processes occurring in populations, theoretical analysis of pos-

sible mechanisms of form-development, exact study of the properties of evolutionary material and of the relative role played by various evolutionary factors etc.) have considerably surpassed the practical application, in the realm of precise interpretation of evolutionary phenomena and regularities, from a contemporary theoretical position. Even up to now in a number of cases "theoretisizing" on evolutionary topics continues to flower with complete disregard for the well investigated and accurately formulated facts and theoretical principles of genetics and of the study of microevolution; thus, there naturally arose only completely unconstrained, and sometimes even fantastic statements instead of a theory of natural history. This can be explained, on the one hand, by the fact that numerous biologists of different specialties who possess material on taxonomy, morphology, physiology, ecology, biogeography and paleontology of different groups of living organisms, visibly lack even elementary information concerning the achievements of present-day genetics and of the teaching of microevolution. On the other hand, many biologists, due to a lack of the necessary training in the sphere of precise physico-mathematical reasoning, are inherently incapable of understanding the differences between strictly defined and indistinct conceptions, between elementary and derived phenomena, between precisely established regularities and a fortuitous complexity of observations, between a strict structure of generally required theories of natural history and statements of subjective opinions based on a series of arbitrary assumptions. A number of important evolutionists have, however, already produced abstracts incorporating the results of classical investigations of macroevolution with contemporary achievements of the teaching of microevolution (Rensch, 1948; Huxley, 1942; [Begin p.335] especially Shmal'gausen, 1946, 1948); in a series of cases, present-day evolutionary conceptions are being successfully adopted in theoretical taxonomy and paleontology (Mayr, 1948; Simpson, 1948).

32. A further successful development of investigations in the sphere of microevolution and of the whole contemporary evolutionary teaching calls for considerable expansion of experimental and theoretical works, but chiefly – for efficient cooperation between specialists of the various spheres of science. For the purpose of rendering our conceptions of microevolutionary mechanisms more profound, it is essential that experimental geneticists concentrate their attention on problems of evolutionary and population genetics and that the greatest possible number of convenient investigation objects be utilized in experiments. It is just as essential to increase, expand and define considerably more accurately the work done in intraspecific taxonomy, biogeography and ecology of various plant and animal species; in planning this sort of work it is necessary to select carefully suitable objects permitting the accumulation and treatment of the largest possible amount of material, and also to proceed from an intelligent theoretical point of view in using a method conducive to maximal utilization of the results in evolutionary theoretical generalizations. Special attention must be paid to a strictly accurate quantitative study of population and biocoenotic [biotsenoticheskoi] dynamics. A quantitative study of polymorphism and also of intrapopulation and interpopulation correlations is of much interest and offers almost unlimited possibilities; on the basis of the above it is possible to obtain substantiated opinions on the different forms and pressures of selection within populations. Convenient objects (species yielding readily to observation and to being gathered in huge quantities, with a series of adequately varying morphological characteristics) must be utilized in carrying out extensive monographic investigations of phenogeography and,

in proportion to the genetic analysis of the corresponding characteristics, also of genogeography (Baldi and Pirocchi, 1939; Buzzati-Traverso, Jucci and Timofeev-Resovskii [Timofeeff-Ressowsky], 1938; Serebrovskii, 1928, 1929; Timofeev-Resovskii, 1938). Ecologists can collect the most interesting material on the pressure of various forms of interpopulation and intrapopulation isolation.

All of these field and laboratory investigations must be tied up with the theoretical concepts concerning the mechanisms of the microevolutionary process. Apart from this, a study of the rate of development of intraspecific and interspecific forms conducted by means of a carefuly quantitative investigation of the degree of divergence of isolated forms is of utmost importance due to the absolute chronology of the geological age of their habitats. The quantitative morphological differences between the corresponding forms can be expressed in terms of biometrical methods, for example, by calculation of divergency coefficients (Tsarapkin, 1934, 1937, 1939); [objects] of special interest to be used as material are represented by some lake and island forms and also by a series of species of bipolar and real amphibian [amfiboreal'nykh] fauna and flora complexes described in the classical works of L. S. Berg (Andriashev, 1939, 1944; Berg, 1918, 1920, 1934, 1947, 1949). In the sphere of study of macroevolution, the theoretical interpretation of the phenomena, stages and regularities described requires that the present-day point of view be consulted to a considerably higher degree and in a more precise form, especially the contemporary concept [offered] by the action of natural selection in conjunction with the rest of elementary evolutionary factors. Finally, as indicated in the "Introduction", it would be very valuable if theoretical work were strengthened in the realm of evolutionary teaching by enlisting mathematicians for the purpose of precise logico-mathematical formulation of elementary phenomena [Begin p.336] and for a further development of methods for a mathematical analysis of micro-evolutionary processes.

33. In conclusion it must be emphasized that the brief summary of our conceptions of the elementary phenomena and processes of microevolution has been maintained consciously in an aphoristic-axiomatic style, omitting citation of extensive factual material. Even concrete examples illustrating some or other principles were not cited, since the fundamental problem of this report is a description of the logical skeleton of the basic concepts and formulations underlying the contemporary teaching of micro-evolution. Factual material and numerous solid, well-known examples can be derived from the special abstracts of Dobrzhansky (1937, 1939), Mayr (1938), Müller (1940), Melchers (1938), Rensch (1948), Schwanitz (1943), Stubbe (1938), Timofeev-Resovskii (1934, 1937, 1938, 1940, 1943) and I. I. Shmal'gausen (1946, 1948). The present report, however, represents merely a brief and schematic generalization of material.[1]

1 A list of basic literature on microevolutionary problems will be published in the next issues of "Botanicheskii Zhurnal".

Microevolution. Elementary Events. Material and Factors of The Microevolutionary Process

By N. W. Timofeeff-Ressovsky

Summary

The paper gives a brief and schematical system of definitions of the process of evolution, the scope of macro- and microevolution, the species concept, the population concept, the elementary evolutionary event, the elementary raw materials of evolution and the four elementary evolutionary factors (the process of mutation, the population waves, the isolation mechanisms and the process of natural selection). In the last paragraph there is also given a brief description of the chief phenomena of the differentiation of populations, of the adaptations, of speciation and of the mechanisms of microevolution.

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If one reviews the path, which was traversed by biology in Russia during the last 100 years, one can see that it was divided into three sharply demarcated periods: progressive materialistic ideas of Darwinism developed very rapidly during the second half of the 19th century; at the beginning of our century a departure from Darwinism was noted, and Mendelism-Morganism became widely spread; after this, beginning with the thirties, a period of struggle against Mendelism-Morganism set in, a further development of materialistic elements of Darwinism, but on a higher stage, on the basis of Michurin's teachings.

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History of biological thought in Russia is characterized clearly by expressed materialistic traditions. The idea about development of living nature was defended by many of our scientists much before Lamarck and Darwin. We find it in works of Lomonosov and Radishchev. As yet, before the publication of Darwin's "Origin of species", I. E. Diad'kovskii, P. F. Gorianinov, K. F. Rul'e, A. D. Galakhov, G. E. Shchurovskii, A. N. Beketov, and N. A.

Vitse-president Vsesoiuznoi ordena Lenina akademii sel'skokhoziaistvennykh nauk imeni V. I. Lenina [Vice-President of the All-Union Order Lenin Academy of Agricultural Sciences imeni V. I. Lenin] (VASKHNIL)

Severtsev regarded living nature from the position of development. All of them recognized the variability of heredity of plants and animals under the influence of external conditions, the possibility of inheriting features and properties, which were acquired during the process of life. The leading Russian philosophers and biologists have in many ways, prepared the ground for confirmation and development of Darwinism in Russia; the ingenious generalization of Darwin appeared as a solving of many suggested, and to a certain degree cleared up by them, problems about the development of the organic world.

Darwinism spread in Russia as a wide torrent. From the beginning of the sixties of the 19th century much was done for its propaganda by D. I. Pisarev, S. S. Kutorga, M. A. Antonovich, S. A. Rachinskii, and especially, K. A. Timiriasev. A deep, systematic and clear exposition of Darwinism by K. A. Timiriazev, who revealed in his works the fundamentals of Darwin's teaching, helped with the training of several generations of Russian Darwinists and did not lose its importance at the present time also. The outstanding works of A. O. Kovalevskii, V. O. Kovalevskii, I. M. Sechenov, I. P. Pavlov, I. I. Mechnikov and others, each one of them in their own field, enriched, confirmed and developed the teaching of Darwin. Darwinism became a scientific basis for the leading biology of prerevolutionary Russia.

Wide acknowledgement and spreading of Darwinism in Russian science aroused a counteraction on the part of reactionary forces. [Begin p.4] N. Ia. Danilevskii, N. N. Strakhov, V. Solov'ev and other reactioners stepped forward against Darwinism. But they did not succeed in stopping the spreading of Darwin's ideas. Materialistic biology has been developing in Russia during the struggle with anti-Darwinists.

Nevertheless, at the beginning of the 20th century Mendelism-Morganism obstructed further development of the materialistic biology. After the works of Chermak, Correns and de Vries, who repeated the experiments of Mendel, similar experiments were begun to be conducted everywhere. Mendel's ideas were developed in the works of Morgan and of his school, which referred the supposed rudiments of the characteristics, factors-genes, to chromosomes. Very soon all the textbooks on biology presented Mendelism-Morganism as their basis, interpreting all the sections of biology in its light; and in any monograph, which, in some way, touched upon biological problems, the "successes" of genetics were praised in every manner. Biologists, who worked, and who did not work, in the field of genetics, but who admired its imaginary achievements, have formed around it an aureole of fame. The interest in formal genetics for a while crowded out the truly essential problems of biology from the field of vision of the greatest number of scientific workers.

Notwithstanding the warning voices of K. A. Timiriazov, I. V. Michurin, M. V. Rytov, M. F. Ivanov, and of some other men of Russian science and practice, who did not share the enthusiasm in the fashionable "epidemic", a wave of Mendelism-Morganism engulfed biology.

During the twenties and the thirties it was propagandized from the Chairs of higher educational institutions, was widely spread in biological and agricultural scientific-research establishments. This can be explained by a sharp need of a theory, which was necessary for solving great practical problems, that the young Soviet Government placed before agriculture. The role of science rose unusually intensely; all the activity of Soviet Government was built on a scientific basis. The celebrated decrees, signed by V. I. Lenin, of the Council of People's Commissars "About pedigreed cattle"

(1918) and "About seed growing" (1921) were published. The most favorable conditions were being established for development of science, and of agricultural science among others too. The network of scientific-research establishments was widened; the number of scientific workers was raised considerably. Expeditions were sent out to different countries of the world in order to collect specimens of cultivated plants; during this period, under the leadership of N. I. Vavilov, world collections of them were gathered, which were of invaluable importance for selection work. The doors of science were wide open to the public at large. New high and secondary agricultural educational institutions sprang up; numbers of students increased by several times. Accomplishing heroic deeds, the masses mastered the sciences, and Mendelism-Morganism was considered to be the last word in biology. This is the reason why it spread in USSR, considerably wider, than in any other country.

A great role was played by books, which were published at that time: "Heredity" and "Variability" of Iu. A. Filipchenko, a collection of articles "Landmarks of selection" under the editorship of A. A. Sapogin, as well as the activity of the leading plant growing scientific-research establishment - Institute of Applied Botany and New Crops, which was later renamed to the All-Union Institute of Plant Industry.

Preponderance of Mendelism-Morganism in research of those years was clearly revealed in the works of the All-Union Conference on Genetics, Selection, Seed Growing and Pedigreed Animal Husbandry, which took place in January 1929 and which gathered together over a thousand and a half participants. The scientific tendency of the Conference and the contents of theoretical reports, given there, were strong expressions of the blossoming of Mendelism-Morganism. Nevertheless, even then a sharp non-correspondence was evident between [Begin p.5] the wide range of practical problems and the weakness of the biological theory - Mendelism-Morganism. In many reports you could feel a strong desire, after having mobilized all the strength of science, to assist in the quickest development of Soviet agriculture. But the genetic science was not able to give correct answers to practice, to show how, by which means to solve the important problems next in turn. Geneticists, as usual, continued to revel in their imaginary successes, piling up one hypothesis over another, one supposition over another supposition and, wandering in the jungles of conclusions, inconsistent with life; they promised very much both to practice and to science, held out alluring prospects, but only in a far future.

Meanwhile, the greatest transformations occurred in our country. Millions of small peasant farms united into Kolkhozes. Calls for science increased tremendously. Developing socialistic agriculture required active scientific help ever more. What could Mendelism-Morganism offer to the practice that would be useful? Nothing, as before. More than that, its erroneous theoretical ideas in many cases oriented the production incorrectly and, thus, not only did they not help but brought losses to practice. Morganism did not stand up to the test of life. Here then was disclosed the fallacy of its methodological foundation.

During this period Soviet scientists began to master dialectical materialism. Methodological foundations of science were reviewed, the struggle increased with all kinds of metaphysical, vulgar - mechanistic and idealistic points of view. It is true, there were many attempts to reconcile theoretical ideas of Morganistic genetics with materialistic dialectics. Sometimes it succeeded externally, formally: at the first sight to people, who did not know practice, it seemed that theoretical ideas of formal genetics were in accord with the laws of dialectical materialism. Nevertheless, the nature of Morganism-Weismannism contradicted practice, was inconsistent with life and development of the organic world, did not and could not correlate the philoscphy of dialectical materialism.

One should point out that at that time a mass kolkhoz experimentation developed widely. Right after the collectivization everything was utilized, which was effective from the old peasant experience for the building up of kolkhoz economy; and at the same time new methods and measures were formed, which answered the requirements of large-scale socialistic agriculture.

New suggestions had to be tested on comparatively small scale before expanding them widely. New ideas were born daily, were tested immediately and introduced. The whole production activity of kolkhozes was a kind of continuous mass experimentation. "A member of a kolkhoz is an experimenter, and an experimenter is a transformer", was written by I. V. Michurin in a letter to the Second All-Union Convention of Kolkhoz Shock Workers. It was necessary during a short period to select the best from the varieties of agricultural plants and to utilize the best of the existing procedures of agrotechnics, to find the most perfect forms for the organization of labor, and so on. But much had to be created anew. All scientific suggestions, and, together with them, the foundations of science themselves have obtained an exacting and objective judge. During this period mass production experiments on vernalization of seeds of early cereal crops and of millet, on vernalization of potato tubers, on pruning of upper shoots of cotton, on summer plantings of potatoes, on summer plantings of alfalfa, on intra-varietal and intervarietal crossing in seed growing, on supplementary pollination of cross-pollinating crops, and so on, played a large role in strengthening the connection between theory and practice and in intensification of the materialistic trend in biology.

Thus, a socialistic reconstruction of agriculture, the always increasing demands on science, the mass kolkhoz experimenting, [Begin p.6] utilization by Soviet scientists of the method of dialectical materialism and its conscious use in scientific experiments were causes, and, at the same time also, favorable conditions for development of I. V. Michurin's teaching, which has replaced Mendelism-Morganism in biological science.

Critical appearances of T. D. Lysenko against Mendelism-Morganism followed in the thirties. They were upheld by materialistically minded biologists, and first of all by selectioners. The theory of phasic development of plants, formed by T. D. Lysenko, permitted to arrive more correctly at the understanding of phenomena of heredity and of its variability. Theoretical aspects were being developed one after another, as well as constructive suggestions on the improvement of methods of selection. Their experimental testing was proceeding successfully. Theory for matching parental pairs for cross-breeding on the basis of biological (phasic) analysis and the principle for rejection of selectional material from the first generation of hybrids, which were confirmed by the practice of obtaining new varieties of spring wheat (1163 and Odesskaia 13), of barley (Odesskii 14) and of cotton (Odesskii 1), have demonstrated a fundamental possibility to plan a selection process and considerably to speed up the formation of varieties. Development of the theory of selectivity of the process of fertilization and of a method of intravarietal and intervarietal crossing in seed growing of self-pollinating crops have revealed the incompetence of Johansen's teaching about the pure line, which was considered to be a theoretical basis for selection and which rejected the expediency of repeated selections in the so-called pure lines. Works on directed change of heredity of plants by means of training and by vegetative hybridization, and the extensive factual material obtained during them, have again established and ascertained in science deductions about adequate variability and about the inheritance of features, which are acquired during the progress of life. A new theory of heredity and of its variability was formed. These works strengthened the position of materialism in biology and delivered a shattering blow to Mendelism-Morganism, having shown the unsoundness of its foundation - the theory of genes, according to which the gene represents the corpuscle of the substance of heredity.

Each of the enumerated new cases entered science, having surmounted the opposition of the old. Public discussions of the most important questions on selection and genetics followed one after another. Discussions proceeded on the printed page. More and more scientists were drawn into discussions of disputable questions, as well as into their experimental testing. The new forced its way under conditions when in the Chairs of the higher educational institutions, in scientific establishments, in scientific journals the key positions were occupied by active supporters of the old. Of great importance was the discussion in 1936, organized by VASKHNIL, and discussion in 1939, which was conducted by the editor of the journal "Pod Znamenem Marksizma" [Under the Banner of Marxianism]. As a result of a wide exchange of opinions all the time a larger number of Soviet biologists began to renounce the theoretical foundations of Morganism, consciously to pass over to the position of materialistic biology. A new stage of development of biology advanced which was indissolubly connected with the name of the great transformer of nature, I. V. Michurin.

I. V. Michurin worked creatively until the last day of his life. He was known to many professional and amateur horticulturists; he was personally known to and was in correspondence with Professors V. V. Pashkevich and N. I. Kuchinov, with Academician B. A. Keller and other scientists. V. I. Lenin paid attention to his works yet in 1922. In 1935, I. V. Michurin was chosen as an Honorary Academician of the Academy of Science of USSR and was confirmed as an Active Member of the All-Union Academy of Agricultural Sciences imeni V. I. Lenin. Moreover, I. V. Michurin not only before the Great October Revolution, but also during the time of the Soviets, [Begin p.7] was outside the limits of the "official" biological science. This explains the surprising circumstance, that K. A. Timiriazev, who knew and highly valued L. Burbank, did not take notice of I. V. Michurin. This explains the attitude to him of the cited First All-Union Conference on Genetics, Selection, Seed Growing and Pedigreed Animal Husbandry. The Conference sent to I. V. Michurin a telegram in which they greeted him as " the creator of new forms, which are useful to man". Doing justice to practical attainments of I. V. Michurin, the Conference did not mention a word about the theoretical value of his works.

Even in 1935 the "official" biological science saw in I. V. Michurin only an outstanding originator-selectioner. During this year a fundamental work was published entitled "Theoretical Foundations in the Selection of Plants". Its authors, standing on positions opposed to Michurin's, did not use, of course, the works of I. V. Michurin. The theoretical conclusions of I. V. Michurin did not find in it either a critical review, or even mention, because in the light of the prevailing theory of that time they seemed not only erroneous, but extremely simple and primitive.

The circumstance, that before the middle of the thirties, works of I. V. Michurin were not given general biological importance, can be explained by the case that although copius facts, accumulated by him, his penetrating observations and correct scientific conclusions, were already published, they still had not become the property of wide circles of scientific workers, were not generalized to the common biological conception, which would be able to oppose the conception of Mendelism-Morganism that predominated at those times. This was done soon after his death. The works of Charles Darwin, K. A. Timiriazev, I. V. Michurin, T. D. Lysenko and of their followers have grown into an entire scientific conception, into the Soviet Creative Darwinism, Michurin's teaching.

All the attainments of materialistic biology are synthetized in this teaching. It has refuted the theoretical concepts of Mendelism-Morganism, replaced them as a scientific basis for biology.

The Session of the All-Union Academy of Agricultural Sciences imeni V. I. Lenin, which proceeded from July 31 to August 7, 1948, summed up the results of the several years struggle between the progressive, materialistic, Michurin's trend and the reactionary, idealistic Weismannist - Mendelian - Morganist. The Session stated that these two trends were diametrically opposed. Michurin's trend in biology was a creative development of Darwinism, a new higher stage of materialistic biology. It developed the progressive agrobiological science, which all the time more and more widened the help to kolkhozes and sovkhozes that fought for high productiveness in socialistic agriculture. The unity of theory and practice was embodied in Michurin's agrobiological science as an indispensable condition for a successful perception of regularities of development of living nature. The Mendelian - Morganistic trend in biology extended the idealistic and metaphysical teaching of Weismann about the independence of nature of the organism from the external surroundings, about the so-called immortal "Substance of heredity"; it was severed from life and was almost fruitless in research.

The greatest number of biologists came forward for the materialistic Michurin's teaching during the VASKhNIL session, because it opened wide paths for studies of regularities of nature and took biology out of that dead end into which Mendelism-Morganism had led it; the selectioners were also for Michurin's teaching as they found in it a scientific explanation for the methods of selection, which they were using, and a theoretical basis for development of new and more effective methods; the victory of Michurin's teaching was hailed by the widest masses of practical [Begin p.8] workers, because they obtained from it real help and saw the full incompetence of Mendelism-Morganism.

II.

The August Session of the Academy influenced the development of biology not only in the Soviet Union, but also in the whole world. Ten years have passed since that time. Now it is already possible to sum up some of the results.

During the past ten years the theoretical aspect of Michurin's teachings has received a further development while Weismannism-Mendelism-Morganism has lost its footing more and more. Let us contrast, in more detail, the theoretical conceptions of the one and the other trend and review the modern tendencies of their development.

Such basic characteristics of living beings as growth, development, heredity and its variability, reproduction and others in Michurin's teaching are results of metabolism, which is inherent in all that is living, assimilation - dissimilation.

Growth - increase in the mass of the living body, depends directly on assimilation - dissimilation, during the process of which the organism converts certain conditions of the external environment into its body. Life flows in a single process of adoption, assimilation, self-renewal and self-destruction (assimilation - dissimilation) while in the end more is created than destroyed; hence - the increase of the mass of the living body, its growth.

Development - regular qualitative transformations, which occur during the process of growth of the living body. It is characterized by certain requirements of the organism, which change during different stages, to the conditions of life and by a regular change of form. Individual development represents a continuous regular change of stages; phasic changes of annual seed plants occur in the cells at points of growth and bear an irreversible character. During phylogenetic development the consecutive regular change of specific forms occurs in conformity with the forced assimilation of conditions which are not characteristic to the old specific form.

Heredity - a property of the living body to require certain conditions for its life, its development and definitely to react to one or another condition.

A conclusion about the fact that metabolism is inherent to all that lives does not arouse any doubts. It is clear too, that in each specific case far from all conditions of the environment are assimilated. Which conditions are then assimilated by this or another organic form? "External conditions", writes T. D. Lysenko, "having been incorporated, assimilated by a living body, become already not external conditions, but internal; that is, they become parts of the living body, and for their growth and development require already that food, those conditions in the external surroundings, which they themselves were in the past". The requirement of a living body in those conditions out of which it itself arose is a characteristic just as inherent to all that lives as is metabolism itself. Thus, any living body possesses a metabolism of a definite character, its own type of metabolism, which issues from the affinity with those conditions from which it generated, originated. A concrete biological form - this or another species of plants, animals and microorganism - is a form of a specific type of metabolism.

A requirement of a living body for certain conditions in the external surroundings, which proceeds from the affinity with that nutriment out which it was itself built, appears to be the principle of self-preservation. In this lies the cause of the relative uniformity of the type of metabolism, and, consequently, of comparative constancy of organic forms. [Begin p.9]

Change in heredity occurs in consequence of the forced assimilation by a living body of several different conditions; as a result of this the living body itself, as well as its requirements, changes according to the assimilated conditions. After assimilation of new conditions there arises in the organism a requirement for such conditions of the external environment which transformed in it, and by means of it, into a living body. This is then that of which the law of adequate change of heredity consists.

Biological metabolism is the foundation for the oneness of the organic form and of conditions of its life. When analysing this oneness it is important to discern the external surroundings - a combination of external conditions under which the organic form lives, the conditions of life - conditions, which take direct part in the metabolism, more precisely, which are assimilated by the living body, and factors of influence - factors of the external surroundings, which are not required for a normal development of the organism, which are not assimilated by it, which do not influence its development.

The leading side of the oneness of the organic form and of conditions of life is the external environment. If a living body finds in it the required conditions of life it selectively assimilates them, forming itself in conformity with its heredity. If there are no required conditions then it perishes, or is forced to assimilate the somewhat different conditions and to form differently; when a living body changes, its heredity changes also.

Metabolism lies at the basis of such a property of the living body as reproduction. A normal organism exists in nature as an organized, interconnected, interdependent unity of organs, tissues, cells, and so on down to particles on the level of molecules. Growth of a living body, increase of its weight and dimensions occur as a result of increase of the amount and mass, which comprise its individuality, their growth in turn - as a result of increase of the amount of individualities comprising them, and so on down to the increase in the number of molecules, which form the substance of a living body. Consequently, the growth of a living body proceeds in the form of multiplication of individualities, from which it is composed. During the process of metabolism a living body not only grows, but also develops, is transformed; its individualities develop and multiply. Hence multiplicity and various qualities, continuity and discreteness are characteristic to a living body. Various methods of vegetative and sexual reproduction, which are observed at the present time arose during historic development of all that lives.

Although multiplicity and various qualities, continuity and discreteness are characteristic to a living body, yet in nature it exists specifically as a certain entity, as a specific form, as a biological species, be it an individual, a variety (a multiplicity of similar individuals), or a combination of varieties. In Michurin's teaching a species is regarded as a really existing quality, as a qualitative individual, unit of a living nature. Any living body exists in nature in the form of a specific species quality, which is characterized by a certain organization and type of metabolism. All the processes of life in each species, all its features and properties are directly or indirectly aimed to the increase of mass of the given specific species. Of this then consists the law of life of the biolgical species.

The law of life of the species (the nature of life) appeared together with the appearance of life itself, which arose in these or other forms of living bodies of a certain specific quality.

Such a specific property of the organisms as adaptability results also from the assimilation of conditions of the environment by a living body. Its basis is the law of adequate variability and regular interconnection of conditions of the external environment. Hereditary adaptability of organisms to the environment, together with the survival of the most adapted, and [Begin p.10] with the screening of the least adapted, determines the, so-called, expedient arrangement of the organic world.

We cited here very concisely, schematically, without any developed argumentation, several principles, which comprise the nucleus of the Michurin's materialistic trend in science about life and development of the organic world. Proceeding from this conception, and in close harmony with kolkhoz - sovkhoz practice, the theory and methods of directed change in heredity of plants, animals and microorganisms by means of crossing and distinct training are being developed; questions about biology of fertilization, about vegetative and sexual multiplication are examined; problems of species and of formation of species are studied, as well as the creative role of selection and other important questions in the life and development of the organic world.

Both the strengthening and a further development of theoretical principles of Michurin's teaching are being accomplished during the process of solving the important practical problems.

III.

What kind of changes has then Morganism undergone during this time? It steps forward now under various names: cytogenetics, classical genetics, experimental genetics, corpuscular genetics. Since at the basis of Weismannism-Mendelism-Morganism lies an assertion that there exists a special substance of heredity, which is comprised of corpuscles-genes, that are responsible for the very minutest properties of the organism, then in the future we shall call this trend corpuscular genetics (the author of this name, R. Goldschmidt, thinks that it reflects the nature of the theory the most precisely).

Genetics abroad does not represent a single stream. There too the number of active supporters of Michurin's trend is multiplying. Progressive scientists understand the irreconcilability of contradictions of both the trends and consciously cross to the positions of materialistic biology.

The camp of supporters of corpuscular genetics itself is not united: such a prominent geneticist as R. Goldschmidt denies, as before, the Morgan conception of the gene; Professor K. Lindegren (USA) did not share certain fundamental principles of Morganism, criticizing the assertion about the stability of the gene and the universality of Mendel's maxims; the Japanese geneticist Kh. Matsuura expressed his critical attitude to Mendelism; the Swedish geneticist Heribert Nilsson disagreed with the modern conception of the gene. This scientist wrote: "It is apparent that the gene is a stumbling block to the evolutionary theory." It became also a stumbling block to the geneticists since it yet seems to every researcher of heredity, and of this speaks also the experimental research, in which he is also convinced a priori, that he should not or that he cannot renounce the evolutionary theory. There is, to tell the truth, a fully logical outlet from this difficult situation, namely - to discard the gene altogether. This conclusion was made by Goldschmidt also. Such a sensational assertion of one of the leading geneticists is but a strict deduction from facts, which were obtained by the Morgan school, and, first of all, by Muller as the last verity concerning the nature of mutants. The results were as follows: that which was presented by the classical genetics was abolished by the classical mutation theory (1). The frame of mind of geneticists in this section was well expressed by Lerner, Chief of the American Genetic Delegation to the Ninth International Genetic Congress, who in the summing up article "The Ninth International Genetic Congress" (The journal "Science", 1953, [Begin p.11] vol. 118, no. 3076, p.708-709) wrote: "....the most significant tendency of the Congress in Belladjio proved to be the factual rejection of the classical idea of the gene as a subject of study". Lerner refers Morgan's idea about the gene to the naive and simplified conceptions, which were justified only for their time. Let us suggest, that even recently the demonstrability of the theory of gene seemed so indisputable that Morgan thought it no less persuasive, than the observation of the gene before one's eyes, directly. And N. P. Dubinin, in 1932, ascertained that already at that time "The notion about the gene was materialized and concretized". It proved to be that it was far from this. And ten years ago as well as now

(1) Is cited from the article by V. Retmaler "Inheritance and changes" ("Pressa Sovetskogo Soiuza", 1956, no. 62)

the theory about the gene was and remains an unprovable hypothesis.

On the pages of some of our journals during the last two years articles of N. P. Dubinin and of others were inserted, which in all possible ways praised the hypothesis about the specific genetic role of desoxyribonucleic acid (abbreviated as DNA) that entered into the composition of the cells' chromosome. N. P. Dubinin presented the hypothesis "gene-molecule DNA" in such a way as if it did not contain any contradictions, which were noted by its own authors; does not give any foundations for doubts and objections, which were voiced by many other biologists. He ignores the factual material that does not conform to it, but, instead, presents the hypothesis about chemical composition of DNA so categorically and with so much detail, that the hypothetic character of the main premise becomes lost behind the chemical computations and, as a result of this, the doubtful hypothesis outwardly looks substantiated.

All the theoretical ideas of Morganism are preserved in the new hypothesis, but with a new treatment of the problem about the material concretisation of the gene. Formerly the gene was conceived in the form of a particle of the chromosome, then in the form of the protein molecule of the chromosome, and now it is thought to be in the form of the molecule of DNA, which enters the composition of the chromosome, more precisely in the form of its part, which is presented by four nitrogenous bases. The newest supplement to the old Morganist conception of the gene consists in just that. As previously, the gene determines one or several characters; one character can be determined by several genes; genes are obtained in a finished form from the parents through the fertilized ovicell; in the chromosomes of the formed zygote all the peculiarities of the structure of the organism are preformed in the form of genes, - from the great ones to the minutest. Genes are very stable, they do not change while multiplying during the course of thousands of years, "... a copy of a copy of a copy, which was repeated several millions of times, is still practically undiscernable from the initial model" (G. G. Muller, journal "Priroda", 1956, no. 6). If the genes change now and then (mutations), then it is in a qualitative respect, independent of conditions of life. As the organism has countless properties, and even the minutest of them are determined, according to Morganism, by its gene, a doubt arose how such a huge number of genes could be located in the chromosomes. In order to overcome this difficulty, a new assumption was adopted; namely that the specific influence of DNA is conditioned by the order of the succession of nitrogenous bases in its complicated molecule. "Mathematical expectation [probability] shows, that the possible number of specific relative positions of these four bases is unusually great. In a segment of a DNA chain, which contains 100 nucleotides, the possible number of various specific relative positions of the four bases equals 4^{100}. This number exceeds the amount of atoms in the solar system". (N. P. Dubinin, journal "Voprosy Filosofii" [Philosophic Problems], 1957, no. 6, p.150).

Having declared the gene to be a DNA molecule, and having assigned to it all the properties of the gene, then in the properties of DNA, having admitted additional allowances they find the confirmation of the supposed properties of the gene. Nothing was changed in other respects. The organism, as before, is divided into embryonic plasm (DNA) and soma; as before genes are placed above the organism, it does not develop itself, but is developed by the genes, which find themselves in it as in a sheath; [Begin p.12] gene - DNA is declared to be the stable element of the cell, which virtually does not require any renewal. Here metaphysics and idealism remain the same as they were, and the purely chemical interpretation of phenomena of heredity only redoubles the already mechanistic character of the conception.

As a direct proof of the exclusive genetic role of DNA facts are enlisted, first, about transmutation of one strain of bacteria into another as a result of growing them on a medium, which contains DNA of this other strain; secondly, transmission of infection through the nucleic acid of the virus, and, thirdly, transmission of individual properties from one species of microorganism to the other with the aid of DNA particles of the bacteriophage. The facts proper represent great interest as they, first, confirm the conclusion about the fact that any particle of a living body possesses a property of heredity, secondly, ascertain the possibility of vegetative hybridization also in the microworld. But they are far from being proofs of the accuracy of the genic theory if only because in some case DNA is entirely absent at different stages of development of embryonic cells.

Thus, there are no new data, which prove the correctness of theoretical ideas of corpuscular genetics. The modern hypothesis "gene-molecule of DNA" - is the continuation of Morganism in its most orthodox expression. The noise, which was raised around the supposed achievements of corpuscular genetics, had a purpose to create in unskilled readers an impression as if they achieved some successes in concord with mathematics, physics and chemistry. But in reality no successes exist. The theory of gene, which lies at the basis of Morganist conception of life and development of organisms, is supplemented by the next hypothesis "gene-DNA molecule" in which the imagined is presented as the real.

IV.

Some supporters of corpuscular genetics claim, that in as much as they conduct research in the field of material bases of heredity, in as much as, according to their ideas, the gene is a material particle of the chromosome, more exactly - a DNA molecule, their understanding of biological phenomena must be regarded as materialistic.

Such statements can mislead inexperienced people. Firstly, the, so-called, substance of inheritance is endowed with supernatural functions: it governs the body, but is not itself governed, being present in a living body it at the same time remains outside the metabolism; secondly, only a part of the living body - the special substance, genes, is endowed with the property of heredity (let it be parts of the chromosome, DNA molecules, some corpuscles of the plasm, that is unimportant) and the remaining part of the body is deprived of this inalienable property of all that lives. In a living body there is no peculiar substance of heredity as there is no peculiar substance of life or of life force. Each particle of the living body and the living body as a whole possess the property of heredity. To search in it for a special substance of heredity is equal to searching for a substance of heat (thermogen) or the origin of combustibility (phlogiston).

Some maintain that Michurin's teachings ignore facts which were obtained by supporters of the opposite trend. This is simply untrue. Not the facts proper, but their incorrect interpretation, the inaccurate, nonmaterialistic theoretical explanation is denied by the Michurin's trend.

Morganists claim, that Michurin's supporters deny the cytological methods of research. This is also untrue. Undoubtedly, [Begin p.18] the most detailed examinations of the nucleus, of plasm and of other structures of the cell are useful. But the Michurinites are positively against those theoretical reasons from which Morganists proceed and those problems, which they set during cytological research, trying to find a mythical substance of heredity with the aid of the microscope.

Morganists say, that Michurinites are against their favorite object - the Drosophila fly. This is untrue also. One cannot be against one or another object of research in general. Both the Drosophila and the guinea pig, as well as the snapdragon have their merits as objects for an experiment. But, while experimenting with these objects one should always have in view the scientific, that is, objective fact, and the fact is tested and ascertained only by practice. Scientific, objective knowledge is always useful to man; it helps him in solving practical problems. In science it is necessary very often to revert to practice, as it alone is the criterion of fact.

But when there is no such goal, if scientific conclusions are not tested in practice, if science does not draw out from practice the strength for conducting new experiments, then theory inevitably breaks away from life, and then experiments with such objects as Drosophila only redoubles this break. If Morganists, experimenting with Drosophila, would test their results, for instance, on a cow, they would soon become convinced in the inaccuracy of their theory, as they would see that as a result of application of their methods the milk yield would decrease instead of increasing. Basic biological problems, both at the time of Darwin, as well as at our time, were solved and are still solved on those or other objects in close connection with agricultural and medical practice.

Often an opinion is expressed, that if a scientific worker influences an organism with x-rays, colchicine, then, they say, he is a Morganist; but if with a natural factor - heat, cold, grafting, then he is a Michurinite. Here is a clear misunderstanding. Advocators of the Morganist and of the Michurin's trends in biology are divided not by objects of research and not by methods of influencing the organism, but by theoretical approach to phenomena, their understanding and interpretation. Some raise a question if, in reality, the Michurin's and the contemporary Morganist trends in biology are irreconcilable or does their divergence come from the fact that one and the same phenomenon - heredity is studied from different aspects: here - as if from the ecologo-morphologic aspect and there - cyto-chemical. It is necessary, they say, to welcome the activity of geneticists of the corpuscular trend, who proceed from laws of mathematics, physics and chemistry when studying heredity.

For instance, is it bad that geneticists try to study cytological structures and chemical composition of these or other organs of the cell?

Such a stating of the question leads away from the essence of the work. One cannot but welcome the scientific works which have a purpose to study the structure of the cell and the transformations that occur in it. But cyto-genetics is not occupied with this, but seeks in the cell a nonexistant substance of heredity, an organ of heredity.

Undoubtedly, works on biochemistry are needed in general and biochemical studies of the cell in particular, but geneticists of the corpuscular trend are not interested in this, they only utilized the works of biochemists, concerning DNA and RNA, for the interpretation of phenomena of heredity in the manner of their mechanistic theory of gene.

At the same time it is necessary to point out a great lagging in bio-physical and biochemical research. The materialistic, Michurin's biology has now advanced so far ahead that physico-chemical studies of various aspects of the process of metabolism, which lies at the basis of growth, development, reproduction, heredity, [Begin p.14] variability, adaptability and other phenomena have become extremely important. It is necessary to widen and to deepen biophysical and biochemical research. Unfortunately, one has to point out that while physics and chemistry achieved wonderful successes in many fields, which generate a rightful pride and delight in human genius, biological physics and chemistry still fall behind the developing materialistic Michurin's biological science.

In any organism there take place both the physical and the chemical forms of movement: physical processes proceed there on the basis of physical laws, and chemical on the basis of chemical laws. The first must be studied by biophysics, the second by biochemistry. But any biological form (Plant, animal, microbe) is first of all a biological form of movement. Michurin's biology studies this form of movement.

A constant interconnection and interdependence of various forms of movement are peculiar to the organism; the biological form of movement is inseparable from the chemical and the physical. The interconnection and interdependence of physical, chemical and biological forms of movement really existing in nature stipulates also the interconnection of sciences: of physics, chemistry and biology.

During the report, which was given in March of 1958 at the annual Convention of the Academy of Science of USSR, Academician A. N. Nesmeianov reproached the biologists that they do not sufficiently develop a complex "which could be called physico-chemical biology". But it is quite obvious that physical and chemical transformations of living bodies must be studied not by biologists, but by biophysicists and biochemists. Because in the given case it is biophysics and biochemistry which are lagging, and not biology, even if physico-chemical. Incidentally, there is no such science as physico-chemical biology, and in our opinion it cannot even exist.

V.

The past 10 years have confirmed the efficacy of Michurin's teachings and still more have revealed the full practical sterility of Weismannism-Mendelism. Let us illustrate this on the example of the selection of plants.

Varieties of plants and breeds of animals are raised by man since long ago. It is known that Charles Darwin, forming the theory of natural selection, leaned upon a rich selection practice. The theoretical foundations of the selection activity of man, which were unrealized in the past are ever fuller disclosed in the light of Michurin's teaching and new methods of selection are being developed.

As earlier, so also now, selection lies at the basis of the process of raising new varieties of plants. The supporters of corpuscular genetics do not see any creative principle in selection. From their point of view it does not create anything itself and does not influence the production of new forms. But in actuality it is quite otherwise. Natural and artificial selections are a creative principle, which in a certain way influences the production of new forms, as it is connected very closely with heredity and variability.

Darwin's selection - is a metaphorical expression. Into it are included three indissolubly connected factors: heredity, variability and survivability (selection in a direct meaning).

Having revealed the essence of the process of selections, it is possible designedly to influence it. The ways for increasing effectiveness in selection are various. First of all this is an intelligent growing, training of plants. We find, in this respect, many valuable instructions given by I. V. Michurin in respect to fruit and berry plants. Our knowledge is also widening regarding annual crops. Now it is fairly easy, in the course of two-three generations, to directedly change spring wheat into winter, and vice versa, winter into spring wheat. It was ascertained, that [Begin p.15] changing spring wheat into winter in a given region, it is possible to obtain forms which are the most adapted to conditions of winter in the same region.

As an example of the change of nature of plants, when training them under appropriate conditions, can serve the change in the nature of potatoes by means of summer planting. During summer plantings of potatoes in the southern, hot regions potatoes not only do not degenerate, but their varietal qualities improve noticeably. Good nutrition, which is produced by a fallow tilling of soil and other favorable conditions of development (low autumn temperature, sufficient insolation) change the heredity of potatoes to the best.

If one finds out the conditions of formation of one or another feature in plants of any species, then it is possible, by suitably changing the conditions, directly to change its heredity. For most of the crops the specific conditions were not discovered as yet, which can improve their varietal qualities. That is why in selection work it is necessary to adhere to only a general rule: train the selection material under conditions, which help in obtaining the highest yield, the best quality of production, the development of resistance to different hazards.

One can increase the effectiveness of selection by means of directed influence on the processes of fertilization. Influence of near relational propagation and crossbreeding on the vitality and heredity of organisms was proved, and methods for utilizing these measures in selection work were established. Seeds with crossbred vigor were obtained from many crops, and especially from corn for production plantings; intravarietal and intervarietal crossbreeding is utilized in seed growing; supplementary pollination is used for cross-pollinating crops; methods for utilizing foreign pollen as a mentor are being developed, and so on.

Intraspecific and remote hybridization are utilized in selection work ever more wider. Principles for selection of parental groups for crossbreeding are being made more precise, as are methods for rejection of hybrid material, methods for controlling the so-called segregation of hybrids, overcoming the inability to crossbreed remote species, methods for producing new characteristics in this or another species of plants during interspecific hybridization and fixation of these characteristics. Development of hard winter wheat is of great scientific interest. Thus, for instance, F. G. Kirichenko (All-Union Selection-Genetic Institute, city of Odessa) when crossing spring hard wheat with winter soft wheat, and training hybrids under conditions of fall planting, has obtained hard winter wheat.

It is known that I. V. Michurin used vegetative hybridization fairly extensively. Of late it is also used in selection work with herbaceous plants.

Conscious mastering of the process of variability of plants, animals and microorganisms makes the selection in the hands of man an ever more powerful factor for producing new varieties and breeds, hybrids and strains.

The success of selection depended always and still depends on isolation and keeping for breeding the forms most useful for man. That is why improvement of methods of evaluation of selection material and of methods of selection, which will permit the more precisely to isolate, pick out and propagate the best forms are of vast importance for the results of selection work.

Let us cite certain data for characterizing the results of work of Soviet selectioners; these were taken from materials of the State Commission on Variety Testing of Agricultural Crops.

In 1957 the State Commission has tested 2,495 varieties of 122 crops; included in these were 1,703 variety of Soviet selection, 626 of local varieties and 166 varieties of foreign origin. Let us cite certain data on individual crops. [Begin p.16].

Varieties of winter wheat Odesskaia-3 and Odesskaia-16 were regionalized in steppe regions, with little snow, at the south of USSR (in 22 oblast's). Having high drought-resistance and winterhardiness, they give higher and more stable crop yields, than the varieties Ukrainka and Gostianum-237, formerly grown there. The new varieties are planted on an area over 6 million ha [hectare = 2.471 acres]; as a result of this kolkhozes and sovkhozes yearly obtain an additional crop yield of over 15 million c [centner = 220.46 lb.] of grain.

For the regions of forest-steppes of the Ukrainian SSR the highly productive large-seeded, more resistant to rust varieties "Eritrospermum-15, and Liutestcens-17" from the Verkhniachskaia Selection Station and "Lesostepka-75" from Belotserkovskaia Selection Station were recommended to replace the "Ukrainka" variety. These varieties, which occupy in production over 2.5 mln. ha, exceed "Ukrainka" in crop yield, on the average, by 3-4 c per hectare, but during the years of strong development of rust even more. Variety "Belotserkovskaia-198", which was regionalized in 12 oblast's of Ukrainian SSR, with a good quality of grain and a resistance to Hessian fly and to leaf rust excels in crop yield the old varieties by 4-7 c per/ha.

In North Caucasus the varieties "Novoukrainka-83 and 84, Bezostaia-4 and Skorospelka-3" of the Krasnodar Institute of Agriculture and "Gibrid-481" of the Stavropol' State Selection Station are widely spread, they combine high productivity and excellent quality of grain. It was calculated, that in 1956 alone kolkhozes and sovkhozes have additionally obtained over 5 mln. c of grain from the introduction of these varieties.

In Western Siberia and the Urals the spring varieties of wheat "Mil'turum-553, Iskra, Liutestsens-758, Al'bidum-3700", which replaced old varieties "Liutestsens-62, Noe and Mil'turum-321", considerably surpass them in yielding capacity (by 1.5-4 c per/ha); they are far more resistant to lodging and have grains of better quality. In 1956 their seeding area comprised about 6 mln. ha and in the near future can be increased by approximately two times; this will increase the general crop yield in kolkhozes and sovkhozes of Siberia by 22-25 mln. c.

The varietal make-up of grain crops was also improved in their resistance to diseases and pests.

There are exclusively large achievements in the selection of sunflowers; Academicians V. S. Pustovoit and L. A. Zhdanov work with them fruitfully for many years. If earlier in production varieties were planted with oil content of 35% in the kernel, then now the basic areas (76%) are occupied by high-fat varieties, the kernel of which already contains up to 50% of oil. Broom rape resistant varieties comprise 71.4% of sunflower plantings.

High-productive varieties of sugar beets Ramonskaia-06, Uladovskaia-752, Verkhniachskaia-038 and some others in 1957 occupied over 800 thousand ha of commercial plantings. These varieties give an increase in sugar yield of 2.0-3.5 c per/ha. Varieties, in which high saccharinity is combined with good production, such as "Verkhniachskaia-020, Verkhniachskaia-031, Ramonskaia-931, Ramonskaia-023 and Cercospora-resistant Pervomaiskaia-028" occupied in 1957 an area of about 400 thousand ha and gave an increase in the yield of sugar of 1.5-2.7 c per/ha. Saccharinity of the raw material increased by 0.3-1%. According to the most modest calculations, owing to the change to planting of the cited new varieties of both groups, the yield of sugar, in 1957, increased by 250-300 thousand tons.

During the years of Soviet power the change in varieties of cotton was carried out 4 times. As a result the length of the fiber was increased from 20-25 to 30-36 mm and the yield of fiber from 29-30 to 36-37%.

Among the 21 regionalized cotton varieties seven varieties belong to fine-fibered. The Soviet fine-fibered variety "2I3" gives a fiber which is not surpassed in quality by the best varieties of Egyptian [Begin p.17] cotton. At the present time still better varieties of fine-fibered cotton were developed: "8763-I, 5230-B, C-6002". Variety "8763-I" is better yielding than variety "2I3" by 7-10%, is 5 days ahead in early ripening, is more adapted to mechanized harvesting (as it has a more compact bush) and is not surpassed by it in the quality of fiber.

Working with the formation of varieties of agricultural plants the Soviet selectioners V. Ia. Iuriev, P. P. Luk'ianenko, F. G. Kirichenko, V. S. Pustovoit, L. A. Zhdanov, A. A. Krasniuk, A. S. Musiiko, S. S, Kanash, I. Kh. Maksimenko, A. L. Mazlumov, K. E. Bakhtadze, M. A. Lisavenko, S. F. Chernenko, F. K. Teterev, Kh. K. Enikeev, S. A. Pogosian, E. I. Ushakova, A. V. Alpat'ev, A. S. Iablokov, A. V. Al'benskii and others were guided by Michurin's teachings, which is apparent from their repeated statements from the rostrum of various conferences, conventions and in print, and especially from the nature of their work.

The services of the greatest Soviet selectioners - Academicians V. Ia. Iur'ev, P. P. Luk'ianenko, V. S. Pustovoit and S. G. Kirichenko were marked by awarding to them of the high rank of Heroes of Socialistic Work; many selectioners and other agrobiological-scientists were rewarded with decorations and medals.

In connection with the above said the intensified propaganda of the conception of Weismannism-Morganism by the "Botanical Journal" and certain other publications arouses astonishment. It proceeds under the guise of the exposition of new scientific data, which as though strengthen the corpuscular genetics. At the same time biologists of Michurin's trend are reproved of ignoring these valuable facts, but such facts are not specifically mentioned. Agreeing, in words, with the criticism of "old" Morganism, its supporters speak about some qualitative shifts in it, ascertaining that modern corpuscular genetics is far from that which it was earlier.

All these arguments serve only as a smoke screen for instance for such expressions: "Similar to the fact as these or other parts of our brain "direct" the activity of different organs of the body, these or other sections of the chromosome contain within themselves peculiar rudiments of various features and characteristics of the future organism. Such sections of the chromosome are called genes" - writes one of them(2). "A remarkable characteristic of living organisms proves to be the fact that in each organism, since the moment of birth, a certain apparatus is inserted, which governs the process of its development...From the point of view of a biologist in the embryonic cell there is a set of genes, which determine the features of the organism", writes another(3). To that which was earlier proved by Morganism,

(2) A. Emme. "Komsomol'skaia Pravda" no. 219 of September 14, 1957.
(3) A. A. Liapunov, journal "Tekhnika Molodezhi", no. 6, 1957.

now is added that the gene is a molecule of DNA or its part, - writes the third one[4]. In the recent works of biologists, physicists and chemists "...the fundamental laws of transfer of hereditary features by Mendel receive a scientific materialistic basis", ascertains the fourth,(5) and so on an so forth. Thus, the old idealistic substance of Mendelism-Morganism is presented as a new theory.

The practical sterility of the theory of corpuscular genetics is obvious. Nobody yet succeeded in achieving any practical results on its basis and will not succeed. The absence of facts, which prove the efficacy of the theory, are substituted by purely wordy declarations and loud projects.

"As a result of work of geneticists, physicists and chemists, unlimited possibilities were discovered in the features of living organisms and already a series of practical results has been achieved, the meaning of which is difficult to overrate", ascertains Academician I. L. Knuniants (journal "Tekhnika [Begin p.18] Molodezhi", no. 5, 1957). However, not only "a series of practical results", but not one important practical fact is mentioned. But, of course, no fact can be cited, in as much as there are none.

Again they promise golden mountains in the future and a rather remote one: "one should not be an ill-founded optimist", declares Academician V. A. Engel'gardt, "in order to believe that in 50 years 'the biological code' - chemical ciphering of hereditary characteristics, will be deciphered and read.

From that moment man will become full sovereign of living nature. Changing the position of atoms in genes, in chromosomes, he will give the

(4) N. P. Dubinin, journal "Voprosy Filosofii", no. 6, 1957.
(5) I. L. Knuniants, journal "Tekhnika Molodezhi", no. 5, 1957.

plants and animals those useful characteristics which they, obeying the will of man, will reproduce in the future generations" (Komsomol'skaia Pravda, no. 135, June 9, 1957). In a word, it is recommended to just wait for as long as ten Five-Year-Plans.

Not being satisfied with these broad declarations, the propagandists of "practical successes" of Mendelism-Morganism are not squeamish about pure misinformation. One can encounter many publications about the fact that on the basis of the theory of corpuscular genetics there, as though, were produced many economically valuable kinds of different varieties of plants, valuable breeds of animals, and so on. But, upon verification, it appears that actually there are none of those.

The modernized Morganism - the hypothesis "gene - molecule of DNA" is presented as a result of development of Darwinism, of Michurin's teaching and of exact sciences - mathematics, physics and chemistry. By means of purely worded manipulations, it is being made "loyal" in respect to dialectical materialism. More than that, they try to convince one, that modern Morganism is almost the natural-scientific foundation of materialistic philosophy. Simultaneously they publish sensational information "which experimentally prove", in spite of numerous facts, the impossibility of changing spring wheat into winter wheat, the impossibility of vegetative hybridization, and so on. The authors of these works, instead of learning that, which, apparently, they themselves do not know how to do, explain their failures as regularities, and present them as indisputable proof of the correctness of their theoretical points of view.

Such are the methods to which modern Morganists resort.

One cannot remain indifferent to those persistent attempts to regenerate Weismannism-Mendelism-Morganism in Soviet biological science. It is a duty and obligation of progressive scientists to carry on irreconcilable struggles against metaphysical, mechanistic and idealistic opinions in biology, which will remove biological science from helping agricultural science, which will distract it from solving the problems for a sharp rise in agricultural production, for the accomplishment of which the Soviet people work with such enthusiasm.

During the course of the whole history of the Soviet State, the materialistic Michurin's teaching, which is aiming to serve the needs and requirements of production, was always supported and is supported now by the Communist Party and the Soviet Government. Under the leadership of our Party and Government, the Soviet scientists in the future also will develop and improve the materialistic Michurin's biology.

Trans. A-995
(In full)
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Trenina, G. A., Gauze, G. F., Preobrazhenskaia, T. P.,
Brazhnikova, M. G., and Shareva, Iu. A.

Antivirubin - protivovirusnyi antibiotik, obrazuemyi Actinomyces longisporus ruber.

[Antivirubin - antivirus antibiotic produced by Actinomyces longisporus ruber].

Antibiotiki, vol. 1, no. 4, p.9-13.
1956. 396.8 An84.

(In Russian)

995

In testing the inactivating action of a large number of cultures of the different actinomycetes upon the tobacco mosaic virus, V. A. Sherin, O. K. Rossolimo and E. S. Kudrina observed that some strains of the species Act. longisporus ruber [longispororuber] (including strain no. 8173) display on this model a strong inactivating action upon a virus. In applying agar blocks excised from cultures of the indicated strains, the virus fails to develop on the surface of a leaf inoculated with the tobacco mosaic virus, and necrosis is absent not only under the agar blocks, but also on a considerable area that surrounds them. In connection with the above, an attempt was made to extract an antibiotic from the cultures of the above-mentioned strains of Act. longisporus ruber capable of inactivating the tobacco mosaic virus, and to test the action of this antibiotic upon different viruses in vitro, as well as in vivo. As a result of the work carried out a new antibiotic representing a bright red pigment was obtained; this antibiotic inhibits the growth of staphylococci, inactivates the virus of

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grippe and the virus of smallpox, yet exerts no action upon bacteriophage. We named this antibiotic antivirubin (antivirus substance derived from Act. longisporus ruber).

Characteristics of antivirubin producing organisms. Antivirubin producing organisms are rarely encountered. Strain no. 8173 of Act. longisporus ruber was isolated from the desert soils of Kara-Kum. We isolated similar strains from the soils of Dagestan, Armenia and the Krasnodar Territory.

These strains were related to each other as regards their morphological and cultural characteristics. They inhibit the growth of the golden staphylococci [Staphylococcus aureus], but do not inhibit the growth of the enteric bacillus. The characteristics of strain no. 8173 of Act. longisporus ruber which proved more productive and which we utilized in experiments in biosynthesis are cited below, as are data on the isolation and chemical purification of antivirubin.

Strain no. 8173, when grown on a synthetic medium with starch and mineral nitrogen, forms a bright red substrate mycelium with an orange hue (the color of eosin). The medium does not take on the color. The aerial mycelium forms on the 3rd to 4th weeks and sometimes has a velvety, rose color. The sporophores [sporonostsy] are short, in most cases upright, sometimes with one incomplete spiral turn [oborotom spirali]. The spores are extended and oval.

On a medium having an organic source of nitrogen, and actinomycete forms a brownish red substrate mycelium and an orange-colored aerial mycelium, ... staining the medium brown. On potato slices the colonies have protuberances and a brown-green-red or red substrate mycelium and an orange-colored meager aerial mycelium. [Begin p.10].

In milk the culture produces a bright red mycelium and imparts to the milk a slightly brownish color. The milk does not change for a period of 20 days.

On starch agar the colonies are a bright pink, on the 10th day of growth they form a 5 mm hydrolytic zone.

On gelatin the culture grows adequately, forms a bright red substrate mycelium and liquefies it on the 5th day. It grows on cellulose and reduces nitrates energetically. It does not invert saccharose. The cultures belong to the species Act. longisporus ruber (Krasil'nikov, 1941).

A study of the spectrum of the antibacterial action of the antivirubin producing organism was conducted by the method of intersection on agarized culture media containing Hottinger's broth, peptone, glucose and NaCl. The results are cited in table 1.

Table 1.

Spectrum of antibacterial action of the antivirubin producing organism

Test microbe	Zone of growth inhibition of the test-microbe (in mm)
St. aureus La	16
Bact. coli	0
Bact. mycoides d-7	19
Bact. mycoides d-4	19
Proteus vulgaris	0
Bac. subtilis	19
Bact. pyocyaneus	0
Saccharomyces cerevisiae	10
Candida albicans	6
Sarcina flava	20

Production of antivirubin. As indicated above, agar blocks of Act. longisporus ruber culture no. 8173 grown on organic media at 28° [C] for

4-5 days possess the capacity to inactivate the tobacco mosaic virus when applied to the surface of an infected leaf. We established that these agar blocks contain an antibiotic inhibiting the growth of the gold-colored staphylococci. After steeping the agar blocks for an hour in an equal amount of sterile water, the antibiotic found in the water extract inhibits staphylococcal growth in a 1:64 dilution.

Further, we used the gold-colored staphylococci as test-objects in isolation and in chemical purification of the antibiotic. The antivirubin preparation, isolated and purified on the basis of [its] antistaphylococcal action proved to be a carrier of antivirus properties as well.

A further study of the physiology of antivirubin formation in liquid nutrient media by means of submerged growth of the producing organism has demonstrated that the new antibiotic is concentrated mainly in the fungus mycelium and is excreted [Vydeliaetsia] into the cultural liquid only in certain media in very insignificant amounts. The extraction of antivirubin from the mycelium of the producing organism was accomplished as follows: The filtrated mycelium was dried to a state of air-dryness, was drenched with strong acetone 5 times its volume and was extracted by shaking for 2 hours.

The antivirubin producing organism was cultivated on various media. The best results were obtained when an actinomycete-producing organism was cultivated on media [Begin p.11] containing $NaNO_3$-0.3%; starch - 0.5%; maize - extract 0.1%; $FeSO_4$ - 10 mg/1; K_2HPO_4 - 0.05%; $MgSO_4$ - 0.05%; NaCl - 0.05%, or on a nutrient medium the composition of which included the following components: Hottinger's broth - 3%; starch - 0.5%; $FeSO_4$ - 10 mg/1; K_2HPO_4 - 0.05% and $MgSO_4$ - 0.05%; activity of acetone extracts derived from the fungus mycelium reached 300 units of dilution /ml (test-microbe - St. aureus).

The best [culture] medium for the formation of antivirubin is nutrient agar containing Hottinger's broth (30 mg% amine nitrogen), 1% glucose and 0.8% sodium chloride. If after 4-5 days of growth on this agar, the fungus were to be extracted by means of water, then the antibiotic inhibiting the growth of staphylococci in a 1:64 dilution would be found in the water extract.

Antivirubin is adsorbed from water solutions on activated carbon during a neutral reaction of the [culture] medium. It cannot, however, be desorbed by various organic solvents. Nor does antivirubin undergo sorption on a column containing permutite. Extraction of antivirubin from water solutions by means of amyl alcohol and chloroform is very inadequate. But by using multi-replicate extraction by means of butanol with supplementary salting of the cultural liquid with sodium chloride, it is possible to extract up to 60% of the antibiotic. The extraction degree does not depend on the pH of the medium.

The fullest isolation of antivirubin was achieved by steeping the agarized nutrient medium on which the producing organism was cultivated with strong acetone. If the acetone extract is concentrated under a vacuum, then a bright red precipitate insoluble in water settles out. The activity of the precipitate comprises 800 antistaphylococcal units per mg. The spectrum of the antibacterial action of such a preparation is presented in table 2.

Table 2.

Spectrum of antibacterial action of antivirubin

Test-microbe	Titer of the water-alcohol solution of the antibiotic (in unit solution/ml)
St. aureus Ia	600
Bac. mycoides d-7	800
Bac. subtilis	600
Bact. coli	15
Candida albicans	30

The antibiotic is fairly stable and is not destroyed when heated for 15 minutes in a water bath at pH 7.0. If antivirubin is heated under the same conditions at pH 3.0 and 8.0, then its activity is decreased twice.

Antivirubin represents a bright red pigment with the properties of a dye: it dyes excellently hides, silk fabrics and some other substrates.

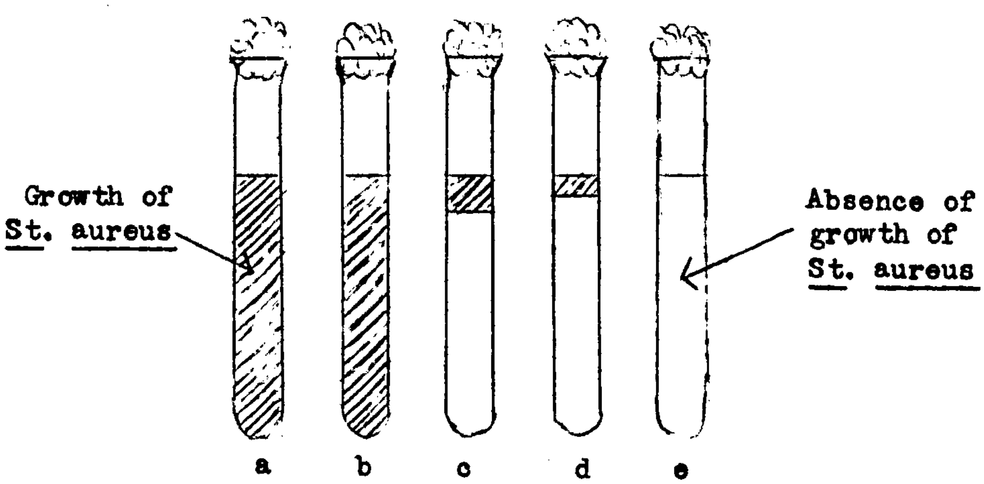
The presence of fairly large quantities of blood sera leads to but minor inactivation of the antibiotic (table 3).

For the purpose of a more detailed characterization of the antibacterial properties of antivirubin, we studied the action of the preparation on St. aureus Ia (a facultative anaerobe) that grows under aerobic and anaerobic conditions. In so doing, we used the following method: filtered agar (composition: meat infusion [miasnaia voda] - 1000 ml, peptone - 5 gm, agar-agar - 4 gm) was poured out in test tubes of a small diameter (10 ml per test tube) and sterilized. A suspension of the gold-colored staphylococci in a physiological solution [Begin p.12] (500 million microbe bodies per ml) was prepared for plating. Prior to the plating, the test tubes containing the medium were placed in a boiling water bath for 20-30 minutes (as a result of which air was removed from the agar) and afterward they were chilled to 45-50°. At this temperature, 2-3 drops of the bacterial suspension and antivirubin dissolved in alcohol containing water were added to the medium. The required concentrations of antivirubin were produced in the medium by adding 0.1 ml of concentrated solutions of this antibiotic to each test tube. Then the medium was thoroughly mixed and the necessary precautions were taken against the penetration of air bubbles into the agar. The test tubes were placed in cold water for awhile and then in an incubator at 37° [C].

Table 3.

Influence of blood serum upon the activity of antivirubin (in vitro)

Concentration of blood serum in the medium (in %)	Antivirubin titer in units of dilution/ml. Test-microbe, *St. aureus*
0 (control)	3200
1.5	3200
5	3200
10	1600
20	1600
50	1200



Antivirubin action upon staphylococci under aerobic and anaerobic conditions (scheme).

In the control test tubes the bacteria grew throughout the entire agar layer. Yet in those in which antivirubin was present in the medium, we observed the following picture. At an antibiotic concentration of 0.5 units of dilution/ml, the growth of the gold-colored staphylococcus did not differ from the controls. At an antivirubin concentration of 1 unit of dilution/ml growth of the test-microbe was clearly marked in the upper part of the test tube, the lower part of the test tube remained transparent, i.e. in such concentrations the antibiotic inhibited the growth of St. aureus Ia under anaerobic conditions. In the presence of 2 units of dilution/ml the growth of test-bacteria was fully inhibited over the entire agar layer, i.e. under anaerobic as well as aerobic conditions (see figure). Thus, antivirubin inhibits the growth of staphylococci under anaerobic conditions to a higher degree than under aerobic.

CONCLUSIONS

We have described the producing organism of antivirubin, the new antivirus antibiotic which belongs to the Actinomyces longisporus ruber species. We discovered this antibiotic in the mycelium of an actinomycete. A nutrient medium containing Hottinger's broth and glucose is optimal for its formation. Antivirubin represents a bright red pigment with the properties of a dye. It was obtained in the form of a dry preparation containing 800 antistaphylococcal units per mg. Antivirubin possesses selective action [with respect to] staphylococci, Bacillus mycoides and the hay bacillus; it inhibits slightly the growth of the enteric bacillus and Candida albicans. Blood serum attenuates antivirubin action upon bacteria only to a small extent. The preparation inhibits the growth of bacteria under anaerobic conditions to a greater extent than under the availability of oxygen.

LITERATURE

Shorin, V. A., Rossolimo, O. K., and Kudrina, E. S. Antibiotics. 1956. no. 2.

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Khadzhinov, M. I.

Selektsiia samoopylennykh linii kukurusy so steril'noi pyl'tsoi i linii vosstanovitelei fertil'nosti.

[Breeding of self-pollinated lines of corn with sterile pollen and line-restorers of fertility].

Selek. i Semen., vol. 22, no. 1, p.8-13. 1957. 61.9 Se5.

(In Russian)

996

Hybridization of self-pollinated lines for the purpose of obtaining high-yielding hybrids is one of the most effective methods of selection of corn. As it is known, tassels are removed from female plants during hybrid seed-growing. This work is carried out by hand and requires large expenditure of labor. Consequently, development of methods of growing hybrid seeds of the first generation, when the input of hand labor for the removal of tassels will be eliminated or sharply curtailed, is of essential importance.

One of such methods is built on the utilization of sterility of pollen, which develops on the basis of cytoplasmic heredity. At the present time in USA there already exist corn hybrids the seeds of which are grown without the input of labor for removing the tassels in female plants, as well as hybrids for the obtaining of which the expense is decreased by 50-75%. Some of these hybrids were tested on our variety test plots in 1956.

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The peculiarity of inheriting cytoplasmic sterility of pollen consists in the following. When crossing plants, which have sterile pollen, with some self-pollinated lines usually all the plants of the first generation prove to have sterile pollen and have ears normal in productivity. After repeated saturation crossings with this same self-pollinated line, during the course of many years, the sterility of pollen is preserved in all plants of the race. Along with these there are self-pollinated lines, which after being cross-bred with plants having sterile pollen, have among their offspring plants that are sterile, as well as semisterile and fertile.

At last, occasionally line-restorers are met which have, after such a hybridization, offspring with only fertile pollen. Difference in the inheritance of the characteristic of sterile pollen can be explained by the circumstance that although its transfer is accomplished through the plasm of the maternal plant, the appearance of sterility or fertility of pollen in the hybrid depends on certain hereditary peculiarities of the paternal line (Jones, 1950).

I would remind you of a scheme of selection work utilizing the phenomenon of sterility of pollen of cytoplasmic type of inheritance, which was suggested by Mangelsdorf in 1944 (Rodgers and Edwardson, 1952). The maternal line A of the maternal simple hybrid was transformed to a sterile analogue-line Ac, which differed from line A only by the sterility of pollen, by means of 4-5 fold saturation crossings with the initial sterile form. [Begin p.9] Line B, which had an ability to produce, after crossing, a hybrid with sterile pollen and productive ears, was selected in the capacity of the paternal line for obtaining the maternal simple hybrid. The maternal sterile hybrid $(A \times B)_c$ was produced in this way. For the production of the paternal simple hybrid a line was utilized, which was capable to fully reestablish fertility after crossbreeding. In a double hybrid which was obtained from crossing a maternal simple sterile hybrid $(A \times B)_c$ with such a specially selected simple hybrid, the fertility of pollen should be fully restored. If only one line of the simple paternal hybrid possesses the restoration ability, and the other does not, then in the double hybrid only a part (about 50%) of plants will have sterile pollen. As a rule, the number of these fertile plants was sufficient for a normal pollination of ears in commercial plantings. When for a simple paternal hybrid lines are utilized which do not restore the fertility, all the plants of the double hybrid will have sterile pollen. For an economic utilization it is necessary to add to the seeds of such sterile double hybrids 30-50% of seeds of the same fertile hybrid in order to guarantee the normal pollination of ears.

Work on selection of lines with sterile pollen was begun at Krasnodar Scientific-Research Agricultural Institute in 1954. Specimens of local varieties of Moldavian SSR served as initial material, in which plants were found with sterile pollen of a cytoplasmic type of inheritance. It was ascertained at the Kuban Experimental Station VIR [All-Union Institute of Plant Industry] that in the specimens of the VIR collection Pin'oletto X Chinkvantino, catalogue no. 11165, Ganganka X Chinkvantino, catalogue no. 11179, and Moldavanka X Chinkvantino, catalogue no. 11202, there is a high percentage of plants with sterile pollen. At the Krasnodar Scientific-Research Agricultural Institute plants with sterile pollen were isolated in 1954 from the specimen of the American variety, Mexican June, catalogue VIR 4638. According to data of Rogers and Edwardson (1952) in this variety and in those related to it, appearance of plants with sterile pollen was observed. Since 1955 a sterile form was included in the work, which arose as a mutation in the self-pollinated line of a variety related to Mexican

June. This sterile form is characteristic to the so-called Texas type of sterility and is utilized in USA for the production of a line with sterile pollen.

For solving the problem of production of hybrids without detasseling it is necessary first of all to appraise a large collection of self-pollinated lines according to their behavior as hybrids with sterile plants. Such an evaluation will permit the isolating of lines, which are suitable for the production of sterile analogues and of line-restorers of fertility.

Plants from original specimens of Moldavian varieties and of the variety Mexican June served as initial sterile maternal forms for such crossings in 1954. Crossing with sterile plants of the original specimens of the Texas type of sterility were conducted in 1955.

Later on the sterile plants of these hybrids were utilized for crossings with the new self-pollinated lines.

Usually, fully sterile plants were used as maternal forms. One to four crossings were conducted for each combination, whereupon for each one the pollen from one tassel of different plants of the given line was utilized. This was caused by the necessity to select in the limits of the paternal line, as, according to the existing data, many self-pollinated lines preserve heterosis [Begin p.10] according to the hereditary peculiarities, which determine the formation of pollen in hybrids with sterile plants (Jones, 1950).

Hybrid seeds (40-200 specimens of each combination of crossing) were planted next year at two-three dates with an interval of 10 days. The flowering of tassels of hybrid plants was examined twice: at the beginning of the appearance of silks and at the end of blooming of the ear, when the stigmata began to wither. Each plant was referred to one of the groups - sterile, semisterile, or fertile.

The initial material, which was utilised in the work, as it will be shown later, belonged to genetically different types of cytoplasmic sterility - Moldavian (MPS) and Texas (TPS). The external character of manifestation of sterility in the examined types was somewhat different. To sterile plants of type MPS belong those in which the anthers do not emerge from the spikelet at all at the time of blooming, as well as plants with a very insignificant amount of disorderly emerging anthers. Such single anthers do not open up and do not disperse dust. To this group those plants were also referred in which the anthers, even when they emerged from the spikelets in large numbers, did not produce any pollen. When the pollen of sterile plants, of the MPS type was colored with carmine or a solution of iodine in potassium iodide, it appeared to be crumpled and very fine; it did not become tinted because of the absence of starch. To semisterile belong the plants with a small number of opened anthers, which give a small amount of pollen. Opening of the newly emerged anthers during the process of blooming of the tassel stops often and they cease to disperse the dust. In some cases the single opening anthers appear only at the end of the tassel's blooming. In semisterile plants considerable fluctuations are observed in the degree of coloration and in the dimension of pollen.

Flowering of tassels of plants, which are referred to the group of fertile is practically undistinguishable from that of normal tassels. Emergence and opening of anthers proceeds normally, pollen is produced in ample quantity.

Sterile plants of TPS type, as a rule, do not project any anthers. Very rarely one observes in them a disorderly emergence of single minute anthers with sterile pollen. In semisterile plants of this type usually a very small amount of anthers with normal pollen are projected, and often such anthers appear with great delay, when the silks of the ears begin to wither. When examining the colored pollen of the emerged anthers under a microscope a large percentage of normal pollen is discovered. According to data of Rhoades (1933), of Rodgers and Edwardson (1952), the reduction division in sterile plants proceeds normally, degeneration of pollen cells occurs during a later period of formation and is connected, apparently, with a disruption of accumulation of starch in them.

Results of evaluation of self-pollinated lines after crossing with sterile plants of type MPS are cited in table 1 and of type TPS in table 2. In each table the results on lines of VIR and of KNIISKH [Krasnodar Scientific-Research Agricultural Institute] are cited separately. In order to reduce the volume of tables and for the convenience of reviewing, all the studied lines were referred to one of the four groups according to their behavior as hybrids with sterile plants:

1. All the plants of the hybrid are fully or very highly sterile; there are up to 5% of semisterile plants. 2. Hybrids with a large predominance of sterile plants, but semisterile and single fertile plants appear. 3. Along with sterile plants there is a considerable amount (50-70%) of fertile and semisterile plants. 4. All the plants of the hybrid are fertile (line-restorers of fertility).

[Begin p.11].

Table 1.

Evaluation of self-pollinated lines VIR and KNIISKH in hybrids with sterile plants of MPS type

Group	Lines of VIR collection	Lines in group	Lines of KNIISKH	Lines in group
1	28, 34, 40, 41, 44, 51, 52, 53, 55, 67, 81, 83, 89, 94, 97, 115, 118, 134, 157, 164, 175, 176, 182, 191, 219, 235, 239, M_{13}, A, WF_9, A_{48}.	31	KR.9, KR.37, KR.48, KR.88, KR.100, KR.113, KR.123, KR.132, M.18, M.38, M.105, M.202, KZ.22, KZ.82, KZ.111, 2KZ.14-1, 2KZ.46, GF.9, GF.30, Gb.10, Gb.24, Gb.303, Gb.34, Gb.338, Gb.441, Gb.459, Gb.499, C.13	28
2	17, 29, 38, 39, 43, 64, 69, 84, 98, 112, 123, 137, 152, 155, 158, 174, 180, 188, 238, G.23, Tr, K.	22	KR.111, KZ.8, KZ.86, KZ.102, 2KZ.14-3, Gb.28/23.6, Gf.32, Gb.135, s/o.29-5, Gb.445, C.10, Dn. C.84.	11
3	26, 27, 135, W.155	4	KZ.50, Gb.135, s/o 50-2, Gb.458, Gb.500	4
4	82, 73.	2	KZ.126, SG.2, Gb.144, Gb.107, s/o 87-1.	5

Table 2.

Evaluation of self-pollinated lines VIR and KNIISKH in hybrids with sterile plants of TPS type

Group	Lines of VIR collection	Lines in group	Lines of KNIISKH	Lines in group
1	27, 29, 32, 38, 51, 81, G.9, 115, R_3, 135, 137, 164, Tr, A_{48}	14	Kr.37, M.105, KZ.8-3, 2KZ, 50, GF.30.	5
2	26, 28, 40, 47, 67, 76, 78, 82, 83, 88, 90, M_{13}, 101, 106, 118, 123, 125, 129, G.23, B.R. J90, WF_9, Mu, 139, 140, 144, 148, 152, 165, 182, 235, 238	31	Kr.48, Kr.111, KR.132, M_{239}, KZ.8-2, KZ.22, KZ.30, KZ.95-5, KZ.103, KZ.111-2, 2KZ, 14, GF.9, GF.32, Gb.28/23. 5-3, Gb.135 s/o.29-4, Gb.138 s/o.30, Gb.107, Gb.144, Gb.441, Gb.460, Gb.500	21
3	31, 34, 64, 219	4	KZ.82, KZ.129, Gb.77, Gb.305	4
4	39, 44, K	3	2KZ.35, Gb.135 s/o.18-1	2

[Begin p.12].

Studies of the behavior of a great number of self-pollinated lines in hybrids, which were obtained from crossing with sterile plants, permits making a series of conclusions, which are of practical importance for selection of hybrids, that are grown without detasseling.

The obtained data with certainty indicate the fact that the genetic nature of sterility of type MPS and TPS was different. This conclusion is established on the basis of a series of cases of different behavior of the same self-pollinated lines after crossings with plants of type MPS and TPS.

In Table 3 data are cited for lines, which after crossing with plants of various types of sterility have shown great differences. They are especially great in lines VIR-44, VIR-39, VIR-27, Gb.144-1, Gb.305 and others. Results of experiments permit one to think that sterility of pollen, which is inherited through plasma of the maternal plant, can be caused by various hereditary changes of the plasm since for the restoration of fertility in the offspring the paternal form must possess necessary genetic peculiarities. Selection value of this fact, established for the first time, consisted of the matter that as a result of genetic difference in the nature of sterility of types MPS and TPS the number of lines increased greatly, from which [Begin p.13] sterile analogues can be produced, as well as a number of line-restorers of fertility.

Lines of group I can be transformed into sterile types MPS and TPS by means of saturation crossings. For the transfer of lines in group 2 an additional selection work is required - conducting of repeated self-pollinations with a simultaneous checking of the ability of obtained sublines to produce fully sterile plants after crossing. Jones (1950) points out the effectiveness of such repeated selection of lines.

Among 107 studied lines after checking seven line-restorers of fertility for sterile plants of type MPS (6.5%) were isolated and among 84 five line-restorers for type TPS (5.6%). These values are somewhat lower than those obtained by Rodgers and Edwardson (1952), who isolated 3 line-restorers from 33 studied lines (91%); this fact, apparently, is explained by the difference in the origin of the studied self-pollinated lines. Apart from lines, which fully restore the fertility, we brought out 8 lines each (group 3), for both types MPS and TPS, which restored the fertility in a considerable number (50% and over) of hybrid plants in lines with sterile forms. Conducting repeated self-pollinations, selection and examination of hybrids will permit to reveal sublines, which will be capable to fully restore the fertility of pollen.

The existing collection of full line-restorers and of lines, which are able to restore high fertility of hybrids, permits already now to produce many simple paternal hybrids, which can guarantee full or sufficiently high fertility of pollen of the double hybrid and its high yielding capacity. To such simple hybrids, which restore fertility in sterile lines of type TPS, belong hybrids VIR-44 X VIR-39, VIR-39 X VIR-34, VIR-44 X VIR-34, VIR-219 X K, Gb.305 X VIR-44, and for the lines of type MPS - simple hybrids VIR-26 X S.o. 87, EBZ X SG.2, VIR-82 X VIR-73, and others.

Results of work on production of sterile analogues for a series of self-pollinated lines, as well as of simple hybrids and studies of heredity of restorative ability, which were conducted by K IIBKH during the period of 1954-1956 will be described by us in addition to this.

Table 3 is on the next page.

Table 3.

Comparison of behavior of self-pollinated lines in hybrids with sterile plants of type MPS and TPS

Lines	Sterility of type MPS					Sterility of type TPS				
	Group of lines	Number of hybrid plants				Group of lines	Number of hybrid plants			
		Total	Sterile	semi-sterile	fertile		Total	Sterile	semi-sterile	fertile
VIR-26	3	214	46	44	124	2	77	47	17	12
VIR-27	3	120	64	19	47	1	58	55	3	0
VIR-135	3	38	11	11	16	1	40	40	0	0
VIR-34	1	40	38	2	0	3	38	15	1	23
VIR-84	2	40	35	5	0	3	37	10	13	14
VIR-219	1	28	27	1	0	3	36	17	3	16
VIR-39	2	139	104	11	14	4	58	0	2	56
VIR-44	1	192	192	0	0	4	98	0	1	97
K	2	18	15	3	0	4	40	0	0	40
Lines from Krasnodar Scientific-Research Agricultural Institute										
Kz. 82-1	1	40	40	0	0	3	37	2	19	16
Gb. 305	1	38	38	0	0	3	38	11	4	23
Kz. 30-1	3	70	25	13	32	2	39	13	21	5
Gb. 135 s/o.30-2	3	38	15	10	13	2	38	31	4	3
Gb. 500	3	5	1	0	4	2	32	17	13	2
Gb. 144-1	4	40	0	3	37	2	39	14	24	1

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Chudnovskii, A. F.

Sovremennoe sostoianie uchenila o teplovom reshime sel'skokhoziaistvennogo polia.

[Contemporary status of knowledge about thermal regime of agricultural fields].

In Ioffe, A. F., and Samoilova, I. I., ed. Voprosy agronomicheskoi fiziki, p.127-142. Leningrad, 1957. (Not yet D.A. Library).

(In Russian)

It is generally accepted that heat, along with light, water and food, is a basic factor of the external environment, which shapes the development of the agricultural plant and of the crop. In view of this, of late, studies of heat conditions in the soil became very important in agrophysics. Unfortunately, the greatest number of works in this direction contain only research on heat conditions of the soil.

Yet it is easy to show, that the knowledge of temperature in the soil or even of the temperature field, that is the distribution of temperature in the soil along the depth and in time, is quite insufficient when solving a large number of even such problems, which basically bear an energetical character.

Here is an instance. We studied in Leningrad oblast' in 1954, and our comrades, Latvian physicists, in 1953-1954, a problem of the ameliorative effect of hill planting of vegetables and potatoes. We were interested in the question about causes for the origination and about quantitative evaluation of the supplementary heating of the hills, that under conditions of the Union of SSP can be utilized for the purpose of early growing of vegetables and potatoes. If one should limit oneself to only temperature measurements, then it will be proved that the upper 5-centimeter layer of soil in the hills, during the early spring period which interests us, compared to the flat field at the same depth, is warmer during the day, and colder during the night. Thus, we cannot find any advantages in the thermal condition of soil by just recording the temperature of the soil. Nevertheless, a deeper analysis of the whole thermal regime of the soil, which is determined, in addition to the temperature in the soil, also by heat accumulation, by thermal characteristics, and by the heat flow in the soil, convinces us of a definite advantage of hills.

Really, the hill, compared to a flat field, appears to be mellower and drier, and, consequently, has lesser values of volumetric thermal capacities C and of coefficients of heat conduction λ. It would seem that these facts would speak against a better heating up of hills, since smaller coefficients of heat conduction on the hill indicate a smaller flow from the surface of the hill into its depth. But at the same time, a lesser thermal capacity indicates, that a smaller portion of heat is needed for heating up each cubic centimeter of the hill soil. Thus, although less heat is directed inside the hill, but considerably less stays in it, and a great portion can pass through the soil. Consequently, [Begin p.128] the speed of heating up the hill, which is characterized by a coefficient of thermal diffusivity K, is found to be greater on the hill. This is in line with ratio $K = \frac{\lambda}{C}$. During the night because of a greater K, the hill may cool off faster than the flat surface of the field, but one should have in view, that during the period of early spring the day interval of the 24 hour day in northern zones of the Union of SSR is longer and the effect of heating up during the period of vegetation will prevail over the effect of cooling off. It is important then to remember that during the sunny spring days the hilly surface of the soil is considerably warmer (by 3-5°) than the flat surface. Both values - the temperature of the surface T_o and the coefficient of thermal diffusivity K are found to be higher on the hill, than on the control; and it is known from the theory of heat conductivity, that only these two values (and no others) influence the temperature of soil at any moment of time and at any depth. Indeed, at a given temperature on the surface T_o the resolving of the equation of heat conduction is reduced to the form (1):

$$T = f\ (x,\ t,\ T_o,\ k) \qquad (1)$$

which contains only T_o and k. Consequently, it is no wonder that through the whole mass of the hill x, starting at 5 cm and deeper, the soil is warmer than in the control.

Thus, owing to the analysis not of the temperature, but of the full thermal regime of the soil, one succeeds to understand, in the case of the hill planting method, why the hill heats up more intensely than the flat field. Nevertheless, one fails to understand in this way the full mechanism of the phenomenon, that is to discover and quantitatively to evaluate the sources of the heat-ameliorative effect, which is obtained in the hill when compared to the control. This is explained by the fact that so far we were interested only in that which proceeded in the soil, forgetting althogether the accompanying processes in the air near the ground in which the plant lives. Meanwhile, only their united examination will permit their many sided and fuller understanding; to quantitatively appraise and to point out the possibilities of an efficient and directed change of the studied effect, in the given case - the thermal - ameliorative effect in the hill. Apparently it is necessary to lend a wider meaning to the idea of the thermal regime of soils, which will include not alone the thermal condition of the soil itself, but also the connected with it states and properties of the second environment - the air near the ground: the turbulent characteristics of the surface air, heat exchange capacity of soil with the surface air, and the thermal-physical characteristics of the last one. Equalization of the heat balance on the soil's border is the most general and unifying condition for both environments (soil-surface air), the analysis of which under various, specific conditions permits exposing more fully and in more detail the physical state and properties of these media, and thus to solve the complicated agricultural, agrotechnical and agro-ameliorative problems. As it is known, the equation of heat balance during the summer time for the day period is expressed thus:

$$Q_n + Q_p + Q_q - Q_o - Q_u - Q_{ak} - Q_k - Q_{uc} = 0. \qquad (2)$$

and for the night period:

$$Q_q - Q_u + Q_k + Q_{ak} + Q_{uc} = 0. \qquad (3)$$

Q means a current of heat, which is expressed, for instance, in calories per 1 cm^2/sec., the sign + refers to the current which flows to the surface, and the sign - to currents which flow out from this surface. The signs "n" "p" [Begin p.129] and "q" denote direct solar radiation, scattered radiation and long-wave radiation, "o" and "u" stand for reflection and radiation from the surface, "k", "ak" and "uc" - denote convective heat exchange, exchange of the surface with bottom layers and heat, which was expanded for evaporation from the surface. Equation of the heat balance usually plays a role of a border condition, which together with other simpler conditions, such as: continuity of temperatures on the surface, limitedness upon infinities in the soil and air, permits to solve the system of differential equation of heat conduction for the soil and air and, thus, find temperature fields inside them.

Difficulty in realization of this solution consists in the fact, that it contains within itself along with easily determined characteristics of heat balance, such as the altitude of the sun over the horizon h, declination of the sun δ (which dtermine the magnitude of direct solar radiation), cloudiness n and temperature of the air T (which determines the long-wave radiation), also the complexly determined and sharply changing parameters of air and soil, such as the degree of cloudiness of the air i (which determines scattered radiation), coefficients of radiation of the atmosphere σ_a and of soil σ_n (which determines the flow of radiation of the atmosphere and soil), albedo of soil A (which determines Q_o), coefficients of heat conduction λ_2 and of volumetric thermal capacity of soil C_2P_2 (which determines the heat current into the soil); C - specific heat, P - compactness of soil.

Currents of heat flowing into the soil and air, which are conditioned in the last case by turbulent exchange and evaporation, are determined correspondingly by temperature gradients in the soil and gradients of temperature and humidity in the surface air, that is

$$\left(\frac{\partial T}{\partial x}\right)_n, \left(\frac{\partial T}{\partial x}\right)_b \text{ and } \left(\frac{\partial q}{\partial x}\right).$$

Thus, the sought for temperature field in the soil proves to be a complex function of a form:

$$T = f\left[x, t, h, \delta, i, n, \sigma_a, \sigma_n, A_1, A_T, \left(\frac{\partial T}{\partial x}\right)_n, \left(\frac{\partial T}{\partial x}\right)_b, \left(\frac{\partial q}{\partial x}\right), \lambda, C_P\right] \quad (4)$$

A_T - coefficient of turbulent exchange.

Consequently, in order to solve any problem in the field of thermal regime of the soil it is necessary to be able to measure or calculate all the parameters which enter the equation (4). This complicated, but more complete way can be utilized only for theoretical synthesis, but is not suitable for obtaining a solution, which can be used for practical purposes. For the solution of specific problems a whole series of simplifications must be introduced.

One should have in view, that this equation becomes complicated in the presence of the plant cover, by processes of freezing and thawing, intrasoil condensation, plentiful precipitation, snow covering, hilly relief, and so on. Utilization and analysis of the equation of heat balance permits to understand many questions, particularly in the mentioned complicated problem of influence of the hill planting method on the improvement of the heat regime of soils.

Scientific co-worker, E. P. Riabovoi, has theoretically and experimentally proved that a daily radiation balance of the flat and of the hilly sections of the field are practically similar in consequence of reciprocal compensation of elements of the radiation balance, namely of increase of albedo and decrease of effective radiation on the hills as compared to the control. In view of this, the source of accumulation of heat at the ridge must be considered, quite unexpectedly, not the change of the radiation heat [Begin p.130] but the expense items of the balance, particularly, evaporations from hill tops as compared to the control. This conclusion is fully confirmed by a theoretical calculation, which permits sufficiently accurately quantitatively to appraise the excessive heating up in the hill. The method of heat balance made it possible for us to solve also other complicated problems such as: a) influence of forest belts on the thermal conditions of the fields with cereal crops, b) influence of irrigation on the thermal regime of fields with cereal crops.

All these problems were solved according to the same method.

On a given field and on the control (that is a field without irrigation, without forest belts and without hills) all the elements of the heat balance are being registered all around the day and night, every hour, and, of late, automatically and continuously.

The following analysis of these results permits to appraise those changes, which are brought in by irrigation and forestation, in the redistribution of individual items of the heat balance into the microclimate of the field, as well as to arrive at the forecast of those changes in the climate of the soil (particularly, temperature and humidity) of arid regions, which will happen as the result of use of the cited hydro-ameliorative methods. One succeeds, thus, in clearing up many practically important questions. Solution of all the above enumerated problems can be accomplished only in that case if one takes into account the influence of the plant itself, its condition and stage of its development, on the thermal-physical characteristics of the external environment where the plant lives. Consequently, only a joint analysis of properties and characteristics of the root-inhabited layer of soil, of the air near the ground and of the plant itself can give a full idea about the heat conditions under given specific conditions for the given specific agricultural crop. Thus, in all the problems, in which agricultural plants appear, the investigation of the heat regime of the soil is insufficient in the sense cited by us, when an account was being conducted of only the external environment, that is of the soil and of the connected with it state of properties of the surface air. The object itself, that is the plant, must be included in the research besides the environment. With such an approach (2) it would be more correct to reject the conception "thermal regime of the soil" and introduce a more general idea "thermal regime of the agricultural field". From this latter one should understand such a state of the field, which will be determined by an interconnected complex of values, that characterize, first of all, the soil, secondly the surface layer of air, and, thirdly, the plant itself.

To the first category of values belong: the field of temperatures in the soil, thermal characteristics of the soil, heat flow into the soil, radiation characteristics of the soil. Into the second category of values enter: thermal-physical characteristics of surface air, heat flows, which are dependent on evaporation and turbulent heat transfer, on the field of humidity, temperature and wind in the surface air. The third category of values consists of radiational characteristics of the plant (albedo and emittance, exposure to light, spectral selectivity), transpirational and convective peculiarities of the plant. Thus, one would like to particularly stress the following thought. Study of the temperature regime of the soil, as a rule, helps very little in solving and analysis of various agricultural problems. One can achieve much more in solving the problem when studying the thermal regime of the soil, that is the state which is characterized by a complex of thermal-physical values in the upper layer of soil and the lower layer of the atmosphere. Finally, the fullest idea about the required heat and methods for satisfying this necessity of the plant can be obtained by studying the thermal regime of the agricultural [Begin p.131] field, that is of the interconnected complex of the characteristic of the soil and air, as well as the plant itself.

It is necessary to mention that a method of the temperature regime, when the appraisal of the effect of this or another agricultural measure by means of comparison of temperatures on two terraces, where one was subjected to the given measure, but the other was a common field, a control, whould not be rejected in all cases and in a categorical form. When utilizing just this method alone, the idea is not understood in its fullness, is only a crude method of approximation and of use only in the simplest cases, such as, for instance, when comparing the degree of heating through of the northern and the southern slopes of a hill, when comparing the heating up of upper and lower layers of soil and in certain other primitive cases.

As a rule, the agrotechnical, agricultural-forest-ameliorative and such similar measures cause changes in the whole complex of thermal, radiation and transpiration properties of the soil and of thermal physical properties of the surface air. In such a case the purely temperature approach proves to be insufficient and unreliable and the use of the method of the thermal regime of the soil is required.

Taking into consideration the final purpose of every problem, which concerns the yield of an agricultural crop, it is necessary to introduce also the properties of the plant itself, that is to pass over to the utilisation of a more general and fuller method for the thermal regime of the agricultural field. In order to illustrate the above said, let us pause on the question of influence of forest belts on the energetical regime of the soil and, finally, of the plant, as measures, which are directed against drought. If we will proceed from only the "Temperature" way of formulating the question, we shall receive a wrong idea about the value of the forest belts. Indeed, measurements of temperatures at the left bank of the river Volga, in May, in fallow fields have shown that between the forest belts the soil is 1-3° warmer than in the steppe. It turns out that forest belts not alone do not lower the temperature of the root-inhabited layer of soil, but help in its raising. If one should stop at these measurements and not advance further in the sense of a deep analysis of the question, we can easily conclude, that forest belts help in the development of drought. Yet, analysis of how the heat, flowing to the soil, is expended, that is examination of the full heat balance on the soil-air border leads to other conclusions. Let us consider a section in the steppe and one between the belts. The amount of the radiation heat, which flows to each of them is similar. But the absorption of heat by the soil, which is situated between the forest belts is greater than in the soil of the steppe, owing to a decrease in the reflecting ability. As a result the temperature of the surface there is also higher, and the gradients of temperature in the upper layer of soil are raised also. All this leads to the fact that on such a soil the flow of heat inwards is greater than in the soil situated in the steppe. But as the receipt of radiant energy of both sections is practically similar, then the loss of heat into the air in the steppe is greater than between the forest belts. This means, that the temperature of the air near the soil and the loss of heat for evaporation is higher in the steppe than between the belts. This is in keeping with the fact that the wind between belts is weakened and the humidity of air over fallow lands is higher than in the steppe.

Thus, the temperature of soil between the belts is somewhat higher, but this increase, which proceeds on the general high temperature level, is not essential. On the other hand the leaves of plants are in a more humid and colder air, while the roots are under conditions of increased moisture. Thus, the favorable influence of a forest belt is doubtless and one succeeds in discovering it only by means of study of the full income - outlay of the heat in the system "upper layer of soil - lower layer of air". [Begin p.132]

Until we take into account the properties and dynamics of development of plants we cannot appraise all the advantages of forest belts even in the energy respect. With such a neglect of the influence of plants the result is that the temperature of soil on fallow fields in the space between the forest belts is higher than in the open steppe. This excess equals 3° at the depth of 5 cm., and at the surface it reaches up to 8°. The temperature regime of the soil on fields, which are covered with plants, sharply differs from the temperature regime of fallow lands. During the early periods of development of plants, when density and height of the plant covering are insignificant the interrelation of temperatures in the soil between the belts and in the open steppe is similar to that of fallow fields; this refers to the early spring period. In proportion to the growth of plants and develppment of the green mass difference in temperature fields diminishes attaining at the moment of booting the extent of 0.3-0.5°. During the interval between booting and heading stages temperature of the soil in the space between forest belts becomes lower than in the open steppe. A similar regularity is observed in the changes of temperature of the surface of the soil. Such a correlation of temperatures is preserved up to the end of the vegetative period. Changes in correlations of temperatures are explained by the fact that at the moment of booting the soil is shielded from direct sun rays at a maximum. Owing to the fact that plants in the space between the forest belts are more developed in height and vigor, the shielding of the soil here is more expressed, than in the open field. At the same time the temperature at the depth of 50cm, owing to a more considerable accumulation of heat in the space between forest belts, is higher than in the open field. During the second half of the vegetative period the amplitude of temperature in the upper layers of soil is greater in the steppe than in the space between forest belts. Thus, calculation of all processes, which proceed together in the soil, air and plant, shows the advantage of forest belts both in the early period, when the plant needs heat, as well as during the summer period when the soil and the plant require to be spared from excessive heat. We see that a forest belt satisfies these complex requirements (3).

Let us turn to another instance. If we proceed from measurements of temperatures, then we must point out the following: during the night period, under conditions of radiational regime of cooling of the soil and air, the soil surface has the lowest temperature. The air becomes warmer and warmer in proportion to the elevation over the soil. Reasoning thus, we must conclude that the leaves, say, of a fruit tree, which are situated at the height of 3 m and more over the surface and which are in contact with a warmer air than the air at the surface of the soil must also have a higher temperature than the air at the surface of the soil.

Nevertheless, such a conclusion contradicts experience. In reality a leaf is often colder than the surface of air. It is possible to explain this fact only after analyzing the heat balance of the system "leaf-soil-air".

The radiation of the atmosphere, which flows to the soil and to the air, partially returns back into the atmosphere. That or another temperature of the soil and the plant becomes established as a result of the sum of inflows and outflows of the radiant and of other forms of energy. Yet the reverse radiation in leaves considerably exceeds the radiation from the soil, owing to the fact that ratio $\frac{S}{V}$ of the radiating surface to the volume is greater in plants than in the soil. Hence a considerable lowering of the temperature of the leaves results, which can lead to the fact, that the leaf is colder than the soil surface, and the more so than the surrounding air. [Begin p.133].

And the difference in temperatures of the leaf and air can be very considerable. It is possible to calculate this difference, if one figures out the heat exchange between the leaf and the air. This difference, naturally, will depend to a large degree on the velocity of wind. If one does not conduct a full analysis of the heat balance in the system "leaf-soil-air", then it will be hard to understand such phenomenon as a hidden first autumn frost, on account of which the leaves freeze when temperature of the air is considerably higher than zero degrees. Formation of a scheme of forecasting of the first autumn frosts comes to a solving of a combined system of differential equations of the conductive (for the soil) and turbulent (for the air) heat conduction when considering the equation of the heat balance as a border condition. A whole series of simplifications of a physical character (assumption of the radiation balance as a constant value during the night, connection of thermal characteristics of the soil with its humidity, joining of the coefficient of turbulence with the velocity of wind, and so on) permits to make the scheme practically simple.

As a result, the operative scheme of forecasts of autumn frosts comes to the observation during the evening of 3 commonly registered magnitudes: temperature, humidity of air and velocity of wind, at the height of the meteorological booth, and visual calculations of 2 values: moisture content of the soil surface and the cloudiness. According to these observations, with the aid of addition and multiplication of values, which are contained in three available tables, one succeeds in finding the expected night temperature minimum.

The merit of the scheme is in the fact that it proceeds not from the usual widely used empirical formula, but is based on the physical analysis of the energy process of chilling in the upper layer of soil and in the lower layer of the atmosphere; it is applicable to any region of USSR; it gives not alone the value of the temperature minimum, but also the length of the frost and, in general, the reading of the temperature during any hour of the night. Tested on many instances by different authors and in various climatic zones, the scheme has shown a sufficiently high accuracy.

One should realize that the forecasting of frosts is not a purely meteorological problem. From the forecasting of the temperature of the air it is necessary to pass to the forecasting of temperature of the plant, particularly of its leaf surface. Such a scheme has been developed at the Agrophysical Institute. On the basis of examinations of the heat balance of the leaf and of analysis of the process of its heat exchange with the surrounding air, one succeeds in passing over from the forecasting of temperature of the air to forecasting the temperature of the leaf. But even this does not solve yet the problem about the danger of early autumn frosts for the given plant at the given stage of its develppment. Only the presence of detailed data about thermal stability of the plant is the 3rd consecutive and concluding phase in the scheme of forecasting the autumn frosts. Thus, in the present case also an analysis of physical processes in the soil, air and in the plant proper bring the solution in forecasting of autumn frosts. This illustrates the insufficiency of the temperature method, and even the insufficiency of the method of thermal regime of the soil, which leads to the solution of the problem from the meteorological aspect, as well as the necessity for drawing a more general thermal regime of the agricultural field, which will give an answer to the question about the possibility of freesing of the plant itself (4).

It is extremely important in a series of problems to know the state of the plant at the given moment, as well as the stages of its development, the dynamics of its vegetation. For instance, difference of temperatures between the leaf surface and the surrounding air, which appears to be, as we have seen it, the most important factor when evaluating the radiation of the plant, changes sharply with the change of the state of the plant. The problem of the role of heat exchange between the plants and the surrounding air is not yet completely investigated, whereas on the basis of this analysis [Begin p.134] of the heat exchange a solution of important theoretical and practical problems can be obtained. For instance, one can describe a very reliable scheme of calculation of the norm for irrigation which has proved itself on a series of examples.

Let us consider the heat balance of the leaf surface. K. N. Aseikin (5) was the first to consider such a balance, although for another problem (about the hidden autumn frost).

Let us introduce such concepts: W - accumulation of heat by the leaf, P - radiation balance of the leaf, I - evaporation from its surface, L - convective heat exchange of the leaf with the surrounding air, N - heat conductivity along the material of the leaf. Radiation balance can be represented as:

$$R = (Q + q) A + (u - e_1) - (e_1 - P). \qquad (5)$$

In other words, to the leaf flows a short-wave radiation in the form of the sum of the straight line Q and scattered radiation q, from the leaf a part is reflected which equals the albedo A. To the leaf also flows long-wave radiation from the atmosphere e_1 and soil P, from the leaf goes out to the soil e_1 and to the air e_1. The leaf, practically, does not accomplish any heat accumulation and by means of heat conductivity only an extremely slight part of heat is transferred.

In view of this W and N = 0, the whole balance is simplified and acquires the form:

$$R = I + L. \qquad (6)$$

Thus, the unknown evaporation from the leaf surface I = R - L. Corcerning the value of convective heat transfer L, it can be written, as it is known, in the form:

$$L = \alpha \Delta T \cdot 2F. \tag{7}$$

Here α - coefficient of heat transfer from the leaf into the air, which is determined, according to V. P. Kislov (6), for a living leaf through the velocity of the wind v near the leaf by a formula:

$$\alpha = 5 + 3.75v,$$

F - surface of the leaf, ΔT - overheating of the leaf, that is a difference between the temperature of the leaf and the air, v - velocity of wind.

Thus, the unknown evaporation, which is expressed in heat units I is found to be equal:

$$I = \frac{1}{F}(Q + q) A + (u - c_1) - (c_1 - P) - 2(5 + 3.75v)\Delta T \tag{8}$$

Thus, for determination of evaporati n the knowledge of radiational balance of the leaf surface, the overheating of the leaf ΔT and velocity of wind nearby are required. Value ΔT was measured by us for cereal crops under conditions of the lands on the left bank of Volga. Its value depends on the period of vegetation of plants. It represents an appreciable value, which reaches up to 1.5°. Dimensions of this overheating obviously are calculated simply.

During a light wind v = 2 m/sec. $\Delta T = \frac{80}{2 \cdot 12.5} = 3.2°$

During a strong wind v = 4 m/sec. $\Delta T = \frac{80}{2 \cdot 20} = 2°$.

Here also one can show the limits of permissible overheatings. If I_o is the expenditure of water for evaporation for the provision of the allowable overheating ΔT_o, then

$$\Delta T_o = \frac{R - I_o}{2} \tag{9}$$

[Begin p.135]

The permissible overheating is determined by: 1) absolute value of air temperature, 2) permissible temperature for plants without damage to them. But the unknown intensity of evaporation I_o depends on the intensity of radiation, on conditions of aeration and the degree of the permissible overheating.

The cited approach permits to solve two problems: 1) to work out a simple method of calculation of evaporation according to the degree of overheating and the radiation balance, 2) to indicate the norms of expenditure of water during overheating at the expense of a better aeration of plantings.

Of course, the described method has many defects during a practical application, which are connected with the difficulty of simultaneous and inertialess registration of the difference of temperatures of "leaf-air", as well as with the necessity of introduction of several assumptions about the character and size of transpirational surface. But in many cases, for instance for cotton, this method provides correct orientation and a precise number for norms of irrigation.

From all the earlier cited instances it ensues with obviousness that any agricultural problem can be solved as a complex problem, when taking into consideration the interconnected properties of soil, air and the plant itself. Therefore, this full and wide, and already not a meteorological and not agricultural, but agrophysical aspect must find its development and further deepening as a fuller and more effective one. In connection with this, a wide front of research must be conducted of the yet unstudied physical properties of plants, of their radiational, convective and transpirational properties; work must be developed on studies of microclimate of that near-surface layer in which the plant lives, namely, temperature, humidity of air and of wind inside the stand of grass. It is necessary in great detail to examine the role of the root system when ascertaining the thermo-physical properties of the root-inhabited layer of soil, and so on. But the indicated method should not be used blindly and noncritically in all cases of life. Along with such a wide approach, in a whole series of cases, it is possible to proceed in a much simpler way.

As a rule, these are the cases where there are no plants in the soil or when the processes of vital activity are slowed down. Such are the cases connected with the spring period, with the post-harvest time, with the overwintering of plants.

A considerable number of problems, in such a case, can be solved according to the method of the thermal regime, that is with the participation of properties and of the state of not 3, but only 2 objects: soil and surface air. I shall dwell on such problems, as for instance development of a scheme of forecasting the temperatures of the soil according to a given forecast of the temperature of air, and, in general, according to the assigned forecasting of weather.

A correct and timely forecasting of temperatures of the soil are of great importance for a series of agricultural problems; for instance during the spring period when it is necessary to plan the dates of planting and when this planning is determined in many respects by the thermal regime of the soil (as well as by the regime of humidity connected with it); during the return of cold weather, during overwintering of plants, when it is necessary to know if one can expect in the next few weeks such a temperature regime, which will lead to the intensification of the activity of seeds before the setting in of the spring period, or when it is necessary to reply to the question, is it possible to expect, that as the result of the forecasted cold weather such a low temperature will ensue in the air and in the soil, which will be dangerous for the overwintering plant.

Forecasting of temperature, which is systematically and regularly conducted by the agencies of the Chief Administration, Hydrometeorological Service ["Gidrometsluzhba"] is insufficient for the air, since the changes [Begin p.136] of the temperature of air are transformed in the soil in a very complex way. Meanwhile one can proceed from the forecasted air temperature to the temperature of the soil by means of calculation. It is necessary to solve a differential equation of heat conduction, where the coefficient of temperature conduction "K" changes along the coordinates in the following manner: its value is permanent in the limits from the depth of constant temperatures in the ground to the surface; it rises linearly from the surface to the height of the break, and above the break again it is assumed to be constant.

The border conditions: 1) continuity of temperature on the zero surface at the height of the break H, 2) continuity of derivatives at the same height of the break H, 3) condition of the heat balance on the soil border $x = 0$.

The last condition is noted down only temporarily since the value of the heat balance is excluded during the process of solution of the problem in so far as the progress of temperature is set at some fixed height in the second intermediate layer. As a result simple formulas (7) were obtained, which permitted to determine the progress of temperature in the soil when the progress of temperature in the air, the velocity of wind and the intensity of precipitation were known. Not the process of solving the problem is of interest, but the development of an operative scheme of forecasting, which is based on the drawing of experimental connections between the soil thermal characteristics and the regime of humidity, on the one hand and between moisture content in the soil and the amount of precipitation, on the other hand, as well as on the evaluation of the fraction of evaporation in the general income of moisture at each specific point in USSR in a given month or even a decade.

Utilization of this same method, when one can get by without knowing the heat balance, can be demonstrated on such a useful and important instance as heat amelioration. This way permits to find out the influence of loosening and of packing of the soil, its drying out, sanding, and so forth, on the temperature regime during spring time, that is, during the period when the temperature produces a deciding influence on the development of the agricultural crop. We have in view the examination of the temperature regime of the soil under the effect of change of its thermal characteristics since all the above enumerated heat-ameliorative measures cause a sharp change in these characteristics and, thus, can be regarded as regulators of the heat regime of the soil.

Solution of the posed problem is facilitated by the circumstance, that during the spring time moistness of surface layers of the soil on the greater part of territory of the country considerably exceeds the value of the magnitude of the maximum molecular moisture capacity. Under such circumstances the intensity of evaporation of moisture from the surface of the soil does not depend on the moistness of the soil and on other properties of the last one, but is entirely determined by the temperature at the surface and the condition of diffusion of water vapor in the surface air. Independence of intensity of evaporation from the moistness up to the showing of the maximum molecular moisture capacity is given in the works of the Agrophysical Institute for specimens of various soils. The second circumstance, which should be kept in mind, consists of the fact that the mean daily value of heat exchange at the surface of the soil with the deep layers during the warm time of the year is negligibly small compared to the remaining members of the balance.

This notion is ascertained by measurements of the heat balance of the soil at different climatic zones. As it was pointed out previously, the temperature at the surface is determined by the correlation among the terms of the heat balance. Since the magnitudes Q_{δ}, Q_{uc}, Q_k in spring time, under definite climatic conditions, at a similar form of the surface and [Begin p.137] similar optical properties of the latter, will depend on the type of the soil, its moistness and thermal characteristics, and one can ignore the flow Q_{ak}, then the value of the average daily temperature at the surface of a denuded soil also will not depend on the properties of the soil. Therefore differences in temperatures of the soil at small depths, corresponding to the level of root-inhabited layer by plants, will be fully determined by thermal characteristics. An adequate calculation, based on the given progress of temperature at the surface, which represents a cut of the yearly temperature wave, gives a possibility to evaluate the "heating through" of various soils during the spring season, to explain the known in practice presence of "warm" and "cold" soils. All these properties of the soil will depend only on its temperature conduction. Hence it is clear, that an improvement of the thermal regime of the low-heat-conduction, heavy soils can be achieved by means of such measures as sanding, improvement of the structure, and so on, which increase the temperature conduction of the soil. One can, in a similar way, evaluate the thermal effect of such measures as loosening and rolling of the upper layer of the soil. In such a case it is necessary to solve the problem about the convection of heat in a two-layer medium (one layer of a finite thickness, the other - infinite) with leap-likely changing thermal characteristics at the borders of layers. Knowing, if only from laboratory data, the change in thermal characteristics of the soil during changes of density, one can appreciate the effects of retarding or of accelerating of the tempo of heating the soil.

The value of the coefficient of heat assimilation $\sqrt{\lambda Cp}$ in the plowed horizon is smaller, owing to a lower density of the soil, than in the underlying layers of the soil. This circumstance, together with the reduction of the coefficient of temperature conduction "K", must assist the relative reduction of temperatures in the plowed layer when compared to the virgin soil.

Observations of different authors ascertain that the mean temperature in the plowed layer is lower than the temperature at corresponding depths of virgin soil. It is seen, on the basis of obtained formular, that an increase of temperature in the plowed layer during spring time can be achieved by increasing the density of the soil, as well as by deepening the plowed layer.

When examining the temperature field in the soil in the presence, on the surface, of a thin layer, having differing thermal characteristics from the underlying layers, it is easy to see, that the temperature of the soil increases in the presence of a surface layer with thermal characteristics, other than the rest of the soil, in such a case when heat conduction of this layer is higher than heat conduction of the remaining soil $(\lambda_1 > \lambda_2)$, whereupon the value of thermal capacity of the soil in this layer is not of great importance.

Increase of the daily average temperature up to 3-5° in the 10-centimeter layer of soil after rolling of the soil, observed by several authors, becomes clear after proper calculations.

This agrotechnical measure increases density in the upper layer of the plowed horizon of the soil by 10-15%, which leads to a noticeable increase in heat conducting. Thus, according to data of Shpakovskaia (9), increase of density by 10% for a lightly clayey soil, in the range of densities 0.8-1.6, with a weight moistness of 25%, increases the coefficient of heat conduction on the average by 5%.

Conversely, the presence at the surface of a little-heat-conducting layer (for example, turf) impedes the heating through of the soil during spring time.

Directed artificial change of thermal characteristics in the soil can be of great practical importance not only for [Begin p.138] heat-ameliorative measures in the soil, but also in the surface air. It is known, for instance, that on sections of soils with low heat conduction (reclaimed swamps) frosts are observed even during summer months, which serves as a hindrance for their utilization for agricultural purposes. Such measures are required during reclamation which would guarantee a sufficiently advantageous heat conduction of the upper layer of soil. The foregoing problems were solved according to a method of the heat regime of the soil, taking into consideration the states of two media - of soil and air, and by means of drawing a unified condition on their border - an equation of the heat balance. But we saw, that this last one was needed by us only for analyzing the question. Whereas for the result there was no need for calculation or knowledge of the heat balance, which was substituted by the knowledge of the progress of temperature at the surface of the soil and of its thermal characteristics.

Although studies of problems of heat-ameliorative character, as well as of other questions, not mentioned here, on freezing and thawing of soils, on intrasoil condensation, and so on, can be accomplished without the knowledge of the complex condition of heat balance and can be reduced to the equation of heat conduction, yet it appears that the latter becomes complicated at the expense of the changeable in depth character, of thermal characteristics in connection with a change along the depth of density, moistness and mechanical composition of soil. Besides, this equation must contain additional terms, which characterize the action of inner sources in connection with phasic transformations of water in the soil.

Therefore it was necessary to carry out a wide cycle of theoretical and laboratory works in 3 directions: 1) establishment of contact of λ, k and C with dispersion, temperature, density and moistness of basic soil differences; 2) development of a scheme for solving the equation of heat conduction, which was complicated at the expense of the variable character of thermal characteristics, according to experimental data in various cases; 3) accounting of additional thermal effects in all processes, which are connected with aggregative transformation of soil moisture.

Basic conclusions from these works are as follows (9).

1. For moist soils the character of dependence of heat conduction - porosity proves to be similar both for sands and loams, as well as for clays, although in a quantitative respect the effect is sharper for the first and less noticeable for the second and third ones. Character of this dependence shows that only at small percentages of porosity the relations, which interest us, are clearly expressed. Meanwhile, the majority of natural soils have considerable porosities (40-60%), beyond the range of sharp changes of the function of heat conduction - porosity. Taking into account the above said, and in view of the fact that the soils always are moistened to one or another degree, the influence of porosity on thermal characteristics is not as great, as it would seem to be.

Moistness produces a most substantial influence on the magnitude of thermal characteristics; the latter can change the heat conduction and temperature conduction by 5 and more times. We make a conclusion that this factor is dominating in its influence on the thermal properties of the soil. The progress of dependence of heat conduction on moistness for fine-dispersive (clay) and coarse-dispersive (sand) soils is different. For the latter a quick rise in heat conduction with moistness is characteristic at an insignificant moistening with a following decline of the growth of the value λ; for clays it is the other way round; the growth of heat conduction proceeds very slowly at low dampnesses, and only at a sufficiently heavy moistness begins a turbulent growth of heat conduction. One can give a perfectly reasonable physical explanation concerning these facts, the concise [Begin p.139] substance of which comes to the following: each addition of a small amount of moisture in a coarse-grained material leads to filling of air pockets among the grains, to the formation of watery, well heat-conducting bridges among still better conducting grains; all these bridges very soon become interlocked, and form a highly heat-conducting isle, which after further moistening already but little influences the improvement of heat conduction. In a fine-dispersive material small addition of water cannot lead at once to the formation of water bridges, to the expulsion of all the air and improvement of heat conduction.

The immense surface of soil grains requires a large mass of water for coating them with the thinnest films; there cannot be any noticeable increase in heat conduction, until a still more considerable amount of water is added. When there is enough of this water for the formation of bridges, we shall observe a fast and intensive increase of heat conduction in the material. This explanation completely and fully discloses the differing character of dependence of thermal characteristics of coarse - and fine-grained soils on moistness.

A connection between density of the soil or its volumetric weight and its thermal characteristics is of great importance. The basic conclusion drawn from large experimental material, consists of the following: one can consider somewhat approximately the coefficient of heat conduction linearly dependent (or even more considerably) in the range of small magnitudes of density and rising more sharply after the increase of ρ at great magnitudes of density. This finds its explanation in the fact, that when the soil is mellow, it compresses quite easily in connection with a decrease of air pores, and this leads to a comparatively intense rise of heat conduction, But after a certain, and quickly occuring, limit of compression the heat conduction changes much slower.

Temperature of soil and its chemical-mineralogical composition influence the magnitude of thermal characteristics the least; a degree of dispersity also influences the thermal characteristics of soil. In coarse-grained materials, as a rule, thermal characteristics are magnified as compared to fine-dispersed soils. Explanation of this fact is given in several of our works.

2. Study of the thermal regime of soil in many cases, as, for instance, when appraising the influence of cultivation of soil on its thermal regime can be reduced to the analysis of a solution of an equation of heat conduction with variable coefficients. Here the following approach is implied (9, 10). The equations of heat conducting are solved at given initial border conditions on the basis of in natural soils established dependences of thermal characteristics λ, k and $C\rho\gamma$ depending on depth in connection with real progress of moistness, density, and mechanical composition, ac-

cording to the soil's depth*).

3. One can follow this course when solving problems on thermal regime of frozen soils. These problems become still more complicated in connection with the necessity of resolving equations of heat conduction both with variable characteristics and in the presence in them of terms, which reflect the action of internal sources, that moreover are moving along the depth. A precise solving of the question about heat regime of the soils requires a simultaneous accounting of heat, which is transferred by moisture. Great prospects are revealed when utilising during solutions of such problems a joint system of equations [Begin p.140] of heat and moisture exchange. This course, which was suggested by the works of Professor A. V. Lykov (11) so far has not been sufficiently utilized, both owing to the need, because of mathematical difficulties, of accepting the magnitudes of heat and moisture conduction independently of the moistness and density of the medium, as well as because of the fact, that so far there are no proved ideas about the form of connection of moisture with the particles of material, about the mechanism of movement of moisture under the influence of the temperature gradient, and so on.

There is no doubt, that this course, applied to specific agronomical-physical problems, will produce good results.

Works, conducted by us, utilising tagged atoms can help in discovering the mechanism of movement of moisture in the soil. The matter is, that at the present time there are very few experimental data about the speed of movement of moisture under the effect of the temperature field. Utilization

*) In our work a variant was examined, which presumed a variable character of moistness, density, dispersion of soils by depth; the real progress of thermal characteristics in the soil was taken into account and temperature fields were found in them (12, 16).

cesses.

A new type of "balansomer" (apparatus which measures the balance of radiation) [radiation meter?] is of great interest besides the above enumerated. In contrast to other known devices of this type, it does not change its sensitivity in the wind, since its radiation receiver (thermobattery) is protected by a filter made of sylvite, which is covered with a nitrocellulose film. This filter has a sufficiently uniform transmission in the visible and in the infra-red range of the spectrum. A daylight pyrgeometer, which permits to measure the intensity of infra-red radiation in the presence of short-wave visible radiation works according to a similar principle. This is achieved by using a sylvite filter, which is covered with a layer of amorphous selenium. Such a filter is transparent only in the infra-red range (20). [Begin p.141]

One can point to several more apparatus, which were specially developed for studies of the thermal regime of soils. Apparatus for measuring heat conduction of the soil directly under field conditions, and others should be mentioned here too.

In conclusion we shall point out a whole series of problems in the field of studies, as well as regulation of the heat regime of the soil and surface air, which await their resolving.

1. A further development of work on improvement of the earlier obtained results, taking into account their practical aspect (improvement of apparatus' designs, making forecasting methods more precise, improving schemes for determination of evaporation and water consumption, and so on).

2. Wide theoretical, methodical studies of field thermal amelioration, which was planned for accumulation of heat in northern latitudes of USSR and artificial cooling of soils in southern regions. It should not be forgotten

that general theoretical ideas must be developed about those changes in temperature and moistness of the soil, which are produced as a result of use of measurements of thermal amelioration. For this purpose a theory about the united movement of heat and moisture in the soil should be developed; generalized thermal characteristics in the soil found, taking into account the dissimilar mechanism of movement of moisture in the soil at different stages of its dampening.

This general theory must be applied to the investigation of such questions as: a) heat balance of swampy soils and influence of the processes of drainage on this regime, b) cultivation of crops of early vegetables and potatoes on hills, beds, and so on, c) development of methods of cultivation of gardens in the north with the purpose of considerable improvement of the thermal and water regime under the garden and increase of overwintering ability of fruit trees, d) efficient utilization and regulation of snow retention, snow melting, and so on.

3. Wide theoretical, methodical and field examination of the winter regime of the soil and of the overwintering plant. The following should not be forgotten here: a) working out methods of research of thermal characteristics of the frozen soil, of the depth of freezing through, of the tillering node, ice content, degree of freezing through of plants, and so on; b) studies of the regime of overwintering of plants in the south and the north and methods of its regulation.

4. Heat regime of plants in an open and covered ground. The following should be examined: a) regime of heat and moisture of the plant during the period of vegetation, b) regime of moistness and temperature in the stand of grass and thermal interaction of the surrounding air with leaves and stem, c) mechanism of overheating and freezing of plants, d) optical and radiation

properties of leaf surface, e) microclimate of hothouses, f) thermal effect of an efficient spacing of plants in an area.

All these data are necessary for the basing of agrotechnical methods of cultivation of plants under different climatic and soil conditions.

5. Geographical regionalizing of soils according to their thermal regime. Among these problems one can enumerate: a) plotting of maps of heating characteristics of the basic soil zones of the Union of SSR in connection with moistness, density and mechanical composition of soils, b) calculations of heat accumulation and of heat flow into the soil under different latitudes of USSR during the period of a year.

All these results must help in the problem of planning of an efficient allocation of agricultural crops on the territory.

6. Artificial methods for heating the ground. Here one has in view: a) development of methods of utilization of electric and water heating and thermal pumps for heating sections of the open ground near [Begin p.142] large cities and industrial centers with the purpose of early growing of heat-loving vegetables and with the purpose of accumulation of heat in regions of insufficient natural heat; b) development of methods of heating the buildings and soil under conditions of the closed ground.

7. Forecasting of important phenomena and harmful effects and measures of control of the latter. To bear in mind: a) forecasting of soil temperature under the snow covering, b) forecasting moistness of the soil during spring time, c) development of measures of forecasting dry winds, d) development of effective measures for control of autumn frosts, e) development of measures of control of dry winds.

8. Working out of methods of effective utilization of lands in accordance with their thermal characteristics. One is supposed to evaluate the

possibility of reclamation of unused lands for a rational growing of agricultural plants taking into account their heat requirements: a) heat regime of the slope, b) heat regime of valleys, c) heat regime of swampy lands, d) heat regime of waste and virgin lands.

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Differentsirovanie aktinomitsetov metodom eksperimental'noi izmenchivosti.

[Differentiation of Actinomycetes by the Method of Experimental Variability].

[Source not identified].

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At the present time a pressing need has become imminent in the science of antibiotics for streamlining the works on taxonomy and systematics of producers of antibiotic substances. Of late researchers, who are in quest for antibiotics, describe numerous species among fungi, bacteria and, especially, actinomycetes.

Most of the authors, when describing producers of antibiotics, do not give data which are necessary for determining and comparing with other species described in literature. Often an organism is described according to the growth on media, which are not characteristic for showing the specific features. Some researchers give indicators of growth on synthetic media, while others on organic, protein, and, if on synthetic, then of another composition. The authors do not take into consideration what has been described before them, they do not cite any comparative characteristic and often give a new name to an organism, which already has been described in literature, as if it were an isolated species.

Owing to this uncritical approach to the problems of systematics, we have a great number of new species, which are quite impossible to distinguish. Very often under one and the same name are described entirely different organisms, and vice versa, to different species are added cultures of one and the same organism. Earlier (1955) we cited instances of such incorrect determination of species of actinomycetes, and, at the same time, also about the erroneous determination of the nature of antibiotic substances. In literature one can often find indications that various species of actinomycetes form one and the same antibiotic. For instance, producers of streptomycin are described, [Begin p.2] which, as though, belong to different species, then producers of actinomycin, neomycin, chloramphenicol, viomycin, and others. All these substances, according to data of researchers, can be synthesized by cultures, which belong to different species. Whereupon the authors, as a rule, do not give any taxonomic analysis of organisms, studied by them.

Absence of precise taxonomic information about producers often leads to a duplication of work. The same organisms are studied not only in different countries, but often in one and the same city by different laboratories and persons. The obtained similar antibiotic is described under different names, as substances of different chemical nature.

All this leads to a great confusion, strongly hampers the work not only of practical workers in medicine and other specialists, but also workers of scientific-research laboratories. Organizational methods are needed or an understanding among specialists about working out single principles, which would be obligatory to all who work in the field of studies and research of antibiotic substances and of their producers. This understanding must exist not only among specialists of one country, but also among workers of all countries. It is necessary to have international rules for nomenclature and systematics of producers of antibiotic substances. There should exist special centers, where standard cultures should be kept, as well as antibiotic standards.

The most important question during settlement of microbe taxonomy is the idea about species and methods about their determination. In my former research works (1938-49) I stated the basic conditions, which characterize the species in microorganisms in general and in actinomycetes in particular. It was shown there, that a species is determined [Begin p.5] according to the totality of morphological, cultural and biochemical characteristics. As in higher plant organisms, so also in mycology, the organs of fruit bearing are of the greatest taxonomic value. That is quite understandable because the characteristics in question are the most significant; they are fixed hereditarily and are formed during the course of a long history of the species' development. Experience shows that sporangia in actinomycetes (in fungi also) are very stable external indicators; they do not change under superficial influence. We have never observed that actinomycetes with straight sporangia would acquire an ability to form spiral sporangia. Also a segmentation formation of spores is not substituted by fragmentation in one and the same species in the time of variability.

Some cultural characteristics also are of great diagnostic value. Among them pigmentation of cultures merits the greatest attention. It is necessary, at that, to distinguish pigmentation from staining of cultures. Pigmentation is conditioned by the presence of real pigments, that is stable, hereditarily fixed metabolites of a definite chemical composition - carotenoids, lipochromes, anthocyan, and others.

Tinting of cultures may be caused by casual combinations of certain substances, which were formed by organisms, with the elements of the medium, for instance, with metals - copper, zinc, iron, cobalt, and others. It is known that in fungi and bacteria the cited microelements produce tinting of cultures into one or another color. Antibiotic substances, which are produced by Act. aureofaciens or Act. rimosus in the presence of copper, and nickel [Begin p.4] give a green coloring to the culture, in the presence of iron - red color, and in the presence of some other metals - a yellow coloring. (Albert, 1953).

It is well-known that cultures of Act. streptomycini, which synthesize streptomycin, often, when grown on certain nutrient media and under some conditions of growth, cause tinting of medium to greenish-blue, pink, brownish pink or brownish green. We observed such a coloration in representatives of other species of actinomycetes - Act. levoris, Act. vulgaris, Act. longisporus, Act. bacillaris, Act. toxicus, Act. globisporus, and others. This coloration is unstable; it is more clearly expressed during the first 3-4 days of growth, later on it gradually disappears, and a brownish substance remains.

Such a coloration of colorless actinomycetes can be assumed to be the pigmentation of cultures, and the cultures proper could be mistakenly assumed to be the pigmented organisms. Act. streptomycini or Act. levoris, which have a bluish-green coloring, can be taken for Act. cyaneus, and cultures with reddish-light blue or reddish-dark blue coloration for Act. violaceus. Strains with yellowish lemon coloring can be mistakenly referred to Act. citreus or Act. flavus, and so on.

The coloring of actinomycetes can be explained by intermediate products of decomposition of certain substances, for instance, tyrosine.

It is quite apparent that the given coloration of cultures has a different taxonomic value than the real pigmentation, and it is hardly possible to utilize it for the purpose of systematics. However, may be this coloration has the importance of a species or group characteristic. We do not know as yet which of the substances determine the above cited colored reactions. It is possible, that in the future, after [Begin p.5] deeper studies of organisms, it will be possible to succeed in finding out the conditions for the stability of this characteristic.

Real pigments represent metabolites of constitutive character and, as such, can be utilized in the classification of actinomycetes.

The morphological and cultural features, described here, are insufficient for discerning and subdivision of actinomycetes into species. The structure of sporangia and of spores, as well as pigmentation of cultures are very general; they are characteristic for groups or sections, but not for species. Spiral sporangia with spherical-oval spores are found in many diverse species - Act. violaceus, Act. coelicolor, Act. griseus, and others. Entirely different species can have similar straight short sporangia with elongated spores.

Exactly the same can be said also concerning the feature of pigmentation of cultures. Various species of actinomycetes can have a similar pigmentation. For instance, among dark blue actinomycetes, which form a pigment of a type of antocyanin, we earlier (1941) isolated two species, and now enumerate not less than five.

Physiological features, which are exposed during the usual laboratory research, are also of little use for species subdivision of actinomycetes, such as, for instance, the ability to liquify gelatin, decompose starch, reduce nitrates, change milk, and so on. Indicators of assimilation of nutrients, specifically of carbonic, are more suitable. Research shows that some species assimilate sugars of the type of raffinose, others of rhamnose or lactose; the third ones do not assimilate either of these sugars (Kurosawa, 1951; Zähner and Ettlinger, 1957). [Begin p.6].

We use a complex of features for a species subdivision of ray fungi. Cultures are subdivided into groups or sections according to the structure of sporangia and the form of spores, as well as to the pigmentation. Within each such section, the externally monotypical strains are differentiated according to antibiotic manifestations, according to the character of antagonism.

We came to conclusion, on the basis of our own observations and research, that antibiotics occur as constitutive hereditary-fixed metabolites and, thus, we suggested using them for differentiation of actinomycetes' species [Krasil'nikov and others, 1951-55]. We have developed a method for subdivision of externally similar organisms. This method was based on the character of interspecific and intraspecific antagonism. We proceeded then from the basic biological premise that antibiotics are the tool in the struggle for existence, which is developed by the species during the course of history of its formation. Two principles issue from here: a) it is inherent to each species of actinomycetes to synthesize antibiotics of a certain type and b) antibiotics produced by them are specific, each of them has its antimicrobic spectrum, does not inhibit its own producer.

Concerning the first principle, we, at the proper time, pointed out that the qualitative indicators of antibiotics were determined not by ecology, but by specific peculiarities of the producers. It is known, that streptomycin is formed by cultures, which belong to Act. streptomycini, aureomycin by strains Act. aureofaciens, "longisporin" - Act. longisporus, "levorin" - Act. levoris, and so on.

We do not know any proven cases, when streptomycin or aureomycin was synthesized by other species of actinomycetes. [Begin p.7] Hints, found in literature, that one and the same antibiotic is produced by different species require very thorough testing. According to our data, the authors, who ascertain this, either permit a mistake in determination of the species of the producer, or accept different antibiotic substances, produced by various species, as one and the same chemical combination (see Krasil'nikov, 1955, 1956). Special examinations of original cultures, which were obtained from laboratories of various countries, fully confirm our deductions (A. I. Koreniako, A. G. Kuchaeva, 1957).

As it is known, characteristics that are stable, hereditarily fixed and biologically specified are of importance in systematics of organisms. We conducted appropriate research on the variability of cultures in order to ascertain if the antibiotic characteristics of actinomycetes were such. It was important to establish if the capability to synthesize specific antibiotics was a hereditarily fixed feature, does it arise and disappear, or fluctuate to one or another side, depending on the conditions of growth of the organism? In other words, can we regard antibiotics as a constitutive characteristic of specific importance or do they represent metabolites of a causual character?

For solving the problem under discussion it is important also to establish if the variants of one and the same species can be produced which would synthesize other antibiotics than the initial cultures do. In other cases, would it be possible to force different species to produce one and the same antibiotic?

For this work we took actinomycetes which belonged to one group, namely those cultures which earlier belonged [Begin p.8] to one species, Act. globisporus. At the present time we have in this group 8 independent species. Outwardly, according to the structure of sporangia and coloration of the aerial mycelium and, in general, according to cultural characteristics, they were similar to each other. Even an experienced specialist would not be able to distinguish and differentiate them according to these indicators.

The exposed character of antibiotic properties is dependent on the qualities of the active substances - antibiotics. Analyses have shown, that these metabolites are entirely different in various species of the globisporin group. The broadest subgroup of the given group, which comprises one species of _Act. streptomycini_, produces the well-known antibiotic, streptomycin, or globisporin (preparations of one type of combination). _Act. toxicus_ produce a toxic antibiotic, strongly active, which has nothing in common with streptomycin. Antibiotic "pnevmotsin" [pneumocin?] which is produced by strains _Act. vulgaris_ (strain 070) sharply differs from the first two as it produces an inhibiting action only on cultures of pneumococci; it does not affect the rod-shaped bacteria, it has other chemical, physical and medicinal properties, is not toxic. It possesses medicinal properties during experimentations with pneumococci.

Cultures of _Act. levoris_ produce the anti-yeast and antifungal antibiotic - "levorin". It does not affect the bacteria, but actively suppresses the growth of yeast organisms and to a weaker degree the fungi. Other antibiotic substances, which are synthesized by the remaining species of the globisporin group _Act. bacillaris_, _Act. globisporus_, _Act. arabinosus_, _Act. fluorescens_* differ noticeably by these or other indicators. [Begin p.9]

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* All the new species cited here will be described in a special article.

Table 1.

Antagonistic interaction of actinomycetes of globisporin group

Antagonists / Tests	Act. streptomycini	Act. toxicus	Act. levoris	Act. vulgaris	Act. globisporus	Act. fluorescens a	b	c
Act. streptomycini	-	-	-	+	++	+	+	+
Act. toxicus	++++	-	-	+++	++	+	+	+
Act. levoris	+++	-	-	-	++	+++++	+++++	+++++
Act. vulgaris	+++	+	-	-	+	+++++	+++++	+
Act. globisporus	++	++	-	+++	-	+	+	+
Act. fluorescens-a	-	-	-	-	+	-	-	-
" " -b	+++++	-	-	-	++	+	-	-
" " -c	+++++	+	-	+	++	+	+	-

Yet they sharply differed from each other in antibiotic properties - the character of mutual antagonism (table 1) and antimicrobic spectrum (table 2).

Table 2.

Antimicrobic spectrum of actinomycetes of the globisporin group

Test-microbes \ Antagonists	Act. streptomycini	Act. toxicus	Act. levoris	Act. vulgaris	Act. globisporus	Act. fluorescens a	Act. fluorescens b	Act. fluorescens c
B. coli	+	-	-	-	+	-	-	-
B. prodigiosum	+	-	-	-	+	-	-	-
Staph. aureus	+++	+	+	+	+	++++	++++	++++
Bac. subtilis	++++	+	+	+	+++	+++++	+++++	+++++
Mycob. B-5	++++	-	-	-	++	+	+	+
Sacchar. cerevisiae	+++	-	++++	-	-	++++	-	-
Willia anomala	+++	-	++++	-	-	++++	-	-
Sporobolomyces philipove	++++	-	++++	-	-	+++++	-	-
Aspergillus niger	+	-	+	-	+	+	-	-
Verticillium dahliae	++++	-	++++	-	-	+	+	+
Penicillium chrysogenum	-	-	+++	-	-	-	-	-
Fusarium solani	+	-	++	-	+	-	-	-

[Begin p.10]

If one would proceed from purely morphological and cultural features, one could suppose that the species of globisporin group, cited here, were phylogenetically close to each other. And if this were so, then one could obtain from them monotypic variants on the basis of purely genetical premises. This genetical analysis of cultures was conducted by a method of comparison of variants, which were obtained from different examined organisms. In due course we established by this method of experimental variability c relationship among the representatives of bacteria of genus Pseudomonas in nodule-forming bacteria and in various groups of ray fungi - actinomycetes, proactinomycetes, mycobacteria and myxococci (Krasil'nikov, 1938, 1947).

In our research we subjected representatives of Act. streptomycini, Act. globisporus, Act. fluorescens, Act. levoris and Act. vulgaris to genetic analysis. We utilized the method of shattering the heredity on the one hand and training on the other for obtaining variants. In the first case, cultures were subjected to the influence of special agents - irradiation with UV rays, actinophagy, influence with antibiotics supraoptimal temperature and others. Variants, which were obtained "spontaneously" without any special influences, underwent studying also.

In general, we had over 130 variants. Among them 73 were obtained from 10 strains of Act. streptomycini, 18 variants from 3 strains of Act. globisporus, 11 variants from 4 strains of Act. toxicus, 16 variants from 4 strains of Act. levoris, 9 variants from 3 strains of Act. fluorescens (c) and 8 variants from 3 strains of Act. vulgaris. [Begin p.11]

Variants of every species were distinguished one from another by the character of growth of colonies, by the shade of color of the aerial mycelium (pale yellow, light pale yellow, white or dingy pale yellow, and others); the lower part of colonies in some variants was colorless,in others brownish, sometimes reddish-brown or yellowish-brown. Some variants tinted the substratum into blue color, others into pinkish, brownish-pink or brownish-green and simply into a brownish color over the synthetic medium SR-P.* Many variants

* The composition of nutrient media SR-P, and others was cited in N. Krasil'nikov's book: "Actinomycetes-antagonists and antibiotic substances. Moscow, 1950.

remained colorless on all media under different conditions of growth.

We did not observe any noticeable deviations in the structure of the mycelium, sporangium and spores during this research. The usual physiological or biochemical peculiarities also did not change appreciably. In some variants only the weakening of this or another enzymatic function was noted - liquefying of gelatin, decomposition of sugars and formation of acids, and some others.

In some variants the described divergencies stood out very sharply. Without knowing the origin, such variants could have been taken for separate species.

Simultaneously with studying the cultural-morphological and physiological properties, we also concentrated our attention on the modification of antibiotic indicators. The variants under examination were grown on different nutrient media under various conditions of growth, in a state of rest and on a rocking device. Knowing that the composition of the nutrient [Begin p.12] medium and the conditions of aeration play the most essential role in the formation of antibiotic substances, we tested various sources of nutrition and of aeration at different degrees.

As a result of all this research we had variants with different activities, strong and weak. Among numerous variants of Act. streptomycini there were strains, which were almost devoid of activity, that gave, under the best conditions of growth, not more than 5-20 units/ml. There were also such the activity of which surpassed the activity of the initial culture by 5-10 times (table 3).

Table 3.

Activity of the obtained variants of Act. streptomycini in unit/ml.

Variants	Activity	Variants	Activity
Initial strain	100-200	Variants 88, 265 and others	600-700
Variants 510, 625 and others	5-20	" 24, 56, 372	700-800
Variants 113, 420, 525 and others	200-300	" 33, 38, 214 and others	800-900
Variants 63, 75, 91, 674	400-500	" 305, 898 and others	900-1,000

Similar data were obtained also in variants of other species of globisporin group. Decrease of activity in some and increase in other variants. The formation of variants with a decreased activity was noted the more often. Cultures with a high antimicrobic activity were obtained very rarely.

As it is seen from the above cited, the antibiotic characteristics of actinomycetes changed fairly strongly in a quantitative respect. We have a different picture as to the qualitative changes. Begin p.13

Tests of variants have shown that neither the antimicrobial spectrum, nor the character of the mutual antagonism have changed. In variants both were similar to those in the initial cultures.

All the 73 variants of Act. streptomycini had the same antimicrobial characteristics as the initial cultures (see table 2).

They all inhibited the growth of gram - negative bacteria: B. coli, B. prodigiosum, Ps. fluorescens, Ps. aurantiacus, and others, and gram-positive - Staphylococci, sporogenous bacteria, mycobacteria, including the tubercular rod, then certain yeast and yeast-like organisms and fungi. Possessing well expressed antiactiomycetes' characteristics, all the 73 variants, as also their initial strains, did not inhibit the development of their own cultures. They did not mutually inhibit each other. ~~They did not mutually inhibit each other.~~ They interacted upon each other as "otvivki" [offspring] of one and the same culture. They all reacted monotypically to the influences of other species of actinomycetes. In other words, all 73 variants, with a great diversity of cultural peculiarities, displayed antibiotic characteristics, character of antagonism in the same way as the typical initial culture (table 1.).

The same data were obtained also in variants of other species of globisporin group. All 18 variants, obtained from 3 strains of Act. globisporus differed noticeably culturally, but did not change either the antimicrobial spectrum, or the character of the mutual intraspecific and interspecific antagonism. All the 18 variants, as one, inhibited the growth of those bacteria, yeasts and fungi as did the 3 initial strains, or as their typical representative (table 2).

We did not notice any qualitative deviations from the initial strains in antibiotic characteristics of 11 variants of Act. [Begin p.14] toxicus, of 16 variants of Act. levoris and of 8 variants of Act. fluorescens.

We used the method of induced mutability or the directed method in order to change the antibiotic characteristics in actinomycetes of a given group. In one of the series of experiments the cultures Act. streptomycini were kept in the filtrate of different variants of Act. globisporus, Act. toxicus and Act. levoris.

The length of treatment of filtrates differed from 10 hours to 1.5 months. Cultures were kept at room temperature, at 25° C or 37°C.

In another series of experiments we used phages as vectors for the transforming substance. There are indications in literature about the fact that individual phages have the ability to transport the transforming substance from one culture to another. As a result, the receiving strain acquires the properties of the leading strain. Such changes were described for strains

B. coli - K-12 with the assistance of the special phage (lambda).

Sermonti (1957) observed similar changes in actinomycetes under the influence of special actinophages. A colorless variant of Act. coelicolor, after an injection with a phage, just obtained from the initial pigmented culture, gave colonies of a darkeblue color, which was peculiar to the basic initial culture.

We utilized 19 different actinophages in our experiments. Among them there were some characteristic (monovalent, which affect only the tested actinomycetes) and some non-characteristic for the utilized cultures (polyvalent phages). [Begin p.15]

During experiments of both series, we influenced 15 different cultures, which belong to 3 species: 8 cultures of Act. streptomycini, 4 strains Act. globisporus and 3 strains Act. levoris.

Results of our experiments were negative. We did not succeed in changing the character of antibiotic properties in tested strains either by treatment with filtrates of leading cultures, or by phagous corpuscles. We had variants, as in the preceding experiments, which differ considerably from the initial strains in cultural and certain physiological properties. There were many forms, which were characterized by activity. But not in one single case could we obtain variants which would be qualitatively different in antibiotic properties. We did not observe such kinds of changes in actinomycetes after which the new forms would synthesize a new antibiotic, that was inappropriate to the initial culture. All variants of Act. streptomycini synthesized streptomycin or globisporin. From variants of Act. levoris we obtained only "levorin" but no other antibiotics.

Neither were antibiotic properties qualitatively changed in any other species of the globisporin group. Antibiotic substances, which are peculiar to Act. toxicus, Act. vulgaris, Act. globisporus or Act. fluorescens, remained unchanged in their variants. Only the intensity of their formation and of their accumulation in the medium were changed.

Consequently, the character of antibiotic properties appears to be a hereditarily securely fixed, extremely stable feature. In the same way as the morphological character of spore-bearing (structure of sporangia and of spores) the ability to synthesise characteristic antibiotics did not change qualitatively under external influences and under different conditions of the growth of producers. [Begin p.16]

The described stability of antibiotic properties is not a special case for the globisporin group. The hereditarily fixed stability, in relation to synthesis of specific antibiotics, was observed by us in other groups of actinomycetes: in gray forms of Act. grisinus, white - Act. albus, pigmented - Act. violaceus, Act. coelicolor, Act. aurantiacus.

The stated material gave us the basis to consider that: 1) specific antibiotic substances appear as a very stable hereditarily transferrable characteristic. This feature is more stable than the ability to synthesize many other metabolites; 2) antibiotics are extremely specific, and by their character they determine the character of interaction of microbes, which produce them. Owing to these peculiarities the microbe-antagonists, which form the specific antibiotics, can be well differentiated and recognized; 3) antibiotics, as a specific, biologically effective feature, must be utilized in systematics of actinomycetes, and, perhaps, for all microorganisms also; 4) the feature under consideration, nevertheless, is appropriate only in conjunction with basic morphological, cultural and physiological characteristics. It cannot be used as a basic feature; 5) antibiotics and the character of antagonism must be accepted as a secondary, very exponential specific feature only for the subdivision of morphologically and culturally similar groups of microbe-antagonists. [Begin p.17]

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The International Union of Biological Sciences was founded during the period from the year 1919 to 1925; now it is included in the International Council of Scientific Unions, which unifies international unions of various fields of science. The International Union of Biological Sciences conducted 12 sessions of the General Assembly, since the time of its foundation. Academies of science, national scientific-research councils, and specially formed national committees of about 30 governments are members of this Union and take part in its financing.

The Union at the present time includes several sections - botany, biology of the cell, zoology, entomology, embryology, biometry, genetics, limnology and microbiology. It forms also the scientific-research commissions, for instance, Commission on Applied Ecology and Commission on a Biological Method for the Control of Pests.

The Union of Biological Sciences also takes part in the activities of united commissions, consisting of representatives of unions of different fields of science, founded by the International Council of Scientific Unions (for instance, on oceanography, electron microscopy, radiobiology).

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The International Union of Biological Sciences supported and even founded scientific-research establishments, which gave work to scientists of all countries. Such are the Neapolitan Zoological Station, Embryological Laboratory in Utrecht, International Organization of Microscopic Preparations in Louvain, Collection of Cultures of Microorganisms and Wild Species of Drosophila, International Bureau of Human Heredity in Copenhagen and others.

The Union of Biological Sciences conducted a series of international symposia in different cities of Europe, Asia and America, the subjects of which were: role of microelements in the physiology of plants, botanical nomenclature, interaction of gametes, growth, development and origin of the nervous system, genetic and cytological nomenclature, physiological and genetic problems of embryology, biochemistry and morphogenesis, symbiosis of insects with microorganisms, role of anaerobes in nature, ecology of plants under arid conditions, and others.

Beginning with the year 1947, the Union has rendered help in the organisation of international congresses for sciences of its profile (zoological, entomological, botanical, microbiological, and others).

The Union has in view the conducting of annual conventions (more than two a year).

An important problem of the Union is the rendering of help during publications of catalogues of varieties in National Museums (a list of tick varieties has been published); it has prepared for publication lists of zoologists and of geneticists (list of botanists was published in 1954). Works of the International Committee on Zoological, Bacteriological and Botanical Nomenclature were published with the help of the Union.

In accordance with a decision of the Presidium, the Academy of Science of USSR, personified by the Section of Biological Sciences, has also become a member of the International Union of Biological Sciences since the year 1958.

A National Committee of Soviet Biologists was formed for development and strengthening of connections of Soviet biologists with various international scientific organizations of biologists; it unites scientific workers of scientific-research institutes and universities, as well as individual Soviet scientists, who work in the field of biology.

Different sections are represented in the Committee in conformity with the structure of the International Union of Biological Sciences.

In the field of botany:

1. General botany (Academician V. N. Sukachev, Institute of Forest Industry Studies [INIL] of the Academy of Science, [AN], USSR, Uspenskoe, Moscow oblast').

2. Systematics (B. K. Shishkin, Botanical Institute of the Academy of Science, USSR, Leningrad).

3. Anatomy and morphology of plants (V. G. Aleksandrov, Botanical Institute of AN, USSR, Leningrad).

4. Physiology of plants (P. A. Genkel', Institute of Physiology of Plants of AN, USSR, Moscow). [Begin p.194].

5. Geobotany (E. P. Korovin, Moscow).

6. Phytopathology (M. S. Dunin, Timiriazev Agricultural Academy, Moscow).

7. Paleobotany (A. L. Takhtadzhian, Botanical Institute of AN, USSR, Leningrad).

8. History of botany (P. A. Baranov, Botanical Institute of AN, USSR, Leningrad).

9. Ecology of Plants (O. V. Zalenskii, Botanical Institute of AN, USSR, Leningrad).

In the field of zoology.

1. General zoology (Academician E. N. Pavlovskii, Zoological Institute of AN. USSR, Leningrad).

2. Entomology (G. Ia. Bei-Bienko, Zoological Institute of AN, USSR, Leningrad; M. S. Giliarov, Institute of Morphology of Animals of AN, USSR, Moscow).

3. Embryology (B. L. Astaurov, Institute of Morphology of Animals of AN, USSR, Moscow; B. P. Tokin, Leningrad State University).

4. Ecology of Animals (A. N. Formozov, Institute of Geography of AN, USSR, Moscow).

In other fields of biology.

1. Genetics (N. P. Dubinin, Institute of Biophysics of AN, USSR, Moscow; N. I. Nuzhdin, Institute of Genetics of AN, USSR, Moscow).

2. Microbiology (E. N. Mishustin, Institute of Microbiology of AN, USSR, Moscow).

3. Thalassology (P. V. Ushakov, Zoological Institute of AN, USSR, Leningrad; L. A. Zenkevich, Institute of Oceanology of AN, USSR, Moscow).

4. Limnology (N. S. Gaevskaia, Mosrybvtuz [Moscow Technical Institute of Fish Industry and Fisheries (imeni A. I. Mikoyan)]; Ia. V. Roll, Institute of Hydrobiology of AN, Ukrainian SSR, Kiev).

V. N. Sukachev was approved as Chairman of the Committee, M. S. Giliarov as a Scientific Secretary.

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At the organizational session of the Committee L. A. Zenkevich was chosen as Vice-Chairman, and E. N. Pavlovskii, P. A. Baranov, N. S. Gaevskaia, M. S. Dunin and E. P. Korovin as members of the Presidium of the Committee.

The Committee faces primary tasks, which are connected with the circulation of data in countries abroad about the development of biology in USSR, with the preparation of measures for the participation by Soviet biologists in foreign (international and national) congresses, with the enlisting of foreign scientists for taking part in biological conventions and conferences in the Soviet Union. The Committee must inform the Soviet scientific society about the work of international and national organizations of biologists and help in the development of book exchanges between the Soviet and foreign biologists.

National Committee of Soviet Biologists is attached to the Section of Biological Sciences of AN, USSR.

The address of the Committee is: Moscow, B-71, Leninskii Prospekt, 57.

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Courses for seed grower-agronomists.

Kukuruza, vol. 2, no. 6, p.50.
June 1957. 59.8 K95.

(In Russian)

Over two thousand seed growing farms (kolkhozes and sovkhozes) grow seeds of double interlinear, variety-linear and intervarietal corn hybrids. In order to increase the qualifications of seed grower-agronomists of these farms, permanently functioning study courses were organised at the All-Union Scientific-Research Institute of Corn in Dnepropetrovsk, in conformity with the decision of the TsK of KPSS [Central Committee of the Communist Party] and the Council of Ministers of USSR "About measures for transfer of kolkhozes and sovkhozes to planting corn with hybrid seeds." Specialists from seed growing farms of the Russian Federation, of the Ukraine, Kazakhstan, Georgian SSR, Armenia, Azerbaijan, Moldavia, Uzbek SSR, Tadzhikstan and Kirghiz SSR are studying here.

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The key place in the program of the courses was given over to the selection and seed growing of corn, to the achievements of the Soviet and foreign selection science. The problems on mechanization, cultivation and harvesting, economics and organisation of growing hybrid corn seeds are studied in detail.

The students of the courses become acquainted in detail with the system of fertilizers in crop rotation, with principles of building up crop rotations and the place of corn in them, also problems of plant nutrition.

A large section of the program is oc^u^pied by the seed-control job, by methods for determining the qualities of seeds. Fundamentals in drying, calibration and storing of seeds are also given. Lectures about measures for the control of weeds, diseases and pests of corn are also conducted. In laboratories the seed grower-agronomists study methods for determination of the quality of the seed material.

Over four hundred agronomists have already received their training at these courses. Equipped with knowledge they will strive with a still greater energy for a fundamental improvement of corn seed growing and transfer of kolkhoses and sovkhoses to its planting with hybrid seeds.

Title of figure 1. A group of seed grower-agronomists studying seed growing science.

Title of figure 2. Seed grower-agronomists during studies in the phytopathology laboratory.

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Solov'ev, B. F.

Proizvodstvo gibridnykh semian kukuruzy v SSSR.

[Production of hybrid corn seeds in USSR].

Vsesoiuzn. Obshch. po Rasprostraneniu Polit. i Nauch. Znanii [Broshiury-Stenogrammy Lektsii]. Ser. 5, [Sel'skokhoz. Ser.] 4, 32p. 1958. 20 V07.

(In Russian)

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1001

The Soviet people are putting into practice with great enthusiasm the measures which were projected by the Party and the Government for a sharp rise in agriculture, for a total increase in grain yields and, in the output of animal husbandry products. A movement has developed around the country for carrying-out the most important problems, which were set out by TsK of KPSS [Central Committee of the Communist Party]: to over-take the USA. in the next few years in the production of meat, milk and butter per head of the population.

Corn is the most important reserve for the increase of grain production, as well as of succulent and green fodder for cattle. In compliance with the resolution of the January Plenum of the TsK KPSS (1955) the kolkhoses and sovkhoses of the country have considerably widened the area for planting of this crop. Corn now occupies a substantial place in agricultural production in almost all regions of the country. The kolkhozes and sovkhozes have considerably strengthened the fodder base, increased the productive ability of cattle and raised the output of products of animal husbandry, especially of milk, owing to this crop. Undoubtedly, the importance of corn will increase with every year.

During the past years, areas for corn plantings in basic regions of its cultivation for grain has increased, so much that its widening can be carried out only on an insignificant scale. Therefore, the rise of production of corn must proceed, first of all, along the line of raising the yielding capacity of this crop.

It is known, that corn, unlike any other crop, possesses vast potential possibilities. It reacts extremely well to the stepping up of agrotechnics in its cultivation, to the introduction of organic and mineral fertilizers, to the conducting of irrigations in arid regions and by its high yields it repays, with interest, the resources spent on its growing.

As data of scientific-research institutions show, as well the leading experience of kolkhozes and sovkhozes, a considerable increase in the yielding capacity of corn can be achieved through planting this crop with hybrid seeds. [Begin p.4]

Mass testings of varieties and hybrids of corn, which were conducted during the course of many years at the State variety test plots, have shown that planting corn with seeds of the best double interlinear, and in many cases also variety-linear hybrids of the first generation, increases the yield by 20-30 percent when compared with plantings of regionalized varieties.

Taking into consideration the importance of transfer of kolkhozes and sovkhozes to planting corn with hybrid seeds, the XXth Congress of the Communist Party of the Soviet Union has pointed out the necessity of an organisation of production of hybrid seeds of this crop on a wide scale.

Certain information on corn hybrids

Those organisms are called hybrids, which were obtained as a result of crossing of forms which differ one from another, according to their heredity. Biological Science has long ago established an important regularity, which consists of the fact that the offspring, obtained from crossing unrelated individuals, or those grown under differing conditions, in contrast to their parental forms adapt themselves better to new conditions of life. These offspring differ (in the first generation) by a more vigorous growth and development, by an increased vitality and productive capacity; that is, they give rise to heterosis, as it is customary to call this peculiarity.

This method of hybridization, which produces an increase in the vigor of plants of the first generation of hybrids, has been known for a long time. Iosef Kel'reiter, Assistant of Botany at the Russian Academy was the first in the year 1760 to discover this phenomenon. Later on this question of obtaining and utilization of plant hybrids was developed in detail in the teaching of the great Russian selectioner - transformer of nature, I. V. Michurin.

In 1876, William Bill conducted the first experiments on crossing two varieties of corn at the Michigan Experimental Station (USA).

In our country the first works on the studies of hybrids of corn relate to the year 1910. They were begun by the famous Russian scientist V. V. Talanov at the fields of the Experimental Station of the former Ekaterinoslav district. The yield of seeds of corn hybrids Grushevskaia X Leaming in the first generation proved to be higher on the average, by 5.1

centners per hectare than of the Grushevskaia variety and by 2 centners higher than of the Leaming variety. The vegetative period of the hybrid was intermediate between the two parental varieties.

Production of hybrid seeds of corn began with a simple intervarietal crossing of two most successfully selected, for the specific natural conditions, varieties of this crop. [Begin p.5]

Nevertheless, as experiments have shown, the possibility of obtaining well yielding combinations of intervarietal hybrids is comparatively small.

Research has shown that best results are obtained from crossing varieties which belong to different botanical groups. In the experiments of Academician B. P. Sokolov the highest yield was produced by hybrids, the parents of which were the best varieties of different botanical groups, regionalized for the given zone.

Further research has shown, that the highest increase in yield of corn is produced by such hybrids in the formation of which take part not only a variety, but also a self-pollinated line, or several self-pollinated lines.

What then is represented by a self-pollinated line of corn and why is it so widely utilized for obtaining hybrids of this crop?

Corn belongs to cross-pollinating plants. Owing to such a method of pollination the plants of the common variety of corn are very heterogeneous in their hereditary composition. But this heterogeneity of the hereditary composition of the variety, as a rule, does not come through sharply as long as corn is reproduced by the usual method.

Nevertheless, one can force a corn plant to become pollinated with its own pollen. For this purpose the female inflorescence (the ear of corn) and the male inflorescence (the tassel) are covered up by insulators before flowering; when blooming begins the insulators are removed and the pollen, which belongs only to the plant in question is transferred to the ear of corn, after that the female inflorescense is again covered by the insulator. If the seeds, obtained from each self-pollinated plant, are planted into separate rows, then each row of plants will differ from the initial variety in a great number of economic and botanical properties. If a forced self-pollination is conducted for several generations, then the so-called self-pollinated lines are obtained, which produce similar descendants.

The first generation of the self-pollinated corn plant shows a sharp decrease in the growth of plants, reduction in the size of corn ears and of the amount of seeds on them, as well as of the weight of seeds. During further repeated self-pollinations the productiveness continues to decrease, although not to such a degree as during the first year.

After 4-5 times of repeated self-pollination the yielding capacity of self-pollinated lines decreases by 30-50, and more, percent compared to the yielding capacity of the original variety from which these lines were developed.

At first sight it may seem that such weakened plants, which are obtained as a result of forced /Begin p.6/ self-pollination, are not of any value. Nevertheless, this is not so. Science and practical works have proved that crossing of unrelated in origin self-pollinated lines produces hybrids which, when compared with the initial lines always are characterised by highly increased productivity and viability.

Further crossing of such, specially selected interlinear hybrids produces double interlinear hybrids, which also are characterized by increased vitality and yielding capacity.

Special crossings are conducted in scientific-research institutions in order to detect the most favorable combinations of self-pollinated lines. The, thus revealed, valuable lines compose then the initial material, which the selectioners use for the production of hybrids, that are outstanding in productivity and other properties.

The following corn hybrids are distinguished, depending on the initial forms, taken for crossing.

Simple and double interlinear hybrids. Simple interlinear hybrids, as it was already indicated, are obtained from crossing two self-pollinated lines. Owing to the fact that for obtaining seeds of simple hybrids there is required a great number of seeds of self-pollinated lines, they are not used for commercial plantings, but are utilized as parental forms for growing double interlinear hybrids.

In order to grow seeds of a double interlinear hybrid one should first obtain two simple hybrids from different self-pollinated lines, and then, next year, cross these hybrids with each other. Hybrid seeds, obtained as a result of such crossing, are the seeds of the first generation of double interlinear hybrids.

Production of a good double interlinear hybrid is a prolonged and complicated process, which is accomplished in scientific-research institutions. It consists in developing and selecting the best self-pollinated lines; in producing highly productive simple hybrids by means of selection and crossing of lines; and, finally, in selection of the best combinations of two simple hybrids for obtaining a high yielding double interlinear hybrid.

A diagram for obtaining simple and double interlinear corn hybirds is shown on page 7.

As it has already been pointed out, double interlinear hybrids of corn of the first generation are characterized by a particularly high yielding capacity. This is explained by the fact that several lines take part in their formation; these make them more resistant to various unfavorable conditions of growth, as well as to diseases and pests. Nevertheless, one should point out that not all /Begin p.7/ the interlinear hybrids are highly productive. Highly productive hybrids are obtained only after a successful selection of pairs. The best double interlinear hybrids have been regionalized by the State Commission on Variety Testing of Agricultural Crops for various zones of the country.

Diagram for obtaining a double interlinear hybrid

Female X Male — Female X Male

Self-pollinated line no. 26 — Self-pollinated line no. 27 — Self-pollinated line no. 28 — Self-pollinated line no. 29

Simple interlinear hybrid (Female) X Simple interlinear hybrid (Male)

"Iskra" — "Ideal"

Double interlinear hybrid (first generation)

"VIR no. 25"

Variety-linear hybrids are obtained after crossing the common regionalized variety with a self-pollinated line or hybrid of self-pollinated lines (see diagram on page 8).

Production of a variety-linear hybrid also is a long and complicated process as it is connected with development of a self-pollinated line and with the work of correct selection of parental forms, in which rest the valuable hereditary qualities.

The variety—linear hybrids, which were developed until the present time, have a lower yielding capacity than double interlinear hybrids. Yet, of late, a new variety-linear hybrid Bukovinskii 3 was regionalized for commercial plantings, which produces a yield similar to many of double interlinear hybrids.

Intervarietal hybrids are obtained as a result of crossing two common regionalized varieties (see the diagram). /Begin p.8/

Diagram for obtaining a variety-linear hybrid

Female X Male

"Dnepropetrovskaia" Self-pollinated line "Grushevskaia 380"

Hybrid (first generation)
"Uspekh"

This is the simplest and the fastest method for obtaining hybrid corn seeds. But the hybrids, obtained as the result of such crossing, exceed in yield the usual regionalized varieties only by 6-10 percent.

Diagram for obtaining an intervarietal hybrid

Female Male

"Voroneshskaia 76" "Kubanka dent corn-3135"

Hybrid (first generation)
"Bukovinskii 1"

As research has shown, crossing of two varieties, which sharply differ in vegetative periods, in the first generation produces hybrids, which occupy an intermediate place between the parents, and which, usually, more often approach the early-ripening variety and rarer the late-ripening.

/Begin p.9/

Table 1.

Yielding capacity of various corn hybrids and of the common regionalized varieties
(According to data of State variety test plots)

Hybrids	Number of experiments	Average yield of grain (c/ha)		Excess of hybrid yields over regionalized varieties	
		Hybrids	Regionalized varieties	in c/ha	in %
Intervarietal:					
Pervenets	187	28.7	26.9	1.8	6.7
Rostovskii	112	24.0	22.6	1.4	6.2
Odesskii 1	202	26.8	25.0	1.8	7.2
Donskoi	25	23.7	22.0	1.7	7.7
Bukovinskii 1	263	39.4	36.0	3.4	9.4
Variety-linear:					
Uspekh	222	31.4	26.8	4.6	17.2
Dneprovskii 2	54	22.3	18.7	3.6	19.3
Krasnodarskii 4	32	44.2	37.4	6.8	18.1
Bukovinskii 2	57	37.0	31.3	5.7	18.2
Bukovinskii 3	43	50.9	37.8	13.1	34.1
Double interlinear:					
VIR-25	129	34.2	25.8	8.4	32.6
VIR-42	497	32.5	25.0	7.5	30.0
VIR-37	18	45.8	36.0	9.8	27.2
VIR-156	21	61.4	46.8	14.6	31.2
Hybrid populations:					
Krasnodarskaia 1/49	46	47.0	41.0	6.0	14.6

Footnote. When compiling yielding capacity tables of hybrids and varieties at the variety test plots the most highly yielding varieties for the given region were taken for comparison.

Intervarietal hybrids most often occupy a medium place, compared to the parental varieties in the height of plants and "zalozhenie" /setting?/ of ears, as well as in the number of barren plants, in the resistance to disease, in the yielding of stalks. /Begin p.10/

One should point out, that the greatest increase in yield of grain compared with the common regionalized varieties are produced by double interlinear hybrids (with the exception of the new variety-linear hybrid Bukovinskii 3); next in the size of increase of the yield, come the variety-linear, and, finally, the intervarietal hybrids (see table 1).

In 1957, under State variety testing there were, in our country, 183 corn hybrids of the native and foreign selection; included in them were: 141 double interlinear, 20 - variety-linear and 22 intervarietal hybrids. At the present time the State Committee on Variety Testing has regionalized for various oblast' and krais of the country 26 corn hybrids, among them 10 double interlinear, 7 variety-linear and 9 intervarietal hybrids, and besides this one hybrid population (table 2).

Double interlinear variety-linear and intervarietal hybrids and hybrid populations of corn regionalised in USSR.

Name of hybrid	Maternal form	Paternal form	By which scientific-research institute it was developed
		Double interlinear hybrids	
	Simple hybrids	Simple hybrids	
VIR-25	Iskra	Ideal	Kuban Experimental Station of VIR /All-Union Institute of Plant Industry/ and Moldavian Scientific-Research Institute of Agriculture.
VIR-37	Zaria	Zenit	Kuban Experimental Station VIR and Severo-Osetinskii State Agricultural Experimental Station
VIR-42	Slava	Svetoch	Kuban Experimental Station of VIR.
VIR-50	Roza	Rassvet	Kuban Experimental Station VIR and Krasnodar Scientific-Research Agricultural Institute
VIR-63	Legenda	Luch	The same
VIR-117	Mechta	Maiak	Kuban Experimental Station of VIR and Zakarpatsk Oblast' Agricultural Experimental Station
/Begin p.11/			
VIR-156	Pobeda	Progress	Kuban Experimental Station of VIR
VIR-267	Otrada	Orel	The same
VIR-281	Volna	Orel	" "
Krasnodarskii 5	Krasnodarskii 3	Kasbek	Krasnodarsk Scientific-Research Institute of Agriculture.
		Variety-linear hybrids	
Bukovinskii 2	Variety Voronezhskaia 76	Self-pollinated line Chernovitskaia 24	Chernovitskaia State Agricultural Experiment Station
Bukovinskii 3	Variety Gloriia Ianetskogo	Self-pollinated line VIR-44	The same
Dneprovskii 2	Variety White Dent Kharkovskaia	Self-pollinated line Grushevskaia 380	All-Union Scientific-Research Corn Institute

(Table cont. on next page)

Table 2(cont.)

Name of hybrid	Maternal form	Paternal form	By which scientific-research institute it was developed
Dneprovskii 56	Simple hybrid Iskra	Variety Severodakotskaia	All-Union Scientific-Research Corn Institute.
Kollektivnyi	Variety Minnesota 13 extra	Self-pollinated line Grushevskaia 380	The same
Krasnodarskii 4	Variety Sterling	Interlinear hybrid Krasnodarskii 3	Krasnodar Scientific-Research Institute of Agriculture.
Uspekh	Variety Dnepropetrovskaia	Self-pollinated line Grushevskaia 380	All-Union Scientific-Research Corn Institute.

Intervarietal Hybrids

Name of hybrid	Maternal form	Paternal form	By which scientific-research institute it was developed
Bezenchukskii	Variety Dnepropetrovskaia	Variety Bezenchukskaia 41	Kuibyshev State Agricultural Experiment Station.
Bukovinskii 1	Variety Voronezhskaia 76	Variety Zubovidnaia 3135	Chernovitsk State Agricultural Experiment Station.
Voronezhskii	Variety Voronezhskaia 76	Variety White Dent Khar'kovskaia	Voronezh Agricultural Experimental Station.
Dneprovskii 3	Variety White Dent Khar'kovskaia	Variety Severodakotskaia	All-Union Scientific-Research Corn Institute.
Donskoi	Variety White Dent Khar'kovskaia	Variety Voronezhskaia 76	Rostov Inspectorate of the State Committee on Variety Testing of Agricultural Plants.
[Begin p.12] Odesskii 1	Variety Dnepropetrovskaia	Variety Grushevskaia Odesskaia	All-Union Scientific-Research Selection-Genetic Institute.
Rannii	Variety Bor'ba	Variety Voronezhskaia 76	Ukrainian Scientific-Research Institute of Agriculture.
Rostovskii	Variety Minnesota 13 extra	Variety Grushevskaia	Rostov Inspectorate of the State Committee on Variety Testing of Agricultural Plants.
Khar'kovskii	Variety Khar'kovskaia 23	Variety Voronezhskaia 76	Khar'kov Inspectorate of the State Committee on Variety Testing of Agricultural Plants.

Hybrid populations

Name of hybrid	Maternal and paternal form	By which scientific-research institute it was developed
Krasnodarskaia 1/49	Offspring of mixture of seeds of four interlinear hybrids	Krasnodar Scientific-Research Institute of Agriculture.

It is necessary to point out, that the majority of hybrids of corn, regionalized at the present time, produce high yields of grain, while in the yield of green mass they, as a rule, do not surpass the common regionalized varieties. Besides, corn hybrids were not yet created for many regions of the country.

That is why the most important problem of the scientific-research institutions is the production, in the next few years, of such corn hybrids for various regions of the country, which would surpass the common varieties not only in the yield of grain, but also in the yield of green mass.

Production of hybrid corn seeds in USSR

Data of science and practice show that corn hybrids produce high yields only in the first generation, and further on their yielding capacity is sharply reduced (see table 3).

From the cited data it is seen, that after planting hybrid seeds of the second generation the productivity of seeds is sharply reduced /Begin p.13/. and approximates the yielding capacity of the common regionalized varieties.

Therefore it is necessary for commercial plantings, annually, to grow hybrid corn seeds of the first generation, which are one of the most important reserves in the raising of the productivity of this crop.

Kolkhozes and sovkhozes require hybrid seeds in all the regions of corn cultivation for grain. Nevertheless, up to recently the organization of production of these seeds was poorly adjusted.

Table 3.

Productivity of seeds of corn when planting hybrid seeds of the first and second generation (According to data of State Variety Test Plots).

Type of hybrid	Name of hybrid	Number of experiments	Mean yield of grain (c/ha)			Deviation of the yield of hybrid of the second generation (c/ha)	
			regionalised variety	hybrid of the first generation	hybrid of the second generation	from the hybrid of first generation	from the regionalised variety
Intervarietal	Donskoi	17	22.1	23.9	22.3	-1.6	+0.2
"	Rostovskii	6	20.2	21.8	20.3	-1.5	+0.1
Variety-linear	Uspekh	15	28.2	33.3	30.0	-3.3	+1.8
Interlinear	VIR-42	5	41.4	52.0	43.2	-8.8	+1.8

Hybrid corn seeds were grown in very small quantities on the initiative of leaders and agriculturists of individual farms. Only individual scientific-research institutions were occupied with the production of seeds of self-pollinated lines; they, altogether, grew only slightly over 15 centners of such seeds. Notwithstanding the great economic value of corn, there was not one scientific-research institution in the country, which would direct the work of selection and experiment stations on this crop and render them methodical and practical help. The necessary control for the growing of hybrid corn seeds in kolkhozes and sovkhozes was also absent. Plantings of corn with hybrid seeds of the first generation occupied insignificant areas. In 1955, only 115 thousand hectares were planted to these seeds, or about one percent of the total area of corn plantings.

In order to quicker and better organize the work of seed growing of hybrid corn seeds, the Central Committee of the Communist Party and the Soviet of Ministers of USSR on the 1st of March, 1956, adopted /Begin p.14/ a resolution "About measures for switching the kolkhozes and sovkhozes to plantings of corn with hybrid seeds." "This resolution established an order and plans for production of hybrid corn seeds in the Union's republics before the end of the Sixth Five-Year-Plan; it created interestedness in seed growing farms for growing and delivering such seeds to the State; it provided for construction of special plants for treating corn seeds as well as for other actions.

At the present time great State importance is attached to the growing of corn seeds. Dozens of scientific-research institutions and thousands of leading kolkhozes and sovkhozes were attracted to this work.

The scientific-research institutions are the basis (primary) links in the system of seed growing. Taking this into consideration, according to a resolution of the Government, the All-Union Scientific-Research Institute of Corn was formed; it was entrusted with coordinating all the scientific-research work on corn in the country and rendering methodical help to selection and experimental stations on selection of this crop. Fourteen selection and experimental stations were transferred under its direct supervision. Besides that, 37 of the biggest scientific-research institutions were additionally enlisted for the work of production of seeds of parental forms of corn hybrids. Thus, at the present time over 50 scientific-research institutes, selection and experimental stations are now engaged, in the country, in the production of corn hybrids and the propagation of seeds of their parental forms.

These scientific-research institutions develop highly yielding corn hybrids, which respond more fully to local conditions, are resistant to lodging and diseases, are early-ripening and cold resistant, as well as hybrids with sterile pollen on female plants. Besides that they grow seeds of self-pollinated lines in quantities which fully provide for the production of seeds of simple interlinear hybrids, as well as elite seeds of varieties, that are the parental forms of variety-linear and intervarietal corn hybrids, until the latter will be replaced by more productive ones.

The All-Union Scientific-Research Institute of Corn and the scientific-research institutions under its supervision are developing the most effective procedures of agrotechnics and methods for mechanisation of corn cultivation, as well as studying other problems, which are connected with the increase of the yielding capacity of this crop.

The propagated seeds of self-pollinated lines and the grown elite seeds enter through the State procurement network /Begin p.15/ the second seed growing link - the specially selected 65 seed growing sovkhoses of the first group, which conduct plantings of the proper self-pollinated lines on hybridisation sections and, as a result of their crossing, obtain seeds of simple corn hybrids of the first generation. Besides this, these sovkhoses propagate seeds of simple hybrids up to the second generation, which become the paternal forms of double interlinear hybrids, as well as seeds for highest reproductions of corn varieties, which are necessary for obtaining variety-linear and intervarietal hybrids.

The seeds of parental forms of corn hybrids, grown at seed growing sovkhoses of the first group are transferred through the procurement points to seed growing kolkhoses and sovkhoses of the second group, of which there are at the present time about 2 thousand. These farms produce on hybridisation sections hybrid seeds of the first generation of double interlinear, variety-linear and intervarietal hybrids of corn. Almost all of the grown hybrid seeds of corn are delivered to the Government, retaining only a small quantity for commercial plantings.

Hybrid corn seeds, which are turned over by seed growing farms of the second group, are sold to kolkhoses and sovkhoses for growing corn by the stores of the Ministry of Grain Products.

Every seed growing farm has an agriculturist, specialist in seed growing, who is, as a rule, selected as a highly qualified specialist with sufficient experience in practical work.

Large resources were put aside for construction of special plants for the treatment of corn seeds, as well as for technical equipping of scientific-research institutions, of sovkhoses and kolkhoses, which are engaged in the production of hybrid seeds.

During the years 1956-1957, 16 factories were constructed in the country for treatment of corn seeds. The seed growing farms deliver hybrid seeds of corn directly from the fields to the factories. Corn ears are stripped of their casings by machinery, they undergo heat drying and threshing, the seeds are calibrated into groups according to size and form, are disinfected and are filled into bags. Calibration of seeds helps the kolkhoses and sovkhoses to plant into a hill by checkrow planters a strictly definite amount of seeds and releases them from the most labor-consuming work - the thinning of corn plants. It is projected, in 1958, to construct 25 more such factories, and 59 in the years 1959-1960. The total productivity of such factories will reach 500 thousand tons of seeds per season. /Begin p.16/

Personal financial interest of farms, producing these seeds, helps a lot in the successful realisation of plans for provision of hybrid corn seeds and of their parental forms. Therefore, the Government established increased fixed prices for seeds of self-pollinated lines and hybrid seeds of the first generation and introduced a series of other advantages for those who deliver such seeds.

Every year special resources are put aside for awarding premiums to workers of sovkhoses, MTS /Machine-tractor Stations/, of agricultural agencies, scientific-research institutions, chairmen and agriculturists of kolkhozes, workers of the procurement organizations, who help in the fulfillment and over-fulfillment of projects of production and delivery of hybrid corn seeds.

In order to increase the qualifications of seed growing agriculturists, who work at seed growing farms, permanently functioning study courses were organized at the All-Union Scientific-Research Institute of Corn.

Results of past 2 years showed that the new system of seed growing of hybrid seeds of corn, formed in accordance with the instruction of the Party and the Government, has justified itself fully.

Owing to the wide range of work on the production of hybrid corn seeds, which was begun in 1956, kolkhozes and sovkhoses already in 1957 have planted 2.5 million hectares with these seeds, or 22 times more than were seeded in 1955.

The work proceeded, being still better organized and on much wider scale, on production of hybrid corn seeds in 1957, when the seed growing farms and the scientific-research institutions acquired the necessary experience.

In 1957, the seeds of self-pollinated lines were grown on an area of 1,000 hectares in scientific-research institutions. Seeds of simple inter-linear hybrids were grown on an area of 7,402 hectares on hybridization sections of seed growing farms of the first group, and on sections of propagation on an area of 6,174 hectares. Hybridization sections, where seeds of double interlinear, variety-linear and intervarietal hybrids of the first generation were grown, occupied 263 thousand hectares; included in these were the highest yielding double interlinear hybrids - 220 thousand hectares. Compared to the year 1956, the area of hybridization sections of double interlinear hybrids has been increased by more than 60 thousand hectares.

In the spring of 1957, the network of seed growing farms, which were selected in 1956, were revised. And, at that time, in the more northern regions of production of hybrid seeds, where corn does not attain full ripeness every year, the number of seed growing farms was reduced, and was increased in the southern regions. This measure gave positive results, /Begin p.17/ because a further concentration occurred in the production of hybrid corn seeds in the regions,most favorable for it. Besides this many seed growing farms, which during the first year of their work had comparatively small areas of hybridisation sections, widened them considerably in 1957.

In 1957, almost all the scientific-research institutions, which were assigned this work, mastered successfully the growing of seeds of self-pollinated lines. The scientific-research institutions delivered to the Government 5,173 centners of seeds of self-pollinated lines. Besides this, the seed growing farms delivered to the Government 4,677 centners of such seeds. Thus, Government storages were stocked with 9,850 centners of seeds of self-pollinated lines of corn.

The Moldavian Scientific-Research Agricultural Institute accomplished an especially great work in 1957 on the production of seeds of self-pollinated lines. This Institute grew 970 centners of seeds of self-pollinated lines and delivered to the Government 955 centners of these seeds.

Good results were attained, when growing seeds of self-pollinated lines of corn, by Stavropol' State Selection Station, by Kuban' Experimental Station of the All-Union Institute of Plant Industry (VIR) and by many other experimental institutions.

Seed growing farms of the first group delivered to the Government 9,172 tons of seeds of simple hybrids, having fulfilled the plan of procurement by 133 percent. Now the country has at its disposal such an amount of seeds of self-pollinated lines and of simple hybrids which will permit not only to successfully fulfill the plan for establishing sections of hybridization of simple, double interlinear and of other hybrids in 1958, but also put away part of these seeds into the Government insurance fund.

Characteristic peculiarity of results of the work of 1957 on growing of hybrid corn seeds of the first generation is the fact that this job was successfully accomplished by whole oblast's,krais and republics.

Seed growing kolkhoses and sovkhoses of the second group in Moldavian SSR, in Krasnodar and Stavropol' krais, in Zaporozhsk, Stalin, Dnepropetrovsk and Astrakhan oblast's, in Kabardino-Balkarskaia ASSR have overfulfilled the plans of production and delivery to the Government of hybrid corn seeds.

The seed growing farms of Krasnodar krai were the first in the country, in 1957, to fulfill the plan of procurement of hybrid seeds. They delivered to the grain-collection points over 20 thousand tons of hybrid corn seeds. Seed growing farms of Moldavian SSR delivered to the Government over 15.5 thousand tons; /Begin p.18/ Stalin oblast' - over 8.5 thousand tons and Zaporozhsk oblast' - about 11.5 thousand tons of hybrid corn seeds.

All the seed growing farms of the second group, in 1957, delivered to the Government 127.7 thousand tons of hybrid seeds of corn, or almost twice as much as in 1956, including 112 thousand tons of seeds of the highest yielding double interlinear hybrids. Now there already exist all possibilities in order to prematurely, already in 1958, for kolkhoses and sovkhoses of Northern Caucasus, Moldavian SSR and of most of oblast's of the Ukrainian SSR to change to planting corn for grain purposes with only seeds of high yielding hybrid seeds of the first generation.

One should point out that in 1957 in many regions, where the production of hybrid corn seeds is concentrated, the weather conditions were unfavorable during the vegetation period. Nevertheless, on all farms, where the growing of hybrid seeds was conducted at a high agrotechnical level, good production yields were obtained.

Thus, for instance, the seed growing kolkhoz "Il'ich" in Temriuksk raion of Krasnodar krai (chairman G. P. Levitskii, seed growing agriculturist V. P. Ponomarev), which had the largest area of hybridization sections - 703 hectares, has obtained from it an average harvest of hybrid seeds of 28.1 centners per hectare. The kolkhoz delivered to the state 12.5 thousand centners of seeds; other kolkhozes and sovkhozes will be able to plant over 62 thousand hectares of corn with these seeds in 1958. The kolkhoz received from the Government over 1.7 million of rubles in money for the delivered seeds, not counting the natural compensations for seeds, which were made in part payment for carrying out Government provisions and payments in kind for the works of the MTS. Production of hybrid corn seeds in this kolkhoz became one of the most profitable branches of the economy.

Sovkhoz "Peremoga" in Zaporozhskaia oblast' (director V. Ia. Chaplenko, seed growing agriculturist R. N. Boguslavskaia) has attained great successes in the production of hybrid corn seeds under arid conditions of 1957. This sovkhoz grew hybrid corn seeds of the first generation of the hybrid VIR-42 on an area of 400 hectares and harvested, on the average, 18.8 centners of seeds per hectare. The sovkhoz delivered to the Government 7 thousand centners of hybrid seeds and received for them 1.2 million rubles.

Nevertheless, speaking about positive results on production of hybrid corn seeds, achieved during the two past years, one cannot remain silent about serious defects present in this work. First of all, one has to point out that the technical base clearly fell behind the amount of hybrid corn

seeds produced by scientific-research institutions and seed growing farms.
/Begin p.19/

Poor provision of seed growing farms with drying plants and storehouses for seed corn lead to the circumstance that a considerable part of grown hybrid seeds, in 1956, was not dried on time, underwent deterioration, lost its planting qualities and proved to be unsuitable for seed purposes.

During the process of work at many seed growing farms serious violations of methods were permitted, as well as of the agrotechnics for growing hybrid corn seeds and of their parental forms.

It is very important not to permit a mixing of parental forms of hybrids during the process of growing hybrid seeds. Nevertheless, there were cases, when planting on hybridisation sections was conducted by inexperienced members of the kolkhos, who allowed the mixing of seeds of the male and female forms. Naturally, such plantings had to be rejected from the number of hybrids.

At some of the farms the seeds of paternal forms were planted without addition to them of some other (signal) crop; this, further on, made it difficult to discern the rows with female and male corn plants.

Individual seed growing farms violated the rules of tassel removal from the female plants on hybridisation sections; they were late with this work or permitted leaving a considerable amount of tassels left on female plants. In many cases harvesting of hybrid corn seeds was delayed up to late in the fall; this took place especially in 1956.

During the past period the seed growing kolkhozes, sovkhozes and scientific-research institutions acquired great experience in growing hybrid corn seeds and their parental forms. Studies, generalisation and wide introduction to all farms of the leading experience permits to considerably improve further work on production of hybrid corn seeds.

Basic peculiarities of growing hybrid corn seeds.

As it was pointed out above, hybrid corn seeds are grown at seed growing farms. The yield of corn in kolkhoses and sovkhoses of the country, which will utilise these seeds for the planting, depends a great deal on the correct organization of work and adherence to the methods of growing hybrid seeds at these farms.

On how really important the quality of hybrid seeds is, one can judge from data of research conducted /Begin p.20/ at the Government Variety Test Plots of Krasnodar krai.

Seeds of the same hybrid VIR-42, grown by the Kuban Experimental Station VIR and by kolkhoses, were planted on several variety test plots. The following yield of corn seeds was obtained by the State variety test plots depending on the origin of seeds (table 4).

Table 4.

Yield of corn seeds depending on the quality of hybrid seeds
(According to data of State variety test plots in Krasnodar krai)

Name of hybrid and of the farm that grew its seeds	Name of State variety test plot and obtained yield of corn seeds (c/ha)				
	Slavianskii	Kanevskii	Timashevskii	Otradnenskii	Kiskii
Year 1955					
VIR-42 Experiment station	-	54.7	64.1	-	35.7
VIR-42 Kolkhos	-	42.3	52.3	-	31.0
Year 1956					
VIR-42 Experimental station	73.2	-	-	25.0	-
VIR-42 Kolkhoz	64.7	-	-	17.9	-

It is seen from the cited data that corn plantings, which were conducted with seeds grown at the Kuban Experimental Station VIR, gave by 4.7-12.4 centner of grain more per hectare than plantings conducted with seeds of the same hybrid, but grown at kolkhozes. This is explained by the fact that in kolkhozes, before the organization of special seed growing farms, agrotechnics of growing hybrid seeds were violated and the seeds were inferior.

Generalization of data of scientific-research institutions, as well as of the production experience of leading kolkhozes and sovkhozes, shows that it is necessary for obtaining a high yield of hybrid seeds of corn to ensure the performance of the following basic agrotechnical requirements during their growing.

Selection of the section and of the fertilizer. Corn is very responsive to fertilizers, and it increases its yield sharply after their introduction into the soil. Therefore, the leading farms, even when planting corn on fertile chernozem soils, introduced large amounts of both organic and mineral fertilizers to hybridization sections. /Begin p.21/

At the kolkhoz "Il'ich" in Temriukskii raion of Krasnodar krai and at sovkhoz "Peremoga" in Zaporozhie oblast', which attained high yields of hybrid seeds they introduced manure and mineral fertilizers on hybridization sections under corn plantings.

Kolkhoz "Rossiia", in Ust'-Labinskii raion of Krasnodar krai, harvested a yield of hybrid corn seeds of 30.7 centners per hectare. At this kolkhoz they introduced 2 centners of superphosphate and 0.5 centner of ammonium nitrate to hybridization sections under the preplanting cultivation.

Manure was introduced in the fall before the autumn plowing, reckoning 10-20 tons per hectare.

Mineral fertilizers are most often introduced during spring under the cultivation of the ploughland: 2-2.5 centner of superphosphate, 1-1.5 centner of potassium salt and 0.5-0.75 centner of ammonium nitrate per hectare.

With a good provision of plants with moisture corn sharply increases the yield. Therefore, in regions of insufficient moisture, one should use widely irrigated lands and sections, which are situated in lower localities, but which will permit to produce corn plantings at the most opportune times, for the establishment of hybridization sections.

In all cases the areas allotted for corn planting must be clean of weeds. It is very important that there be no other plantings of corn around the allotted section at a distance of 300 meters, since otherwise there will occur a cross-pollination of plants and the plantings of corn at the hybridization section must be rejected from the number of hybrids.

Preparation of the soil. In those cases, when hybridization sections are being established on areas after the cereal crops, simultaneously with their reaping, or right after the harvest, it is necessary to remove the stubble to a depth of 5 centimeters. Shallow plowing of stubble causes the sprouting of weeds, which are then destroyed by the following autumn plowing. The fall-plowing must be conducted in August - first days of September to a depth of 25-27 centimeters. The early and the deep fall-plowing produces more favourable conditions for the development of the root system and for a better growth of corn plants. All the seed growing farms, which obtained high yields of hybrid corn seeds, conducted the early and the deep plowing of fields in the fall.

If thistle or other perennial weeds are present on the fields the cultivation of soil after cereals is conducted differently.

Thus, for instance, certain sovkhozes and kolkhoses on Kuban after removing straw from the field conduct stubble removal by /Begin p.22/ disc plow-harrow to the depth of 7-8 centimeters in two directions. In 15-20 days, when the growth of perennial weeds begins to appear, the field is tilled with frame harrow-plows without moldboards to the depth of 12-14 centimeters. With such a cultivation the weeds are destroyed better and a deep loose soil is formed, which prevents the soil from drying.

One proceeds with fall-plowing when, after the second disc tilling, a new weed growth appears, but not later than the end of August - beginning of September, because a delay in fall-plowing involves a reduction in the yielding capacity of corn.

In regions with insufficient moisture during the winter period it is necessary to conduct snow retention in order to provide as great as possible accumulation of moisture in the soil during the fall-winter period. Tractor-drawn snowplows are utilized for this purpose on a large scale.

During the early spring, when snow begins to melt on the fields, the thaw waters are dammed up, and, at the first possibility for entering the field, it is harrowed in two tracks, finishing the work in 1-2 days. There should be no delays in harrowing because moisture evaporates very fast in spring. Research has shown, for instance, that in Tikhoretskii raion of Krasnodar krai delay in harrowing of the plowland for one day led to a loss of water up to 100 tons per hectare.

After the appearance of weeds on the field the plowland is cultivated to the depth of 10-12 centimeters. The day before planting corn the field is cultivated again to the depth of embedding the seeds so that they may be planted into the moist earth on a packed seedbed. This helps a faster appearance of corn sprouts.

It is better to conduct the preplanting cultivation of the plowland by cultivators with flat-cutting cultivator teeth /scuffle knives?/, which undercut well and destroy the weeds, but do not overturn the soil and thus do not dry it out.

Preparation of the seeds. The seeds of parental forms of corn hybrids, which were earmarked for seeding purposes must be tested in a seed-control laboratory for their planting qualities 15-20 days before planting.

Seeds of self-pollinated corn lines must have a germination not below 80 percent, and the seeds of simple hybrids and varieties, which are the parental forms of variety-linear and intervarietal hybrids - not below 85 percent.

It is recommended to warm the seeds of parental forms of hybrid corn in the sun in the course of 2-3 days. The air-heat warming helps in the increase of viability and field germination of seeds.

For the protection of germinating seeds in the soil and of sprouts from infection /Begin p.23/ by various fungi the corn seeds are treated with Granosan in the proportion of one kilogram of the "protravitel" /fungicide/ per ton of seeds, or "Merkuran" /contains 2% of ethylmercurychloride, enriched by gamma isomer of Hexachloran (12% in conversion to gamma-isomer) and a filler of talcum or mixture of talcum with kaolin/* in the proportion of 1.5 kilogram of the "protravitel" /fungicide/ per ton of seeds. Besides that, in order to protect the seeds from the wireworm they should be powdered with Hexachloran dust in proportion of 3-4 kilograms of "protravitel" /insecticide/ per ton of corn seeds. Treatment of seeds with azotobacterin, before planting, increases well the yield of corn. In those cases when the

*Translator's footnote - compound taken from P. V. Popov's Handbook on Poisonous Chemicals, p.363, Moscow. 1956.

seeds of corn are treated with azotobacterin, their treatment with Granosan and dusting with Hexachloran should be conducted 2-3 weeks before the planting of corn. The treated seeds are planted immediately after their treatment with the bacterial fertilizer, since the soil protects the bacteria from the harmful action of Granosan and of Hexachloran.

Sowing. Sowing of corn on sections of hybridization is conducted in brief periods after the soil becomes heated up to the temperature of 10-12° of heat at the depth of 10 centimeters.

Seeds of both parental forms are sown by checkrow corn planters and are embedded in the soil to the depth of 8-10 centimeters depending on the type of the soil, its warming through and moistness. The seeds of self-pollinated lines are embedded to the depth of 4-6 centimeters, but without fail into a moist layer of soil.

Placing and alternation of plant rows of the female and male forms must provide a better fertilization of maternal plants. Proper correlation of rows of female and male plants on hybridization sections is established by taking into consideration local climatic peculiarities.

In regions of sufficient moisture, as well as on irrigated lands, the sowing of corn on hybridization sections of double interlinear and intervarietal hybrids are conducted in such a manner that after each two rows of plants of male form follow 4 rows of plants of the female form. In these regions it is also possible to conduct the sowing of corn in such a way that after each row of male plants follow two rows of female plants.

When growing seeds of simple interlinear hybrids, the correlation of rows of parental forms of corn hybrids is changed, and it is made that two rows of plants of the male form would alternate with two rows of plants of female form. The same alternation of rows of parental forms is established also when growing seeds of variety-linear hybrids, in which the self-pollinated line is the paternal form. In the case, when the paternal form of the variety-linear hybrid is a simple hybrid, one can retain the correlation of rows with male and female plants as 2:4, or 1:2. /Begin p.24/

At the kolkhoz "imeni Kalinina" in Gul'kevichskii raion, Krasnodar krai, in 1957, on a part of plantings when growing double interlinear hybrid VIR-42 the correlation of rows of male and female plants was 2:6. On this section the harvest of hybrid seeds was by 4.4 centner per hectare higher than with the correlation 2:4 of rows of parental forms.

In arid regions the best results are produced by sowings on all hybridization sections at a correlation of rows of parental forms as 2:2, since this provides a better fertilization of ears of female plants. Expediency of such an alternation of parental forms was especially obviously confirmed in 1957, when in many Ukrainian regions during the period of blooming of corn a strong soil and air dryness were noted. At those farms, where planting on hybridization sections was conducted according to this scheme, the ears proved to be fully fertilized and corn produced a considerably greater yield.

As it was already pointed out, on hybridization sections the sowing of corn is conducted with checkrow corn planters at a distance between the hills of 70 X 70 centimeters. In order to guarantee the correlation of rows of male and female plants as 2:4, the seeds of the male form are poured into 2 end seed hoppers, and the seeds of the female form into the four middle hoppers.

If on the farm the sowing of corn is conducted in the manner that after each row of plants of male form follow two rows of plants of the female form, then it is necessary to put seeds of the female form into two end hoppers as well as into two center seed hoppers of the planter, and the seeds of the male form into the second from the left and into the second from the right of the outer seed hoppers.

When the sowing of corn at the hybridisation section is conducted according to the plan 2:2, then into the outer seed hopper from the left (along the course of the planter) seeds of the male form are poured in, into two hoppers, next in turn, are poured seeds of the female form, then into two next ones seeds of the male form, and finally into the end seed hopper are put in seeds of the female form.

The experience of past years has shown that female plants are better fertilized in that case when the sowing of corn at the hybridisation sections is conducted in the manner that the rows are arranged crosswise to the direction of the prevailing winds. Therefore, in places where this is possible such a layout of rows should be used widely.

Crosswise plantings at the ends of the field are not permitted under any circumstances, since in such cases a mixing of female and male plants occurs inevitably. /Begin p.25/

In order to distinguish easier the rows of male plants from the rows of female plants, a small amount (0.2-0.3 percent from the weight of corn seeds) of germinable sunflower seeds are added to corn seeds of the male form; later on the sunflower plants are left at a distance of 25-30 meters from each other as a signal crop. During allocation of hybridisation sections on an area where sunflowers were grown, it is recommended to use as a signal crop seeds of other agricultural plants, since fallen sunflower seeds can sprout and disorient the kolkhoz workers in the determination of rows of male forms.

At the kolkhoz "imeni Lenin", Oloneshtskii raion, Moldavian SSR, they used soybeans as a signal crop instead of sunflowers. Moreover, besides a high yield of hybrid seeds, they harvested 3 thousand centners of this crop, that is 5 centners per hectare. This gave the opportunity to the kolkhoz to obtain an additional income from this valuable oil crop.

Some of the seed growing farms arrange an additional sowing of seeds of the male form in the vicinity of the hybridization section so that their pollen should be transported by the wind to the female plants. In addition to that, they sow these seeds 5-7 day later than the corn sowing at the hybridization section. This permits to have an additional amount of pollen, and, mainly, at the time when at the basic planting there is already little of it. In the presence of a sufficient amount of seeds of the male form at the farm, such sowings will thoroughly justify themselves.

Care of the plantings is a deciding measure in obtaining high yields of hybrid corn seeds. Therefore, all the work on the care of corn sowings at hybridization sections must be conducted on time and accurately.

Care of corn plantings is begun with the harrowing of sprouts. In those cases when the appearance of sprouts is detained, and the weeds start growing, harrowing is conducted before the appearance of corn plants on the upper surface of the soil. Harrowing loosens the soil, helps in the destruction of weeds, improves the access of air to the germinating seeds, which is favorably reflected in the development and growth of young corn plants.

Tilling of interrows with cultivators is begun when the first 3-4 leaflets are formed on the plants.

The working parts on the cultivator are placed in such a way that at the edges of the interrows (near the plants) would be the one-sided cultivator teeth - the scuffle knives or chisel-shaped parts of the cultivator.

This is done in order to exclude the possibility of undercutting the plants. /Begin p.26/

The first cultivation is usually done in a crosswise direction to the course of the planter, and the second - perpendicularly to the first. The thinning of plants in hills is conducted immediately after the first cultivation.

Most often three plants are left in the rows of plants of male forms in order to obtain from them more of the pollen. In the rows with female plants in regions of sufficient moisture in each hill two plants are left, in order that, on the average, there be one and half plants per hill. Under conditions of a severe drought this increased the yield and the farm obtained 27.8 centners of hybrid corn seeds from each hectare.

The interrows on corn plantings are usually cultivated 3 times in two directions during the period of vegetation. At the sovkhos "Peremoga" of Vasil'evskii raion, Zaporozhsk oblast' under arid conditions of the year 1957, in spite of the fact that corn plants were almost free from weeds, the cultivation of interrows was continued and this permitted to obtain a high yield of hybrid seeds.

Planting of seeds or plants into the thinned out hills is not permitted on hybridization sections, since at such times usually a mixing of male and female plants occurs.

Varietal weeding is conducted on all hybridization sections, where in the formation of hybrid seeds self-pollinated lines take part (obtaining simple interlinear and variety-linear hybrids).

Varietal weeding is started during the phase of 4-5 leaves, that is simultaneously with thinning of plants. At that time already a certain part of admixtures (hybrid plants) stand out by their more vigorous height, wider leaves and their greater number. Such plants are removed.

Later on the varietal weeding is repeated every 10-15 days and is finished without fail before the beginning of flowering of corn. During each varietal weeding new plants - admixtures are removed, which for some reason were not previously detected and removed.

To the admixtures belong also the plants, which sharply differ from the basic type in color, width and crimping of leaves, presence of anthocyan (violet coloration) at the base of the stalk or on leaves, bushiness, thickness and height of the stalk, an earlier or a too late onset of tasseling and of other properties. /Begin p.27/

The number of varietal weedings on hybridization sections, must be not less than two without counting the thinning.

At the hybridization sections of simple interlinear and varietal-linear hybrids, the varietal weeding must be conducted especially carefully in the rows of plants of the male form.

In order that the varietal weeding be conducted correctly and only the admixtures be removed, the seed growing agriculturalist on the farm must first study well himself the characteristic properties of the self-pollinated lines, and then teach the workers, who will conduct the varietal weeding, how to recognize the admixtures from typical plants of the given self-pollinated line. It is necessary to consult the selectioner in such cases, where the seed growing agriculturalist cannot himself properly separate the basic type from the admixture. It is the job of local agricultural organizations to train the seed growing agriculturalists for conducting varietal weedings.

In 1957, at the kolkhoz "Il'ich", in Temriukskii raion, Krasnodar oblast', the sowings of corn on hybridization sections were treated twice with the preparation DDT and Hexachloran from an airplane; this protected them from damage by the caterpillar of the corn borer. Owing to this there almost were no ears damaged by this pest, whereas in 1956, when the plantings were not treated by poisonous chemicals, there were reckoned over 75 percent of them. Such measures of control of this pest must be also practiced by other seed growing farms.

High-yielding hybrid seeds are obtained only in that case, when female plants on the hybridisation section are pollinated only with the pollen of male plants. Therefore the tassels must be removed from female plants completely and at the proper time.

So as to prevent the possible delay in the removal of tassels from female plants, 10-15 days before the beginning of the supposed tasseling a daily observation is set up of the development of corn at the hybridisation sections.

Moreover, one must keep in mind that in the majority of female forms of plants the flowering of tassels usually begins on the 50-60th day after the appearance of sprouts.

In order to conduct the removal of tassels better, the corn plantings on hybridisation sections must be examined 15 days ahead of this work. During the process of field examination it is necessary to establish how correctly the rows of parental forms alternate; for this purpose the controlling agriculturist and the seed growing agriculturist from the farm together with the team-leader and the field team-leader walk across the corn plantings and check the continuity of distribution of rows of plants of male and female forms of the hybrid. /Begin p.28/

All the cases of deviation from the accepted scheme of alternation of rows are recorded on the plan as well as marked in the field, in order that they be not forgotten, and tassels be removed from all female plants at the proper time and in all entirety. The rows of plants of the male form usually are easily recognised by the presence in them of the signal crop.

During the field examination are checked also the degree of varietal contamination of the plants, the presence of crosswise plantings and the correctness in the observance of space isolation.

Space isolation for plants, where seeds of simple interlinear hybrids are grown, must be not less than 300 meters; while for hybridisation sections, where seeds of double interlinear, variety-linear and intervarietal hybrids are grown - not less than 200 meters.

The greater space isolation for hybridization sections, where seeds of simple corn hybrids are grown, is explained by the fact that these seeds will be utilised not for commercial plantings, but for further hybridisation-obtaining seeds of double interlinear hybrids. If during growing the seeds of simple hybrids there will be permitted the smallest pollination of female plants by the pollen of other sowings, this will tell, to a high degree, on the yielding qualities of seeds of double interlinear corn hybrids.

If the space isolation is not observed then before the appearance of tassels on corn plants the farm sowings of corn should be mowed for green feed or silage in the zone, which will provide the required isolation.

In the case when crosswise sowings are found on hybridisation sections, all the corn growing in transverse sowings must be immediately mowed for green feed.

It is necessary to determine the requirement of the farm in man-power for conducting the detasseling before the beginning of this work. The average work load per man is usually established in the size of 1.5 hectare of the hybridisation section or 1 hectare of plantings of the female form of corn.

One should start the removal of tassels immediately after their appearance is noted even on single plants.

Tassels are removed at their appearance from the bell mouth of the upper leaf, when it is possible to grasp by the hand all their shoots. At such a time the tassels are easy to break off together with the stems with a sharp movement of the hand up. One should aim during this work not to break off the upper leaf of the plant because this negatively reflects in the yield of hybrid seeds. One should remove especially carefully /Begin p.29/ those tassels, which have fully emerged from the bell mouth of the upper leaf and spread out their shoots.

The period of appearance of tassels on corn usually continues for 12-15 days. But during individual years with unfavorable climatic conditions, as, for instance, the year 1957 was, the period of tasseling is greatly extended and continued for 30 days. In order to prevent the pollination of female plants by their own pollen, their tassels must be removed daily, independent of the weather. During the course of the full period of the tasseling phase the work cannot be stopped even for one day, because part of the tassels might start flowering and pollinate a considerable part of female plants of corn.

When in the general mass of the female form there will remain less than 10 percent of plants with unremoved tassels, the removal is completed during the course of one day, removing all the remaining tassels, including those which did not fully emerge from the bell mouth of the upper leaves.

In order to obtain full-value hybrid corn seeds one should remove, without fail, the side shoots on female plants, since often fully developed tassels are formed there. In order to relieve the work load, which is created during simultaneous plucking of tassels and removal of side shoots from the plants of female forms, the side shoots should be removed earlier - at the time when corn plants attain 50-70 centimeters in height, and finish this work before the plucking of tassels. Side shoots on male plants of corn should not be removed since they form tassels and produce additional pollen.

Every farm establishes the strictest daily control of the quality of detasseling during the course of the whole period of conducting of this work. This control is accomplished by the field team-leaders, the team-leaders and the agriculturists at the farms. During the work of detasseling the field team-leaders are constantly in the field with the workers and they check the quality of work of each member of the team.

During this work, the field team-leader walks behind the workers, who remove the tassels, and, while controlling their work removes the tassels, which are left occasionally.

The team-leader of the field work brigade checks the work of each team not less than once every day. Final charging of work-days to kolkhoz members or payment to the workers of the sovkhoz for the work performed is conducted by taking into consideration its quality.

In the seed growing kolkhoz "Rossiia" in Ust'-Labinsk raion, Krasnodar krai, in 1957, each member of the kolkhoz was assigned an area of corn and the payment for the work of detasseling was made reckoning 18 work days for /Begin p.30/ one hectare. According to the information of the administration and of the agriculturist of the kolkhoz, such a system has fully justified itself; the tassels were removed fully and on time. During field investigations no unremoved tassels were discovered.

Agriculturists of the seed growing farms are systematically in the fields during the whole period of hybrid corn seeds growing, while during sowing, detasseling and harvesting - are daily in the field; they examine the quality of work produced on hybridization sections, making necessary notations in their journals.

Taking into consideration a special importance of timely and correct removal of tassels from female corn plants at hybridisation sections, the quality of work is controlled, apart from workers at the farm, also by persons, who are specially appointed by the Oblast' (or Krai) Departments of Agriculture or Ministries of Agriculture of the Republics from the number of workers of agricultural institutions or scientific-research establishments.

When determining the number of unremoved tassels on female plants all the tassels are accounted for on which there are even single anthers. The number of unremoved tassels must not exceed 2 percent during each investigation.

If the number of unremoved tassels on female plants exceeds the established norms, the harvest from such sections is rejected as hybrid seeds.

A field approbation, which has the aim of establishing the typicalness of grown seeds and, the degree of their contamination with disease, is conducted in addition to field examinations of unremoved tassels from female plants on all plantings of self-pollinated lines, which were produced both for the purpose of propagation, as well as for hybridisation (for obtaining simple hybrids), and also on sections of propagation of simple hybrids. Field approbation of self-pollinated lines, sowed on hybridisation sections for obtaining seeds of simple hybrids, is a compulsory supplement to field examinations, which were conducted during the time of detasseling. Field approbation is not conducted on hybridisation sections for obtaining double interlinear, variety-linear and interlinear hybrids.

If, as a result of field approbation, it will prove that the ears have a typicality below, and the "Kseniinost'"* (presence of seeds of a different

*Translator's note. Explanation of this term, as found in the Russian Agricultural Dictionary by A. I. Gaister is: "Number of xenia seeds, which are found per 100 ears".

color in the ear) is above the established norm, then the storing and utilization of these seeds for sowing can be effected only with the permission of the Ministry of Agriculture of USSR and the Ministry of Grain Products of USSR.

Harvesting corn on hybridization sections is a very responsible phase of work in the production of hybrid /Begin p.31/ seeds. Ill-timed or incorrect harvesting of the already grown seeds sharply reduces their sowing qualities or leads to the fact that these seeds prove to be fully unsuitable for sowing on account of low germinating ability. And furthermore, during an incorrect harvesting there might be permitted a partial mixing of hybrid ears with ears of male plants, that is the quality of the seed material will be lowered.

In order to fully preserve the grown harvest and to guarantee the high quality of hybrid seeds, they must be harvested on time and correctly, dried quickly and stored excellently.

Harvesting of hybrid corn ears must be carried out at the onset of full ripeness of seeds in as short period of time as possible. In those cases when the ripening of corn is delayed and there is a possibility of early frosts, harvesting is carried out during the wax stage /yellow ripe/ of the seeds, with an immediate drying of ears in corn driers.

Data of scientific-research institutions show that after a timely and correct drying such seeds prove to be valuable sowing material.

Testing the viability of unripened corn seeds, N. N. Kuleshov has established, that germination of seeds of this crop, which were harvested during the milk-wax stage, but before the onset of fall frosts, and then dried at the proper time and correctly, reached 95-100 percent. Productivity of plants, when utilizing these seeds under field conditions, did not differ from the productivity of plants, obtained from sowing the fully ripened seeds.

Unripe corn ears must be dried in driers or in the sunshine in the open air, and then stored in dry, well ventilated buildings.

Harvesting the yield on hybridization sections is conducted at different times for the female and the male plants, in order not to permit any mixing of hybrid ears from female plants with ears of male plants.

It is better to harvest the plants of the male form at the milk-wax stage, and the hybrid ears after their ripening. Many seed growing farms practiced widely such harvesting, in 1956-1957, on hybridization sections, and it gave good results.

By first harvesting the rows of plants of the male form, the farmers thus prepared openings for the passage of vehicles during the harvesting of hybrid corn ears from the female plants. With such a harvesting the possibility of mixing of the ripened hybrid ears with the ears of the male form was excluded. And the formed openings in the plantings served as good passageways for the wind, which dried faster the hybrid ears on female plants. Therefore this method /Begin p.32/ of harvesting of male plants must be used wider on all seed growing farms.

In those cases when it is planned to use the corn ears from male plants in the form of ripened grain, the ears of female plants, which are the hybrid seeds, are harvested first from the hybridization sections and removed from the fields. After this are harvested all the ears from male plants as well as all the ears that fell to the ground.

The harvested hybrid corn ears are on that same day removed to specially prepared, well ventilated buildings, threshing floors, or sheds.

There they are immediately sorted; ears of another type are rejected as well as those which are strongly infected with fungus and bacterial diseases. The granary approbation of ears is conducted after the sorting.

The harvest of hybrid seeds from hybridization sections of simple, double interlinear, variety-linear and intervarietal hybrids is subjected to granary approbation. The method for conducting granary approbation is the same as for the common varieties.

The granary approbation is conducted by the seed growing agriculturist on the farm. The record of granary approbation is checked by the controller agriculturist. The statements about field examination, field and granary approbations are handed over to the grain-collection points, where the seeds are delivered.

It is necessary to remember that plantings of corn with hybrid seeds are the most important reserve of raising its yielding capacity, and one should take all measures in order that these seeds be of the best quality.

* *

*

The experience of two years of work on production of hybrid seeds of corn, according to the new system of seed growing, shows that we have all the possibilities prematurely to fulfill the task, which was set up by the Party and the State, on transfer to planting corn with hybrid corn seeds in the basic regions of its production for grain.

Vsesouiznaia Nauchno-Technicheskaia Konferentsiia po Primeneniu Radioaktivnykh i Stabil'nykh Isotopov i Izluchenii v Narodnom Khoziaistve i Nauke. 1957. /All-Union Scientific-Technical Conference on the Use of Radioactive and Stable Isotopes and Radiations in National Economy and Science, 1957/.

Trudy: Radiobiologiia.

Moskva, Akademiia Nauk SSSR, 1958. 286p. 442.9 V963.

(In Russian)

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Trans. A-1003
[redacted]
vg/M

Bel'govskii, M. L.

Nasledovanie ustoichivosti nasekomykh k insekticidam.

/Inheritance of the insecticide resistance in insects/.

Zool. Zhur. vol. 37, no. 7, p.1024-1038. July, 1958.
410 R92.

(In Russian)

9. Deduction (pages 1035-1036)

Review of the existing data on genetics of insect resistance to insecticides shows that differences in degree of resistance of various races to poisons can have a different genetic basis. In many cases difference in resistance, as well as in many other quantitative indices of animals and plants, is conditioned by a difference in many genes and, in accordance with this, in the second generation of hybrids we observe a complex segregation, which is characterized by a general increased variability and an absence of clearly delimited classes of descendants. Such inheritance, as we already mentioned, must be expected if the given difference is conditioned by dissimilarity in many characteristics, each of which comparatively weakly influences the general resistance. On the other hand, it is necessary to point out the unexpectedly high (as much as we have to do with a quantitative feature) percentage of cases of monofactional conditioning of increased resistance. Such cases, as we have seen, are known both in house flies, and

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in *Drosophila*, as well as in mosquitoes and in scale insects. They speak about the existence, in the insects, of effective protective mechanisms, which increase the resistance so much, that on their background the influence of secondary differences, undoubtedly always present, already does not tell.

It is known, that in the scale *Aonidiella aurantii* such mechanism consists of the change in the physiology of respiration; in the scales, resistant to HCN /hydrocyanic acid fumigant/, it is not connected with cytochrome oxidase, but with the auto-oxidating enzyme, which does not contain atoms of metals, possibly flavoprotein or cytochrome b_5 (R. Metkalf, 1955; V. Wigglesworth, 1956). In the lines of house flies, most resistant to DDT, a similar role is, possibly, played by the presence of DDT - dehydrochlorinase. In *Anopheles gambiae*, on the contrary, according to research of Bradbury and Standen (F. R. Bradbury and H. Standen, 1956), resistance to γ-BHC is not connected with any mechanism of detoxification. Finally, in many cases nothing is known as yet in general about the nature of protective mechanisms, but one can suppose, that a clear monohybrid segregation, according to resistance, serves as an indication of their presence. From this point of view it would be interesting to conduct a physiological comparison of lines of resistant flies, which will produce, after crossing with the sensitive, monohybrid and, respectively, polyhybrid segregation.

The presence of only one of the cited cases of cytoplasmic heredity shows that, similar to other characteristics of multicellular animals and plants, the resistance of insects to insecticides, is comparatively rarely conditioned cytoplasmically. Nevertheless, natural selection, which produces resistant races, does not neglect a single hereditary change, which is useful for the genus, regardless of which part of the cell it is connected with. That is why in different genera, in different populations of the same genus, and in respect to various insecticides, we then meet such differing genetic mechanisms of resistance.

In conclusion, one should point out, that the previously mentioned experiment in nature, which was involuntarily conducted during the course of the last decade by the workers, who conducted chemical control of harmful insects, has shown how fast evolutionary changes can proceed in insect populations even in quite unusual directions. It has also shown that these changes occur at the expense of genetical /Begin p.1036/ heterogeneity of the population, and their scales depend directly on the degree and character of this heterogeneity. Finally, it elucidates the full groundlessness of the opinion, which is occasionally expressed, as if the adaptable hereditary changes in the population can occur only under the influence of changes of natural factors, which enter into the number of conditions of life of the given genus. Of course, the insecticides least of all fit such a definition, nevertheless, we see that they play a role of a very effective factor of an adaptive change in populations.

Inheritance of the Insecticide resistance in insects

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Summary /In English -- Copied/

The capacity of insect populations to acquire insecticide resistance is connected with the genetic heterogeneity of these populations. Selection of more resistant individuals in genetically homogeneous strains gives negatige results.

The genetical basis of differences in the degree of resistance of different insect races and strains is different in various cases. It can be

monogenic, polygenic or cytoplasmic, depending upon hereditary changes that happened to be fixed in the process of formation of the resistant race in question.

The fact that many cases of monogenic inheritance of resistance are known shows that effective protecting mechanisms able to increase sharply insecticide resistance are rather common among insects. The physiological basis of these mechanisms is known in some cases and needs elucidation in others.

The study of the genetics of the acquired insecticide resistance in insect populations leads to the understanding of the mechanism of rapid evolutionary changes taking place in these populations under the influence of quite new factors (insecticides) introduced in their environment.

(In full)
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Marakhtanov, K. P., Gorbachev, V. O., and Filatkin, P. A.

Za vozdelyvanie odnim chelovekom sta gektarov kukuruzy.

/The growing of 100 hectares of corn by one man/.

Kukurusa, vol. 2, no. 6. p.15-20. June, 1957. 59.8 K95

(In Russian)

The area of corn planting in our country grows from year to year. If in 1954 it equalled 3.2 million hectares, then in 1956 it already was 23.9 million hectares. Towards the end of the Sixth Five-Year-Plan corn plantings will occupy 28 million hectares.

Total harvesting of seeds and of silage mass grow accordingly; the volume of work and expenditure of labor increase also. All this urgently requires now a considerable increase in the level of mechanisation of cultivation of this crop, of introduction of the new, advanced agrotechnique, sharp reduction in the expenditure of labor and cheapening of the cost of production.

According to data of the All-Union Scientific-Research Institute of Mechanisation of Agriculture the expenditure of labor for cultivation of corn and for harvesting on the average comprise, at the present time, 15.72 man-days per hectare. Wide utilisation of machinery, released by industry, and mechanised harvesting of corn by the combine KU-2A, permits to reduce the expenditure to 8.45 man-days per hectare. But when utilising experimental machines, as well as herbicides for destroying the weeds, expenditures of

Glavnoe upravlenie mekhanizatsii i elektrifikatsii Ministerstva sel'skogo khoziaistva Soiuza SSR. /Chief Administration of Mechanisation and Electrification of the Ministry of Agriculture of USSR/.

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labor, depending on the utilized corn-harvesting machines, comprise: 2.05 man-days per hectare of planting, while utilizing combine KSK-2.6U, and 3.31, when using KU-2A.

The existing technology for corn cultivation, when applying the available means for mechanization, is as yet very imperfect: too much labor is expended for planting with a manual transport of the measuring wire, for thinning out, weeding and harvesting, for husking and sorting of ears and for loading and unloading work. (Text continues after the table).

Kind of work	Expenditure of labor in man-days per 1 hectare when utilizing		
	means of mechanization present at the farm	Serial machinery (See the first scheme)	Serial and experimental machines (See the second scheme)
[illegible]ic tilling of soil	0.16	0.16	0.1
Preplanting preparation of soil and planting	0.45	0.33	0.15
Care of the plantings	3.75	2.29	0.29 (with the use of herbicides)
Harvesting corn at full ripeness of seeds*	11.36**	5.67***	1.82-three row combine VNIIMES 1.51--combine KSK-2.6U 2.77-combine KU-2A 2.23-corn ear picker SPU-2

*Taking into account the husking of ears, their delivery to the threshing floor and transportation of the green mass to the silo.
**20 percent of the area of corn plantings was harvested by the combine KU-2 and 80% - manually.
***The whole area of corn planting was harvested by KU-2A.

That is the reason why the Ministry of Agriculture of USSR and the scientific-research /Begin p.16/ institutions of the country have conducted during the present year, a wide production experiment in kolkhozes on the use of a complex of different machines, which provide maximum mechanization of all processes during corn growing, and which permit one man to grow up to 100 hectares of corn.

Experiments in kolkhozes of RSFSR, of Ukrainian, Moldavian and Kazakh republics were conducted according to a similar program and method, which were developed by the Chief Administration of Agricultural Mechanization and Electrification of the Ministry of Agriculture /MSKh/ of USSR together with scientific-research institutions.

Experiments, about which we speak, were laid out in kolkhozes, according to two schemes: first - cultivation and harvesting of corn, utilising a complex of machines, which are now produced by industry (one variant of the experiment and one control); second - cultivation of corn, utilizing serial machines, as well as new experimental ones (four variants of the experiment and a control).

For each variant of the experiment and control sections were separated, in crop rotations, of an area of about 100 hectares, in all 60 thousand hectares. On these farms, where for some reason it was impossible to separate out sections on one field of the crop rotation, they were isolated at various places; but, at the same time, it was observed that they be similar in type and mechanical composition of soil, predecessors, tilling, and so on.

And what kind of machines and implements will be utilized at the experimental sections of MTS /Machine-Tractor station/? Dispatched to the sections were: 450 tractors DT-54, 600 tractors DT-24, 565 seeders SKGK-6B (with a diagonal transfer of the measuring wire); from among these 100 drills with hydraulic controls and 110 mounted, 345 corn-harvesting combines KU-2A, 395 silage-harvesting combines SK-2.6, 80 among them with hydraulic controls, 30 combines KSK-2.6U and as many KU-3 of VNIIMES construction, 15 corn ear-pickers SPU-2A. Earmarked for hauling work were 900 self-discharging tractor trailers, as well as 600 dump trucks ZIL-585, and so on.

Seeder SKGK-6B works as a unit with tractors "Universal", DT-24, "Belarus'" and KDP-35 at a rate of movement of 4.5-5.2 kilometers per hour. The output of the drill, when planting interrows 70 X 70 centimeters, attained 12-15 hectares per 10 hours of work. The sowing unit is serviced by two men: tractor driver and the sower. The measuring wire was being transferred mechanically. When using seeders SKGK-6B for seeding 1 hectare 0.13 man-day is expended, while with seeder SKGK-6 — 0.47 man-day, that is almost four times more.

Corn harvesting combine KU-2A (Figure 1) has been produced by industry since the end of 1956. Its distinguishing feature, as compared with the earlier released model of combine KU-2, consists of the following: the frame of the combine has been raised by 50 millimeters and the wheel axles were shifted back by 110 millimeters. This reduced the load on the mechanism of the inclination, of the cutting apparatus, increased the conveyer clearance, improved the access to silage cutting drums and removed the possibility of damage to the bottom of the silage elevator by the shocker valve. (Text is continued after the schemes).

The recommended assembly of production machines according to the experience of scheme I.

Experiment according to scheme I	Control
1. Preplanting cultivation of soil	
Couplings of zigzag harrows, cultivators KP-4, KPN-4 and others	Is conducted by machines and implements available at MTS /machine tractor stations/
2. Sowing of corn	
Trailer seeder SKGK-6B with diagonal transfer of gauge wire	
3. Care of corn plantings	
Couplings of light harrows or the rotary hoe, KRN-4.2 (two longitudinal and lateral cultivations)	
4. Corn harvesting	
Combines KU-2A and SK-2.6, motor cars GAZ-93 and ZIL-585 or tractor trailer of 2-4 tons	
5. Basic tilling of soil	
Agricultural machines LD-10 and P5-35M	

/Begin p.17/

Recommended assembly of production and experimental machines for different variants Scheme 2.

	Variant "a" (100-200 hectares)	Variant "b" (100-200hha.)	Variant "c" (100-200 ha.)	Variant "d" (100-200 ha.)	Control (100-200 ha.)
1. Preplanting cultivation of soil	Couplings of zigzag harrows, cultivator KP-4, KPN-4 and others	Couplings of zigzag harrows, cultivator KP-4, KPN-4 and others	Couplings of zigzag harrows, cultivator KP-4, KPN-4, and others	Couplings of zigzag harrows, cultivator KP-4, KPN-4, and others	Is conducted by machines and implements available at MTS.
2. Sowing of corn	Trailer seeder SKGK-6B with hydraulic controls	Mounted seeder on tractor DT-24	Mounted seeder on tractor DT-24	Trailer seeder SKGK-6B with hydraulic controls	
3. Care of corn plantings	Couplings of light harrows or rotary hoe KRN-4.2 (2 longitudinal and 2 lateral cultivations	Couplings of light harrows or rotary hoe KRN-4.2. Treatment with herbicide 2.4-D with the aid of OMK (one longitudinal and lateral cultivation	Couplings of light harrows or rotary hoe KRN-4.2 (2 longitudinal and 2 lateral cultivations	Couplings of light harrows or rotary hoe KRN-4.2. Treatment with herbicide 2.4-D with the aid of OMK (one longitudinal and lateral cultivation	
4. Corn harvesting	Combines KU-2A,SK-2.6 with hydraulic controls. Motor cars GAZ-93 and ZIL-585 or tractor trailer of 2-4 tons. Ear-husking machine	Combine SK-2.6 with hydrolic controls or KSK-2.6U,SPU-2. Motor cars GAZ-93 and ZIL-585 or tractor trailers of 2 tons and VN-3. Ear-husking machine	Combine KSK-2.6U. Motor car ZIL-585. Tractor trailer 2-4 tons. Ear-husking machine	Combine SK-2.6 with hydraulic controls, KU-3 of VNIIMES construction. Motor car ZIL-585. Tractor trailer 2-4 tons. Ear-husking machine	

(Continued on next page)

Scheme 2.

Variant "a" (100-200 hectares)	Variant "b" (100-200 ha.)	Variant "c" (100-200 ha.)	Variant "d" (100-200 ha.)
5. Basic tilling of soil			
Agricultural machines LD-10 and PS-35M	Agricultural machines LD-10 and PS-35M	Agricultural machines LD-10 and PS-35M	Agricultural machines LD-10 and PS-35M

Title of figure 1. Corn hargesting combine KU-2A.

The bunker of the combine was raised by 350 millimeters and moved to the left by 160 millimeters, which permitted to load the ears into cars with an increased lifting power. The bunker stand has been reconstructed and this facilitated its mounting as well as the access to the left silage-cutting drum.

Solid-cast rolls were installed on the combine; this reduced crumbling and damaging of corn ears, as well as excluded the possibility of the breaking away of planks from the rolls and their getting into the husking rolls and silage-cutting drums. A new chain-driven mechanism has been installed for opening and closing the bunker's trough /Begin p.18/ and the suspension of this trough was reinforced.

The construction of several tension devices of feed chains, of the drum, drive and the chain of the main drive have been changed. For safety during work, new guards and protecting boards have been introduced, the size of diameter of conveyer's axle of the shocker has been increased, as well as the bracket bracing of the conical transmission in the upper part of the hoist.

The changes, introduced into the construction of the combine, have increased its operation safety and productivity. Now it can harvest 5.2 hectares per 10 hours of work. With such a productivity of KU-2A the expenditure of labor comprises 0.58 man-day, while with the work of combine KU-2, which harvests three hectares per 10 hours of work, 1 man-day per hectare.

Among the experimental machines at the experiment sections are utilized: tractors DT-54, with hydraulic systems and projecting cylinders, mounted plows PN-4--35, mounted spike-tooth harrow, six-row trailer seeders with diagonal transfer of gauge wire, three-row corn harvesting combines, corn ear-pickers SPU-2A, silage harvesting combines SK-2.6 with hydraulic controls, corn-silage-harvesting universal combines KSK-2.6U and machines for husking corn ears.

Tractor DT-54, with a hydraulic system and projected cylinders, is intended for work with tractor-mounted four-bottom plows PN-4-35.

Output of the unit, when plowing to a depth of 20-23 centimeters, is 0.66-0.85 hectare per hour. The unit is serviced by one tractor driver.

The mounted three-section spike-tooth harrow is mounted on tractors DT-24, DT-14, KHTZ-7 and U-2 with the aid of a three-point pivoting hinge. Lifting and lowering of the plow is conducted with the aid of the tractor's hydraulic lift control.

Seeder SKGK-6E, six-row, mounted, with a diagonal transfer of the gauge wire differs from seeder SKGK-6B by the presence of hydraulic controls, with the aid of which the plowshares are lifted and lowered, as well as by the presence of a system of hydraulic controls by knot catchers. Lifting and lowering of markers is done with the aid of special rods from the seat of the tractor driver. The sowing unit is serviced by one tractor driver. According to data of the All-Union Scientific-Research Institute of Agricultural Mechanization, the labor expenditure with the utilization of this seeder is 0.06 man-days per one hectare of the planting.

Title of figure 2. Check-row mounted seeder.

The six-row check-row seeder (figure 2) is mounted on tractor "Belarus'". The measuring wire is transferred as in the seeder SKGK-6B. The precision in sowing a given number of seeds (one, two or three) is guaranteed to 90 percent when utilizing a mounted seeder. This makes it possible to considerably reduce the labor expenditure for thinning the plants in hills. The sowing unit is serviced by one tractor driver and the labor expenditure is

0.06 man-days per hectare of planting.

Corn ear-picker SPU-2A (Figure 3) is intended for harvesting corn in the phase of full ripeness of the grain. It pulls off the ears from the stalks, cuts off the stalks and collects them in the mounted shocker.

The ear-picker is a two-row trailer machine, /Begin p.19/ working from the power-take-off of the tractor "Belarus'" or KD-35; it is intended to harvest corn from interrows of 70 centimeters.

The unit is serviced by four men, including the tractor driver. Its output is 0.54 hectare per hour.

Title of figure 3. Corn ear-picker SPU-2A.

Title of figure 4. Corn-harvesting combine KSK-2.6U.

The three-row corn-harvesting combine, of VNIIMES construction, is intended for harvesting corn planted with interrows of 70 centimeters, both in the stage of full ripeness, as well as during milk-wax phase of seed ripeness. These combines are released in two versions: with and without an apparatus for grinding the leaves and stalks. They have similar cutting apparatus, feeding devices for stalks, break off rolls, corn ear conveyers, bunkers for the ears of 1.5-2 cubic meters holding capacity and trailer shocker for collecting the stalk mass. The working parts are moved from the power-take-off of the tractor.

The combine, with the grinding apparatus, works in a unit with tractor DT-54, and, without the apparatus, with tractors "Belarus'" and KDP-35.

The unit is serviced by the tracter driver, combiner and a worker on the shocker. Productivity of the combine is 5.5 hectare per 10 hours of work; expenditure of labor at such an output is 0.6 man-days per hectare.

The universal corn silage-harvesting combine KSK-2.6U (Figure 4) was made on the basis of the combine SK-2.6 and was intended to reap corn both during the wax-milk stage of ripeness and after full ripeness of grain, as well as for harvesting other silage crops.

This is a trailer combine, the width of the ripper is 2.6 meters, or four rows of corn, sown at interrows of 70 centimeters. The cutting apparatus is of a continuous shearing action and can be used on both the row and the continuous plantings. Unlike combine SK-2.6, it has a feeding apparatus, which consists of a top beater with soft planks and a lower smooth roll, and a break off apparatus.

The break off apparatus consists of rolls with a grooved surface. Between the feeding and the breaking off apparatus there is a space for the removal of broken off /Begin p.20/ ears to the conveyer. This space is shut off by valves when green mass is harvested together with the ears.

The grinding apparatus is placed behind the break off apparatus; it consists, as in the combine SK-2.6, of a knife drum and a countercutting blade. The combine has two horizontal conveyers, one for the ears, another for the ground mass. At the end of the ears conveyer, are rolls which are made to remove from them long stalk splinters, and also a lift for the ears, which transports them to the trailer wagon.

Combine KSK-2.6U works as a unit with tractor DT-54. Four people service this assembly. Productivity of the combine, when harvesting corn at full ripeness of the grains, is 9.7 hectare per 10 hours of work. Expenditure of labor for harvesting one hectare is 0.4 man-day.

Corn ear-husker OP-4 (Figure 5) is a stationary machine, intended for husking the corn-ears. The machine works from the tractor's power-take-off or from an electric motor.

The output is two tons of ears per hour. Seven people must attend this machine. The workers' productivity, using OP-4, is increased by 1.5-2 times, as compared to manual husking.

At the beginning of March of this year, seminars were conducted at the All-Union Scientific-Research Institute of Corn and at the Krasnodar Scientific-Research Agricultural Institute where directors, chief agriculturalists and engineers of MTS were present, as well as workers from scientific-research institutions, who took part in the conducting of experiments. Great work was conducted by kolkhoses and MTS in the studies of the program and methods.

Co-workers of more than 30 scientific-research establishments and of agricultural institutes took part in conducting experiments, together with workers from kolkhoses and MTS. Scientific workers were attached to each MTS and to many kolkhoses. Brigades and teams were formed from experienced mechanizers and kolkhoszniks and machines and implements were assigned to them. Routes of movements of units were laid out for each brigade and team on each experimental section.

The experiments were conducted on the fields of scientific-experimental and educational institutes along with kolkhoses. When conducting experiments, great importance was attached to a correct accounting of labor expenditures, of monetary-material resources, as well as to the accounting of the harvest. Incorrect or inaccurate accounting can lead to faulty conclusions. In connection with this, great responsibility was entrusted to directors of MTS, chief agriculturists and engineers, brigadiers of tractor brigades and accountants of MTS, as well as chairmen, agronomes, accountants and bookkeepers of kolkhoses.

The fuller, more thoroughly and in greater detail will the production experiments be conducted, the faster will the complex mechanization of corn growing be introduced to kolkhozes and sovkhoses, and the more considerably will the labor expenditures be reduced for the production of this valuable crop.

Title of figure 5. Corn ear-husker OP-4.

Trans. A-1005
(In full)
vg/M

Iakukhina, A. F.

Aprobatsiia posevov kukuruzy i usloviia sdachi semian gosudarstvu.

/Approbation of corn plantings and conditions for seed delivery to the state/.

Kukuruza, vol. 2. no. 8, p.21-25. Aug. 1957. 59:8 K95

(In Russian)

It is well-known that when planting corn with seeds of regionalized varieties its yielding capacity is considerably raised when compared with plantings with ordinary seeds. Still better results are obtained from utilizing hybrid seeds. Intervarietal hybrids compared with varieties give an increase in yield in the limits of 10 percent, variety-linear hybrids up to 20, and the double interlinear up to 25-30 percent and over.

Regardless of this, the growth of areas of hybrid and varietal plantings of corn is far behind the growth of general areas of this crop. Hybrid and varietal plantings of corn in 1955 comprised only 25 percent and in 1956 - 57 percent in ratio to the total area of planting. Consequently, about half of all areas under corn are planted with low-yielding, ordinary seeds or a mixture of seeds of different varieties and hybrids. This reduces the total harvest of corn considerably.

A 1005

It is necessary to conduct a series of measures, the course of accomplishment of which is described further on, in order to complete the transfer to uniform plantings with hybrid and regionalized varietal seeds during the next two-three years.

Glavnaia inspektsiia po semenovodstvu Ministerstva sel'skogo khoziaistva SSSR /Chief Inspectorate of Seed Growing of the Ministry of Agriculture of USSR/.

After conducting a twofold field examination of all plantings on hybridisation sections for determining the quality of detasseling the plants of the female form the next task in order approbation.[1]

Field approbation is of a compulsory order:

on all plantings of self-pollinated lines, which were produced both for the purpose of propagation and for hybridization (in order to obtain simple hybrids);

on all sections of propagation of simple hybrids;

on seed sections of kolkhozes and sovkhozes;

on all areas of seed plantings of seed growing and elite seed growing farms and of selection-experimental institutions;

on plantings of deficient and prospective varieties;

on highly yielding sections of general varietal plantings (in quantities, which are necessary for providing varietal seeds to kolkhozes and sovkhozes, and for the realization of the state plan of procurement, taking also in consideration the export of seeds beyond the borders of the republic).

The area of general varietal plantings, which are subject to approbation, is determined annually by the Ministries of Agriculture of the allied republics according to representations of the oblast' (krai) Departments of Agriculture and Ministries of Agriculture of the Autonomous Republics.

Field approbations of corn are conducted at the full ripeness of seeds in strict conformity with methods, cited in the instruction on the conducting of approbation of varietal plantings, and with methodical directions on growing hybrid seeds of corn and of its parental forms.

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(1) See article of A. S. Kinsh "Ukhod za posevami na uchastkakh gibridizatsii" /Care of plantings on hybridization sections/ in Kukuruza no. 7, for the year 1957.

When conducting a field approbation of self-pollinated lines and simple hybrids, one should follow the method, which was established for approbation of common varieties of corn. When accomplishing this work, it is necessary to cross the hybridization section at a diagonal line and analyse the ears of one of the parental forms (female or male), and, when returning /Begin p.22/ along this same diagonal line - examine the other parental form. For each 50 hectares of a hybridisation section, 250 corn ears of maternal and paternal forms must be subjected to analysis.

Plantings of self-pollinated lines must have not less than 99.5 percent of ears of the basic type; presence of xenia seeds should not exceed 20 pieces per 100 ears. On hybridization sections, which were laid out for growing seeds of simple hybrids, the plants of the male form must have not less than 98.5 percent of ears of a basic type, and not more than 50 xenia seeds per 100 ears; on plants of female forms there should be not less than 98 percent of ears of the basic type and not more than 50 xenia seeds per 100 ears. In the harvest of seeds of simple hybrids on sections of propagation there should be not less than 97 percent of ears of the basic type and not more than 400 xenia seeds per 100 ears. Seeds of self-pollinated lines and of simple hybrids are not separated in categories according to typicalness.

If, as a result of field approbation, typicalness will prove to be lower, and the presence of xenia seeds higher than the indicated norms, then the obtained yield, depending on the size of admixtures, is rejected from the number of those grown for seed purposes or is recommended for planting with the permission of the Ministry of Agriculture of USSR and the Ministry of Grain Products of USSR.

Field approbation of self-pollinated lines, planted on hybridization sections for obtaining seeds of simple hybrids, is a compulsory measure in addition to field examinations. In the absence of one of the two documents - the document of field examination or the document of field approbation - the seeds, obtained from the hybridization section, cannot be considered as seeds of simple hybrids.

On hybridisation sections of double interlinear, variety-linear and intervarietal hybrids field approbation is not conducted with the exception of farms, which are attached to factories for delivery of seeds.

Plantings on propagation sections of self-pollinated lines and the elites of varieties are approbated by a plant breeder or a seed growing agriculturist from the selection station or a scientific-research institution in the presence of a representative of the oblast' (or krai) Department of Agriculture.

Varietal corn plantings at the elite seed growing farms are approbated by the agriculturist of this farm together with a representative of the selection-experimental institution or oblast' (krai) Department of Agriculture.

Plantings on hybridisation sections and of propagation of simple hybrids are approbated by an agriculturist controller in the presence of the seed growing agriculturist and representative of the farm.

Varietal plantings of corn on seed growing farms are approbated by specially selected, the most experienced, approbaters from the machine-tractor stations, together with the seed growing agriculturist of the given farm.

In kolkhozes and sovkhozes, approbation and registration of varietal and hybrid plantings of corn are conducted by agriculturists, who work on these farms, and in their absence - agriculturists from MTS /Machine-tractor-station/ or from other organizations, who were appointed for this purpose.

Approbation can be conducted only by those agriculturists who had training at a special course of the seminar arranged by scientific-research institutes, selection-experimental establishment or educational institution. It is necessary to organise short seminars at MTS for agriculturists, who previously had training at the courses of approbation and who have experience in this work.

Before the beginning of approbation, agricultural institutions and machine-tractor stations must organise an inspection of kolkhozes and sovkhozes, if they have varietal documents for planting corn seeds, and also ahead of time to furnish the controllers with blanks for registering the plantings. In case of absence of the planting certificate on the farm, it is necessary to take all measures for its recovery before the beginning of approbation.

Field approbation must be conducted on time and at a high level. The varietal documents must be filled out correctly. For this purpose it is necessary to provide a systematic, qualified control of the work of the approbators on the part of chief approbators, chief agriculturists of MTS and sovkhozes, as well as on the part of interregional inspectors, who are appointed from the number of best approbators of the oblast', krai, republic. In view of the especially great importance of approbation of varietal plantings the agriculturalists approbators receive an established additional pay for their timely and high-quality /Begin p.23/ conducting of the work.

It is necessary to harvest hybrid and varietal ears as soon as full ripeness of the seed takes place, since delay in harvesting leads to a loss of part of the yield and a reduction of quality of seeds. In those cases when danger arises through the arrival of early fall frosts, harvest is permitted when yellow ripe, with an obligatory condition, that drying of corn ears will be organised immediately after harvesting.

It is necessary to harvest corn ears from female and male rows separately on hybridization sections in order to avoid their mixing.

Ears from male plants, as well as all those that dropped to the earth, are not used for seed purposes.

The harvested hybrid and varietal corn ears must be removed from the field the same day and stored on roofed threshing floors, under sheds (specially constructed or adjusted), or in well ventilated buildings.

Sorting of corn ears for seeds is conducted simultaneously with harvesting. It is necessary to remove all ears which are nontypical for the given variety or hybrid or are unripe and diseased. Sorting of seed corn ears must be done very quickly since the presence of unripe and diseased corn ears can cause the spoilage of the sound ears in the heap.

When sorting ears of self-pollinated lines and of simple hybrids small ears are not rejected, as well as those with unfilled tops or partially filled; only diseased ears and those which differ sharply in size and form from the basic type.

The storehouse approbation is conducted after sorting the seed ears of hybrid and varietal corn; it is a compulsory supplement to field examination and field approbation.

Storehouse approbation is conducted by the farm agriculturist; an inspector agriculturist checks his work, while on non-seed growing farms - a chief approbator or the chief agriculturist of MTS, or of a sovkhoz and interregional inspectors. Results of storehouse approbation, which is conducted according to a method specified in the instructions for approbation and in methodical directions for growing hybrid seeds of corn and of their parental forms, are documented.

After sorting and storehouse approbation corn seeds must have:

seeds of self-pollinated lines - only ears of the basic type, without xenia seeds;

seeds of simple interlinear hybrids of the first generation - not less than 99.5 percent of ears of the basic type and not more than 30 xenia seeds per 100 ears;

seeds of simple hybrids, collected from propagation sections, - not less than 99.5 percent of ears of the basic type and not more than 200 xenia seeds per 100 ears;

seeds of the first generation of double interlinear, variety-linear and intervarietal hybrids - not less than 98 percent of ears of the basic type and not more than 600 xenia seeds per 100 ears.

Seeds of self-pollinated lines, of simple, double interlinear, variety-linear and intervarietal hybrids are not separated according to typicalness during both the storehouse and field approbations.

During storehouse approbation of varietal seeds, which is conducted after ear sorting, it is permitted to raise the category of typicalness, but not more than by one, as compared to the category established for field approbation. Such raising of category of varietal purity is not permitted for elite seeds.

All documents about field examinations, field and storehouse approbation must be turned over to the state grain storage points before acquisition begins.

Every consignment of seeds, delivered to the state grain storage point must be accompanied by proper documents.

On hybridisation sections of double interlinear, variety-linear and intervarietal hybrids of farms, which are attached to factories for delivery of seeds, a field approbation is compulsory besides the field examinations prior to harvesting. In such a case, during field approbation on hybridization sections, the percentage of contamination of plantings with other types of corn is established, as well as the number of xenia seeds, and of those infected with fungal and bacterial diseases. At the same time, regardless of the degree of varietal impurities and infection with diseases, rejection of the yield of double, interlinear, /Begin p.24/ variety-linear and intervarietal hybrids is not effected. Harvesting corn, which is to be delivered to the factories, must be begun at the moisture content of ears of about 35%, and in case of a threat of the coming of early autumn frosts - with a still higher moisture content. As the harvested ears are delivered straight from the field to the factory with husks, their sorting and storehouse approbation is not conducted. Each batch of hybrid seeds, delivered to the factory, is accompanied by one document.

In conformity with the resolution of the TsK KPSS /Central Committee of the Communist Party/ and of the Council of Ministers of USSR, there are monetary varietal bonuses in the following amounts paid off for hybrid seeds, delivered to state warehouses, besides the basic price for the seeds:

	Class of seeds, according to GOST /All-Union State Standard/ 651-41	Size of bonus for 1c /centner/ for seeds
For seeds of self-pollinated lines and simple hybrids of the Ist generation...	I	275 rubles
	II-III	250 "
For seeds of regionalized double interlinear hybrids of Ist generation.......	I	150 "
	II-III	125 "
For seeds of regionalized variety-linear and intervarietal hybrids of the Ist generation........................	I	100 "
	II-III	85 "

Seeds of simple hybrids of the second generation and of hybrid populations are paid for as varietal seeds of the I and II reproductions.

For hybrid seeds and parental forms of hybrids, which are delivered to MTS as a pay in kind for their work on the farm, the kolkhoz receives the monetary varietal bonus, while the basic cost of corn seeds is assigned by the state grain purchase points to the State Budget.

Besides that, the seed growing kolkhozes receive preferential countervail in grain for hybrid seeds, delivered to the state as compulsory supplying and as payment in kind for the work of MTS, in the equivalents:

For 1 centner of seeds of propagated self-pollinated lines, of I-III classes of the seed standard.......	3 centners of grain
For 1 centner of seeds of simple interlinear hybrids, I-III classes of the seed standard..................	2 " " "
For 1 centner of seeds of the first generation of double interlinear hybrids, I-III classes of the seed standard....................................	2 " " "
For 1 centner of seeds of variety-linear and interlinear hybrids of the first generation, I-III classes of the seed standard.1......................	1.5 " " "

For varietal seeds, delivered to the state by seed growing farms, a monetary bonus is paid off at the following rate over the fixed price for commercial corn seeds:

For elite seeds, meeting the norms of the seed standard for the elite..................................	200 percent
For seeds of the first and second reproduction and seeds of deficient varieties of all reproductions (except the elite) of I and II categories, I-II classes of the seed standard.......................	90 "
For similar seeds, but of the III class............	70 "
For similar seeds, which were not brought to the norm of the seed standard, but in quality are not below the restricting conditions of state grain purchases..	30 "
For seeds of the 3rd and of the following reproductions (except the deficient varieties) of I and II categories of varietal purity, I-II classes of the seed standard....................................	50 "

For similar seeds, which were not brought to the norms of the seed standard, but in quality are not below the restricting conditions of state grain purchases..	20	percent
For seeds of deficient varieties of all reproductions of III category of varietal purity, I-III classes of the seed standard..................................	40	"
For similar seeds, which were not brought to the norms of the seed standard, but which are not below the restricting conditions of state grain purchases......	20	"

For varietal, as well as for the hybrid corn seeds, delivered to the State, a preferential countervail in corn seeds is made, according to the following equivalents:

For elite seeds, meeting the norms of the elite standard..	1.7	centner	of	seeds
For varietal seeds and seeds of hybrid populations of the 1st and 2nd reproductions, I and II categories and seeds of deficient and prospective varieties of the following reproductions of I and II categories, I and II classes of the seed standard.................	1.4	"	"	"
For similar seeds, but of the III class................	1.3	"	"	"
For similar seeds, which were not brought to the norm of the seed standard, but which are not below the restricting conditions of state grain purchases......	1.2	"	"	"
For seeds of the third and the following reproductions (except the deficient), of I and II categories, I-III classes..	1.25	"	"	"
/Begin p.25/				
For similar seeds, which were not brought to the norm of the seed standard, but are not below the restricting conditions of state grain purchases..............	1.0	"	"	"
For seeds of deficient varieties of all reproductions of III category, but not below the III class of the seed standard....................................	1.0	"	"	"
For similar seeds, which were not brought to the norm of the seed standard, but are not below the restricting conditions...................................	1.0	"	"	"

Seeds of self-pollinated lines and of hybrids, delivered by the seed growing kolkhozes after fulfillment of compulsory supplies of corn and as payment in kind for the work of MTS, are taken into account for fulfillment of compulsory deliveries of other grain crops according to corresponding equivalents of exchange.

For hybrid seeds, turned in to the State for exchange, the state grain purchase points issue to the seed growing kolkhoses ordinary provision grain (weight calculated according to varietal purity and moisture content); equivalents used are the same according to which preferential countervail was made for deliveries of compulsory supplies.

For varietal seeds of corn, which are delivered for exchange the state grain purchase points issue ordinary corn grains in equivalents established by the government. Issues in exchange for grain of other crops can be made only with the permission of the Ministry of Grain Products of USSR.

Varietal and hybrid seeds, which are issued in exchange for ordinary seeds, are evaluated according to fixed prices plus varietal bonuses, and the issued ordinary grain - at fixed prices. Difference between the price of delivered seeds and the price for the ordinary seeds obtained from the state grain purchase points is paid to the kolkhos in cash.

Haulage of seeds, which are turned in, in the course of exchange, to the state grain purchase points by the farms in their own conveyance is paid for to seed growing farms according to the operative tariff for transportation of grain by motor transport.

After fulfillment of all obligations to the State in supplying the grain, the seed growing kolkhoses can turn in the hybrid and varietal corn seeds, using their own discretion; not alone for exchange but also can sell them to the State. In such a case the kolkhoz receives a supplemental monetary bonus over the price of ordinary corn in the amount cited previously.

Sovkhoses turn in the varietal and hybrid seeds only in the order of exchange for ordinary forage grains (weight is calculated according to varietal purity and moisture content). Compensation is calculated using the same norms, according to which such seeds were evaluated for compulsory deliveries and exchanges to seed growing kolkhoses.

Varietal and hybrid seeds, which are turned in by sovkhoses for exchange, are evaluated according to the delivered price established for sovkhoses, with an additional monetary bonus in the amounts cited previously; the forage grains, obtained by sovkhozes from state grain purchase points are also calculated according to the delivered prices. The state grain purchase points pay the deliverer the difference between the price of accepted seeds and the supplied forage grain. Furthermore, the sovkhozes and the selection-experimental institutions, who turned in the corn seeds for exchange purposes, receive also the proper price for hauling the seeds to the purchase point.

Payment of additional monetary bonuses, as well as utilization of preferential equivalents, are done only in that case when the seeds, turned in by the seed growing farms, fully satisfy the standard norms, including moisture content also. For deliveries of conditional seeds, having an increased moisture content, the size of monetary and natural bonuses is reduced, depending on moisture.

Seeds of regionalized corn hybrids of the first generation can be accepted without a contract from non-seed growing farms even in that case, when they are not brought up to the norms of the seed standard, but in quality are not below the restricting conditions of the state grain purchase points. For such hybrid seeds the state grain purchasing points pay a monetary bonus over the price of the ordinary corn in the amount of 100 percent of the fixed price.

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Musiiko, A. S., and Kliuchko, P. F.

Selektsionno - semenoved-
cheskaia rabota s kukuruzoi.

/Breeding and seed growing
work with corn/.

Kukuruza, vol. 2, no. 12, p.32-36.
Dec. 1957. 59.8 K95.

(In Russian)

The All-Union Selection-Genetical Institute imeni T. D. Lysenko has begun its work with corn since the year 1939. The methods of corn seed growing, utilized during these years, basically were directed for the retention of varietal purity and not for the increase of their yielding capacity. But the workers of the Institute, basing themselves on the teachings of Charles Darwin about the selective ability of the organism, and taking into consideration, that the vitality of hybrid offspring increases considerably after crossing the plants, which differ in their biological and ecological characteristics, have developed a new method of corn seed growing.

This method, in 1949, was recommended to all selection-experimental institutions of the country by the Ministry of Agriculture of USSR.

Utilizing the new method of selection, the Institute improved the corn seeds of the "Dnepropetrovskaia" variety, which on the average for 4 years gave 33.4 centners of seeds, and seeds, grown according to the old method, gave only 28.2 centners of seeds per hectare.

Besides improving the yielding qualities of seeds of the existing varieties, new and higher yielding corn varieties can be developed using this method. This was confirmed by the experience in the work of the Institute in developing the variety "Grushevskaia Odesskaia".

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Specimens of the variety "Grushevskaia, which were obtained from various kolkhozes of Odessa and Nikolaevsk oblast's were the initial material for development of this variety. These specimens, together with 37 specimens of corn of the "Grushevskaia" type, which were selected in Moldavia, were planted in 1946 in the nursery for cross-pollination and selection.

As a result of repeated cross-pollination and selection, a new, more productive, variety of corn was created. On the average, during four years of research (1947-1950), variety "Grushevskaia Odesskaia" exceeded in grain yield "Grushevskaia Dnepropetrovskaia" by 5.4 centner per hectare.

During experiments on fourteen variety test plots in Odessa, Kirovograd and Dnepropetrovsk oblast's in 1947, the variety "Grushevskaia Odesskaia" produced, on the average, 40.5 centners more of grain per hectare, or by 4.6 centner more than the variety "Dnepropetrovskaia", which was regionalized for those oblast's at that time.

Since the year 1950, the variety "Grushevskaia Odesskaia" has been regionalized in the zone of distribution of hybrid "Odesskii 1", its paternal forms, as well as in Nikolaevsk oblast' for growing seeds for export to northern oblast's of the country, where it can give high yields of silage mass. "Grushevskaia Odesskaia" refers to a group of varieties with yellow flinty grains. Its positive characteristic, when planted in northern oblast's, is its resistance to low temperatures during the spring period. /Begin p.33/

Together with development of methods of seed growing and breeding of varieties, the Institute also conducted work on breeding corn hybrids.

As a result of studies of many hybrid combinations and of selection of pairs, the Institute bred the intervarietal hybrid "Odesskii 1" by means of crossing variety "Dnepropetrovskaia", maternal form, with the variety "Grushevskaia Odesskaia". This hybrid is characterized by high drought-resistance, and in grain yield it exceeds "Dnepropetrovskaia" variety, on the average, by 4-5 centners per hectare.

Thus, on the average for 9 years of experiments (1947-1955), at the Berezovskii variety test plot hybrid "Odesskii 1" exceeded in grain yield variety "Dneprepetrovskaia" by 3 centners, at the Liubashovskii - by 5.8 and at the Baltskii - by 3.1 centner per hectare.

In 1949 the hybrid "Odesskii 1" was regionalised, and in 1956 it was already planted in Odessa and Nikolaev oblast's on an area of about 160 thousand hectares. In 1952, in Odessa oblast' together with hybrid "Odesskii 1" was regionalised a new, and more productive double interlinear hybrid VIR 42, which was bred by the All-Union Institute of Plant Industry.

Taking into consideration a high yielding capacity of hybrid VIR 42, especially in grain, the Institute paid much attention to its introduction into production of late.

On isolated sections new seed nurseries for self-pollinated lines VIR 44, VIR 38 and VIR 43 are being established using seeds obtained as a result of repeated self-pollinations; seeds of lines 44 and 38 are propagated as well as seeds of simple interlinear hybrids "Slava" and "Svetoch".

Seeds of self-pollinated lines 44, 38, 40 and 43, grown in 1955, were utilised not only on hybridisation sections of special corn seed growing farms. They were sent out for propagation to Krastovskoe, Rozovskoe and Izmail'skoe experimental fields, to Stavropol', Miliutinsk, Alma-Ata, Severo-Osetinskaia and other selection stations.

Fulfilling the resolution of the TsK KPSS [Central Committee of the Communist Party] and of the Council of Ministers of USSR, about measures for transfer of kolkhozes and sovkhozes to planting corn with hybrid seeds, the Institute increased the volume of work on growing parental forms of hybrids.

Title of figure. Ears of corn "Odesskaia 10", bred by the kolkhoz "imeni Michurina" Dzhankoi raion, Krymskaia oblast'.

Last year on propagation sections were grown and turned in to the State 342 centners of seeds of self-pollinated lines, or over four times more than it was specified in the plan. Besides that, the seed nurseries have grown 23 centners of seeds of self-pollinated lines 44, 38, 40 and 43, while the plan specified 3.2 centners. Above the planned assignment were grown 284 centner of seeds of the simple hybrid "Slava" and 116 centner of seeds of hybrid "Svetoch".

The collective body of the Institute also renders practical help to kolkhozes and sovkhozes with introduction of hybrid seeds for production plantings. In 1953 hybrid plantings occupied in Odessa oblast' 68.1 thousand hectares, in 1954 - 105.4, in 1955 - 158.9 and last year - 349.5 thousand hectares.

The yield of hybrid seeds, obtained in 1956, permitted this year to plant with hybrid seeds the greater part of the area, occupied by corn in Odessa oblast', as well as to provide a considerable amount of seeds for planting in other oblast's of the country.

In latter years, the Institute has conducted work also on breeding new corn varieties.

Different methods were applied for this work. But the most effective method of intervarietal hybridization was with free pollination. By this method, on the basis of free intervarietal crossing (without detasseling) of varieties "Kuban Leaming", /Begin p.34/ Dnepropetrovskaia and Minnesota 13 Extra, with the use of additional pollination by the mixture of pollen of variety - pollinators and of the maternal variety (Kuban Leaming) during a comparatively short time, for four years, a new highly-productive variety "Odesskaia 10" was bred.

Variety "Odesskaia 10" is especially valuable for planting for silage and green fodder, since owing to great height and vigorous development of stalks and leaves of plants, it produces high yields of green mass.

During testing on variety test plots of 27 oblast's and republics of the country, variety "Odesskaia 10" considerably exceeded the hybrids and varieties of corn, regionalized there, in the yield of silage mass.

In 1955 the plantings of "Odesskaia 10" on the average in the eight variety testing plots of Odessa oblast' produced by 1372 feeding units per hectare more, than the plantings of hybrid VIR 42.

In the yield of silage and dry mass variety "Odesskaia 10" often is not even excelled by such high-productive late-ripening double interlinear hybrid as VIR 156.

Under production conditions of kolkhozes and sovkhozes "Odesskaia 10" also produced higher yields of silage mass, than other varieties and hybrids.

In 1955 the team of the two-times Hero of Socialistic Labor, S. D. Vishtak, who planted variety "Odesskaia 10" on the area of 12 hectares obtained 231 centners of corn ears in wax-milk stage of seed ripeness and 400 centner of green mass per hectare, and from three hectares, where corn was harvested for seeds - 110 centners of ripe seeds per hectare.

At the kolkhoz "imeni Kirova", Shiriaevskii raion, Odessa oblast' during the same year variety "Odesskaia 10" on an area of 10 hectares produced 1.200 centners of green mass per hectare.

Last year at kolkhoz "Luch", Krasnogorsk raion, Moscow oblast', variety "Odesskaia 10" produced 720 centners of green mass per hectare.

According to its vegetative period, "Odesskaia 10" belongs to a group of medium late varieties. It ripens usually 125-130 days after the appearance of sprouts, 8-12 days later than hybrid VIR 42.

In 1955 variety "Odesskaia 10" was planted in nine kolkhoses, which were serviced by Shevchenko Supporting-Demonstration MTS /machine-tractor station/ of Berezovskii raion, Odessa oblast', where it gave higher yields of seeds, than hybrid VIR 42.

This variety gave high yields also when tested in other countries of People's Democracy. In 1956, at the production cooperative "Friedrich Engels" in Shafstadt (Halle district, German Democratic Republic) 1.200 centners of green mass were obtained from each hectare.

Agrotechnics for breeding variety "Odesskaia 10" is similar to other varieties and hybrids. But in connection with its tallness and a longer vegetation period when growing it for seeds the area of plant nutrition is recommended to be increased by 20-25 percent.

This variety, in comparison with other hybrids and varieties, differs in increased resistance to low temperatures during the spring period; this makes it possible to cultivate it in more northern oblast's of the country.

Of late, the Institute widened its work on breeding early-ripening hybrids and varieties of corn, which have high yielding capacity and are adapted to local conditions of growing. Crossings were conducted of fairly early-ripening varieties, such as Spasovskaia, Bezenchukskaia, Voroneshskaia 76, Kremnistaia /flint/ early-ripening and others with medium-ripening self-pollinated lines, simple interlinear hybrids and varieties.

Testing of obtained hybrids has shown that the best among them are considerably more early-ripening, than the double interlinear hybrid VIR 42, and equals it in yielding capacity.

Variety-linear hybrid "Voroneshskaia 76 X Slava", which ripens 10-12 days ahead of hybrid VIR 42, presents special interest, and during the two years of testing somewhat excelled hybrid VIR 42 in yielding capacity. This year the new hybrid underwent preliminary tests on several variety test plots of Odessa, Kirovegrad and Kharkov oblastś'.

As a result of crossing of varieties "Longfellow" and Kremnistaia early-ripening" and of the following selections a new productive variety" no.16", was obtained, which is more early-ripening compared to the studied varieties and hybrids. After harvesting of plants of this variety, /Begin p.35/ even in northern raions of Odessa and Nikolaevsk oblasts' it is possible to plant winter wheat.

Since 1955 the Institute has conducted works on studies of hybrids, obtained from crossing of early-ripening varieties with late-ripening.

As it is known, T. D. Lysenko, on the basis of studies of the length of the light stage in late-ripening southern and in early-ripening corn varieties, which ripen in northern regions of the country, suggested to cross them for obtaining early-ripening hybrids, which would give high yields in northern regions.

Taking this into consideration, in 1955, the Institute conducted direct and back crossings of early-ripening varieties "Voroneshskaia 76, Spasovskaia, Bezenchukskaia, Kremnistaia early-ripening" and othe rs with late-ripening varieties "Odesskaia 10, Zakarpatskaia sheltaia zubovidnaia [yellow, dent], Sterling and others.

Two-years study of obtained hybrids has shown, that under conditions of the south of Ukraine they, as a rule, occupy an intermediate place in their vegetative period between the initial varieties, or approach the more early-ripening, but only in isolated cases the late-ripening parent. Whereupon, usually, if an early-ripening variety was used as the maternal form, then the hybrid obtained was more early-ripening.

Of late, the Institute widened the work on studies of the collection material and of separating from it the best specimens as initial material for crossing and breeding self-pollinated lines. Last year, in the collection nursery, 582 specimens were studied of various origin, among them 500 specimens from the World Collection of the All-Union Institute of Plant Industry, and this year - 696 specimens.

The Institute began, since 1955, to breed self-pollinated lines of corn. As an initial material are utilized mostly the local varieties "Dnepropetrevskaia, Grushevskaia-Odesskaia, Odesskaia 10, Kharkovskaia 23, Kharkovskaia white dent", and others.

Particular attention is given to breeding early-ripening self-pollinated lines from varieties with flint type seeds.

Utilization of such lines as initial material for double interlinear hybrids will give the possibility to obtain hybrids which are resistant to low temperatures during the spring period and are more early-ripening.

At the present time varieties "Voroneshskaia 76, Spasovskaia, Besenchukskaia, Kremnistaia early-ripening", and others are used for breeding early-ripening lines.

For developing self-pollinated lines, which would in economic-biological characteristics sharply differ from lines developed from varieties of native selection, the best foreign specimens from the collection material were utilized as initial material.

This year in the nurseries were studied 286 lines of the first generation, 357 lines of the second generation and 44 lines of the fourth and fifth generations (from self-pollination). The Institute has also conducted analyzing crossings of several more aligned lines. Next year the obtained hybrids will be studied in comparison with hybrid VIR 42, simple interlinear hybrids "Slava" and "Svetoch", and other hybrids and varieties in order to select the best lines for breeding double interlinear hybrids.

It was discovered that perennial propagation of lines on isolated sections with free pollination leads to the increase of their productivity. Now the Institute studies, how this change of yielding capacity of the line is reflected in the productivity of simple and double interlinear hybrids, obtained from crossing of these lines.

Together with this are examined the variability of self-pollinated lines after their repeated self-pollination and selections. As it is known, when growing seeds for lines, the seed nurseries are planted with seeds from repeated self-pollinations of plants. Regardless of the fact that self-pollination of plants of self-pollinated lines is conducted on well aligned material, sometimes occasional families of one and the same line differ one from another to a considerable degree: in the length of the vegetative period, height and vigor of plants, height of attachment of ears, resistance to diseases, and so on.

For instance, in 1956, some of the lines of VIR 44 tasseled on July 5, and the others on July 12-13. This year also /Begin p.36/ was observed a considerable diversity in families in the limits of one and the same line.

Thus, by means of repeated self-pollinations, selections and propagation on isolated sections of individual families, which differed from other families of the given line in several characteristics, it is possible to develop new lines from the existing, aligned self-pollinated lines.

A wide distribution of double interlinear corn hybrids raised the importance of studies of productivity of regionalized double hybrids depending on the quality of the initial material. As it is known, when growing seeds of the first generation of double interlinear hybrids, seeds are utilized as of the first, so also of the following generations of simple hybrids. Moreover, some workers of scientific establishments think that yielding qualities of double interlinear hybrids do not at all depend on the fact which of the generations of simple hybrids was taken for crossing. One cannot agree with this.

It is known that hybrids are productive only in that case when the most productive varieties, that are adapted to the given conditions, are crossed. Therefore it is supposed, that the result from crossing qualitatively differing generations of simple hybrids cannot be similar.

Tests of seeds of hybrid VIR 42, conducted by the Institute, and which were obtained both from crossing the first generations of simple hybrids "Slava" and "Svetoch", as well as from crossing second, third, fourth and fifth generations of hybrids, have shown that more productive seeds of hybrid VIR 42 were obtained when crossing first generations of simple hybrids. This was confirmed by data from variety test plots.

We think, that the growing of seeds of the first generation of simple hybrids must be organised in such a way that all the sections of hybridization be planted only with seeds of the first generation of simple hybris (especially the maternal form).

The experience of selection - seed growing work of the Institute and data of kolkhozes and sovkhozes show, that it is expedient on each farm to plant not one hybrid or variety, but two or three, which differ among themselves in length of the vegetative period.

The necessity to plant on each farm several hybrids or varieties is specified by climatic conditions, as well as their resistance to low spring temperatures. Having at its disposal seeds of several hybrids and varieties, the farm can start planting earlier those, which are resistant to low temperature. With the setting in of warm weather hybrids and varieties less resistant to cold weather can be planted.

Planting of different hybrids and varieties of corn for silage, which are characterised by ripening at various times, has an economically - organisational importance, since it permits to considerably lower the pressure of work when harvesting and transporting the silage mass.

In kolkhozes and sovkhozes of the south of Ukraine it is expedient to plant part of the area with early-ripening hybrids and varieties, that have a vegetative period of 95-105 days in order to utilize the land after harvesting corn for sowing winter wheat.

The necessity to plant in each kolkhos and sovkhos several hybrids and varieties sets before the selection establishments a problem to develop for their sone such a collection of hybrids and varieties of corn, which would provide both the highest yield of grain, silage and green fodder, as well as would increase the yielding capacity of the winter wheat, when utilising corn as its predecessor.

Odintsov, P., and Shishkova, Z.

Poluchenie glitserina sbrashivaniem drevesnykh gidrolizatov.

/Obtaining of glycerin by fermenting wood hydrolyzates/.

In Akademiia Nauk Latviiskoi SSR. Otdelenie Biologicheskikh Nauk. Biologicheskaia Nauka-Sel'skomu i lesnomu khoziastvu. vol. 3, p.141-142. Riga. Akademiia Nauk Latviiskoi SSR, 1957. 442 NA42

(In Russian)

At the present time the demand for polyatomic alcohols and glycerin in USSR considerably exceeds those amounts, which are manufactured by soap and other branches of industry.

The increased demand for glycerin on the part of many branches of national economy compels the workers of science and practice to find effective methods for its production.

Research in the field of obtaining glycerin is carried on in two directions in our country and abroad. The first direction includes synthetic methods for obtaining glycerin and polyatomic alcohols, the second-biochemical methods.

At the Institute of Forest Economy Problems research in the field of fermentation of hydrolyzates of various plant raw materials began in 1949.

Hydrolysing of plant raw materials with concentrated sulfuric acid, according to the Riga method, permits obtaining solutions of sugars, which, as raw materials for the glycerin industry, possess many advantages over

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Institute Lesokhoziaistvennykh Problem AN Latviiskoi SSR /Institute of Forest Economy Problems at the Academy of Science of Latvian SSR/

molasses as well as over hydrolysates that are obtained by methods of hydrolysis with weak solutions. These advantages consist of, first, in a high concentration of hydrolysate sugars; secondly, in the presence in them of phosphoric acid, which permits obtaining phosphates proper, and, finally, in the absence of foreign admixtures, which hamper the extraction of glycerin from wort and the recovery of salts.

Research, which was conducted with pure glucose was successfully applied to hydrolysates.

A refilling method of fermentation was chosen, where salts were introduced in separate additions in a dry form. The race of yeast was - 7th Tomskaia, in an amount of 10-15% of the sugar, temperature of fermentation - 32 to 35° C, concentration of sugar in the wort - 18%. /Begin p.142/

Fermentation of sugar solutions was conducted in the presence of various salts. The best results in glycerin and alcohol yield were obtained from disubstituted phosphates.

Utilization of blown-through air during fermentation of sugars, in the presence of phosphates, leads to the increase of glycerin yield by 30-40% compared with experiments without aeration. Thus, for instance if without aeration, the yield of glycerin comprises 12% of the sugar and of alcohol - 33%, then with aeration the yield of glycerin comprises 16.5% and of alcohol - 28.3%. The period of fermentation at the same time is reduced from 48 hours (without aeration) to 24 hours (with aeration). The amount of circulating air is in the limits utilized in yeast production. Fermentation must proceed in hermetically closed vats. The volatile products are collected in scrubbers. Contents of glycerin in the wort, when fermenting sugars in a concentration of 18%, and with the addition of phosphates, without utilizing aeration, equals, on the average, 2.16% (with an average yield of glycerin of 12%) and of alcohol - 5.4% (with a yield of 30%).

When fermenting the sugars of the same concentration, but using aeration, the content of glycerin in the wort increases to 3-4%. When stripping alcohol from the wort by, for instance, indirect steam, concentration of glycerin can be increased up to 5-6%.

Taking into consideration the work of the Lokhvitskii mill, which considers profitable the extraction of glycerin from waste liquor at its content of 0.68%, one should point out, that the process of extraction of glycerin from our waste liquor will be more economical.

One can recommend two variants for reprocessing hydrolysates for glycerin.

a) fermentation of hydrolysates, obtained after preliminary hydrolysis, with a neutralization in them of phosphoric acid to sodium phosphates;

b) fermentation of the "ottek" [sediment] after crystallization of glucose with the addition of phosphates, which were obtained from the hydrolyzing factory, by extraction of apatite with sulfuric acid and neutralization of phosphoric acid by soda ash.

At the present time work is being conducted for obtaining glycerin with the aid of Bac. Subtilis. In 1956, with the participation and aid of the Institute of Microbiology of the Academy of Science of USSR (Moscow) 16 strains of the bacillus were isolated; preliminary tests of these gave encouraging data. Thus, for instance, the museum strain 9789 produced 20% glycerin, 33% lactic acid, 12% alcohol and 2% of 2.3 butylene-glycol (that is utilization of sugar to 67%). Another strain, isolated from hay, yielded glycerin and 2.3 butylene-glycol amounting to 30% and other products.

Fermentation of sugars with Bac. subtilis is advantageous because it is conducted without additions of salts, and, thus, recovery of glycerin and of polyatomic alcohols will be facilitated considerably. The work is being continued.

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Timofeev-Resovskii, N. V., and Luchnik, N. V.

Radiatsionnaia stimuliatsiia rastenii i ee vozmozhnaia teoreticheskaia interpretatsiia.

/Radio-stimulation of plants and its possible theoretical interpretation/.

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In Vsesoiuznaia Nauchno-Tekhnicheskaia Konferentsiia po Primeneniu Radioaktivnykh i Stabil'nykh Izotopov i Izluchenii v Narodnom Khoziaistve i Nauke. Trudy: Radiobiologiia, p.258-266. Moskva, Akademiia Nauk SSSR, 1958. 442.9 V963.

(In Russian)

Many researchers noticed that small doses of ionizing radiation (fairly different for various objects and conditions of the experiment) do not inhibit the growth or cause the emergence of any pathological changes, but produce the, so-called, stimulation, which is expressed in the acceleration of growth and differentiation, in the increase of biomass, in the raising of resistance to damaging reactions, in the lengthening of life (in animals) and increase in the yield of seeds (in plants) /1-5/. In our laboratory, since 1949, experiments are being conducted on the studies of radio-stimulation of cultivated plants /6-9/, fresh water organisms /10/, bacteria /11, 12/ and mammalia /13/. In the present report an attempt is being made to give to this interesting phenomenon a theoretical explanation, the elements of which were formulated previously /14/, whereupon experiments with cultivated plants will be taken as basic material for analysis. It

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is necessary to emphasize beforehand that the "toxicological hypothesis" of radio-stimulation, developed further on, is applicable, of course, in only certain "reasonable" limits of doses. In the experiments of our laboratory, in laboratories of L. P. Breslavets, K. Saks and of many others, we deal with the stimulating effect of doses, measurable in tens or hundreds of Roentgen units. The question requires special consideration about a possibility of applying this hypothesis to suggestions, existing in literature, about the allegedly occurring stimulations under the influence of doses of ionizing radiations, smaller by several orders of magnitude.

Basic results, obtained in our laboratory, come to the following. In many laboratory and field experiments, with about 15 species of cultivated plants, it was ascertained, that small doses of X-rays, beta and gamma-rays (varying for different crops and conditions of experiments in the limits from ten to several thousands of Roentgen units) accelerate the growth and increase the general biomass and the yield of grains; after a further raising of doses stimulation changes over to a progressive injury of plants with the increase of doses and concludes with a lethal effect. Radio-stimulation is observed after irradiating dry or swollen seeds from without, as well as when they are soaked in solutions, containing radioactive substances, and also when introducing the emitters into the soil or nutrient medium. The greatest stimulation was observed with a prolonged (in the course of 24 hours) soaking of seeds in a solution of inextricable mixture of products of fission of uranium, the radiation of which consists principally of fairly hard beta-rays. In figure 1, as an example, are represented results of field experiments with /Begin p.259/ 13 species of cultivated plants. Besides this, during the course of 4 years, production plantings were conducted of ten species of plants on the total area of 300 hectares, that gave similar results.

Title of figure 1. Effect of irradiation in small doses on the growth of plants. Deviations of results of field experiments from the control (in %). In the limits of one crop the experiments are divided by large interspacings, and variants of one experiment by smaller spacings.
Words in the upper part of figure 1. Left to right: peas, beans, Phaseolus, vetch, alfalfa, clover. In the lower part, left to right: wheat, barley, oats, millets, buckwheat, beets, flax.

During experiments, attention was drawn to ascertain the conditions, which influence the appearance of radio-stimulation. Very interesting and important proved to be the fact that alpha-rays, being utilized in the same doses and under the same conditions as other types of radiation, do not cause any stimulation of plants. Their inhibitory effect, with the raising of the dose, tells much stronger. This fact, most probably, can be explained by the effect of linear density of ionisation. Therefore, special experiments were conducted by soaking seeds of peas in solutions of isotopes of rare earth elements, which possess beta-radiation of various hardness. Results of these experiments, presented in figure 2, show that a hard beta-radiation Ce^{144} causes approximately the same effect, as a mixture of uranium fragments; and the soft beta-rays Pm^{147} cause an effect intermediate between the alpha-radiation and the hard beta-radiation. A great role is played by the intensity of irradiation and the stage at which the reaction takes place. Numerous experiments have shown that, under similar conditions, stimulation is more strongly expressed after a prolonged irradiation, then after a short, and is pronounced more often when irradiating wet seeds, than dry seeds or sprouts. The results of one group of experiments, where both of these factors were modified, are cited in table 1 for illustrating these regularities.

The results, cited above, are rather hard to interpret theoretically since the growth of plants, and, the more so, the yield are the secondary results of other, more direct effects of irradiation. Therefore, special attention was given in our experiments to cytological studies of tissues of irradiated plants at various dates after irradiation /15/. Already a detailed analysis of results of basic experiments points to the fact that the acceleration of growth occurs at the expense of stimulation of cell division, since in stimulated plants the dry weight is higher than in the control; /Begin p.260/ this tells about the decrease of the mean size of cells and about the corresponding increase of their number. (Text continued after Table 1).

Title of figure 2. Effect of different emitters depending on the physical dose. Results are given in the form of a mean deviation from the control (in %) taking into account the features (weight of roots, of stalks and leaves).

Words in figure 2. Inside: Mixture of fragments. Beneath the diagram: Dose, fer /physical roentgen equivalent, rep./.

Table 1.

Effect of gamma rays on the yield of pea seeds (in % to control) after irradiating the seeds at different stages of 24-hour soaking.

Length of irradiation and stage of soaking	Dose of irradiation 150r	250r
Control	100	100
24 hrs. of soaking and irradiation	150	122
6 hrs. after the beginning of soaking	131	101
6 hrs. at the end of soaking	139	116
30 minutes at the beginning of soaking	123	102
30 minutes at the end of soaking	136	113

Direct biometric analysis, conducted by S. R. Tsarapkin, has shown, that in stimulated plants the average /Begin p.261/ size of cells is substantially reduced, while in the inhibited - is somewhat increased as compared to the control. Similar results were also obtained on bacterial cultures /11, 12/. Cytological examination has shown that the percentage of dividing cells in the root meristem increases considerably after soaking the seeds in weak concentrations of the solution of uranium fragments, while the percentage of cells with chromosome reconstruction differs but little from the control. Similar experiments with solutions of alpha-emitters gave a quite different picture: mitotic activity did not substantially differ from the control, and the percent of abnormal mitosis increased much faster with the dose (figure 3). Comparison of these results with data of the effect of emitters on the growth of plants has shown, that there is a well expressed correlation between the stimulation of growth and the mitotic activity on the one hand, and inhibition of growth and the number of abnormal mitosises - on the other hand.

Title of figure 3. Effect of various doses of alpha-emitters (a) and beta-emitters (b) on the percentage of normal mitosises (A) and mitotic activity (B).
Words beneath both diagrams: Dose, rep.

Special experiments have shown, that under these conditions the raising of mitotic activity is not limited to a short term wave, which follows its inhibition, but begins before the destruction of cells (which proceeds also at stimulating doses). It follows from this, that stimulation of mitosis is not only compensatory and does not occur as a result of the activity of necrohormones, which are formed during the destruction of cells. Therefore, here proceeds a real stimulation of mitosis, which is a fairly direct result of irradiation. /Begin p.262/

The following circumstance helps in the understanding of the mechanism of stimulation of the cell division. In the cells of stimulated plants is observed a considerable amount of binucleate symmetrical cells. Since such cells are almost absent in the control and after the action of inhibiting doses, one has to assume that they are indebted in their appearance not to the injury, but to stimulation, since the effect does not grow with the dose, but has an optimum. In such a case this can be explained only by the fact that the formation of cell walls is behind the increased division of nuclei. Data, cited earlier, about the decrease of the size of cells in stimulated plants can be explained in the same way. Since the increase of biomass is determined, in the first place, by the speed of protein synthesis, this means that protein synthesis is somewhat behind the increased division of nuclei, the number of which during stimulation on the average is somewhat greater. Thus, one must assume, that after radio-stimulation the first in order is the increase in nuclear division.

Examination of interrelation of various mitotic phases leads to an interesting conclusion. It appears that an increase of mitotic activity basically occurs because of the increase of the number of prophases. This phenomenon, like the appearance of binucleate cells, cannot be explained by the inhibition of any process, since this effect does not increase along with the dose. Therefore, an increase in the number of prophases is not connected with the blocking of a transfer from prophase to metaphase, but with the acceleration of transfer from interphase to prophase. Consequently, the acceleration in nuclear division is accomplished at the expense of some process occurring during the interphase. It is more natural to assume that cause of increased nuclear division is the acceleration of synthesis of desoxyribonucleic acid (DNA), which, as it is known, is accomplished during the interphase.

Thus, results of the cytological analysis leads to the following conclusions.

Inhibition of plant growth is connected, to a considerable degree, with destruction of cells, occurring, basically, at the expense of chromosome breakage and of certain types of chromosome aberrations. One of the basic causes of stimulation of growth and development of plants, under the action of small radiation doses, is the stimulation of cell division, at the basis of which lies the acceleration of nuclear division, which is, probably, connected with the acceleration of DN A synthesis.

During biophysical analysis of phenomena of radio-stimulation one should proceed first of all from the following three experimental facts.

1. Effect of radiation on the growth of plants is not a single process, but is formed already on the cell level of, at least, two types of changes: genetical (among which, after the utilised doses, the most essential are the chromosome aberrations) and physiological (among which the influence on the speed of mitosis is especially important to us).

2. The stimulating effect of radiation is in inverse dependence on the linear ionisation density: alpha-particles with high ionisation density do not cause it in general; among beta-particles the most effective are the particles of high energy, among electromagnetic quanta - the shortwaved.

3. In experiments with radio-stimulation appears an inverse factor of time: stimulation is much sharper expressed, with all other conditions equal, during a long irradiation.

Let us begin our analysis with the influence of the linear ionization density. From a macrogeometric point of view the effect of all ionizing radiations on matter is similar. Nevertheless, the microgeometrical picture turns out to be sharply dissimilar. A section of meristemic tissue of a pea is diagrammatically represented in figure 4; /Begin p.263/ it has been irradiated by a dose of 5 rep. of alpha-rays with an energy of 5 Mev and a dose of 0.33 rep of beta-particles with an energy of 1 Mev (which corresponds to the average energy of products of uranium fission). It is seen from this diagram that while during irradiation with alpha-particles no ionisation occurred in most cells, after irradiation with beta-particles all the tissue was pierced with a net of ionising tracks even at a dose 15 times smaller. Linear ionisation density of these radiations is also very different: alpha-particles produce about 4,000 ionisations on 1μ of the way, whereas beta-particles with an energy 1 Mev only about 6 ionisations. It is necessary to especially point out the degree of uniformity of ionisations. Ionisation density changes insignificantly in alpha-particles: from 1,300 ionisations for 1μ at the beginning of the way to 5,200 at the end. In beta-particles, on the contrary, the difference is very great and the number of ionisations changes from 2 to 1,700 per micron so that at the end of the way the same ionisation density is formed as during the course of alpha-particles /16/.

Title of figure 4. Diagrammatic representation of microgeometrical distribution of ionisation after irradiation of meristematic tissue of a pea by a dose of 5 rep of alpha-rays of radium (left) and a dose of 0.33 rep of beta-radiation of products of uranium fission (right).

It is clear from these comparisons, that in those cases when it is necessary to leave great energy on a small section of the area for causing an effect, for instance, in chromosome cross section alpha-particles must be more effective as most of passages of beta-particles leave low energy; beta-particle produces many ionisations only "at the end of the flight". And, on the contrary, if for the realisation of some effect a certain optimising energy is required, then beta-particles must produce a high effect. Indeed, if the question is about the not too fine parts of the cell (beginning with parts of an order of μ and higher), then beginning with small doses of beta-rays the statistical nature of their absorption will tell little; all sections will, approximately receive a similar dose, which will increase with the raising of the general integral dose. With the action of small doses of alpha-rays certain parts will receive a very large dose, whereas others will remain unirradiated; whereupon this effect tells already at the level of the cell. An obvious case of this was obtained in our cytological experiments /15/. With the increase of the dose of alpha-rays the number of cells with chromosome breakage grew, but the number of breakages per injured cell did not change, /Begin p.264/ while in experiments with beta-rays together with the dose grows not only the number of injured cells, but also the amount of breakages per cell (although considerably slower).

As to the inhibition of the growth of plants under the activity of alpha-emitters and high concentrations of beta-emitters, its mechanism was already ascertained previously to a considerable degree. It was known that the inhibition of growth was connected mainly with the destruction of cells /17/, and the destruction of cells, in its turn, was connected with chromosome breakages /16/. It is known also, that energy is required for chromosome breakage of an order of several tens of ionisations. Therefore, the fact of greater inhibiting action of alpha-particles finds its explanation in the peculiarities of microgeometrical disposition of ionisation and fully corresponds to certain biophysical facts and theories /16, 18, 19/.

Biophysical analysis of the phenomenon of radio-stimulation, after soaking the seeds in solution of beta-emitters, is facilitated by the fact that stimulation of mitotic activity and of growth is observed during the action of such concentrations, when the percent of chromosome aberrations almost does not increase owing to the anomalous reaction at small doses /20/.

Therefore the curve of dependence of mitotic activity on the dose can be considered as a simple curve, and not as a result of two effects. One should mention, that radio-stimulation is observed also after irradiation of seeds from without with comparatively high doses, which cause a sufficiently large number of chromosome aberrations; in such cases, no doubt, occurs an interaction of two effects. The presence on the curve of a maximum of the effect of the dose shows that for the stimulation of mitosis a certain optimum energy is required, the exceeding of which does not already cause this effect. Cytological analysis has shown that stimulation of mitosis is accomplished during the time of DNA synthesis at the time of interphase. Biophysical analysis led to the same conclusion. Display of the inverse factor of time after stimulation can be explained by the fact, that the cells are not similarly sensitive to the stimulating effect of rays. Therefore, during short irradiation only few of the cells are irradiated to a specially sensitive stage; while during prolonged irradiation all, or almost all, cells pass through this stage during irradiation. Probably this explains the fact that when irradiating dry seeds from without the stimulation is expressed considerably weaker, for its manifestation are needed much higher doses and the factor of time is absent. It is interesting that in certain cases the phenomenon of the inverse factor of time is explained by the peculiarities of the action of rays on the metabolism of nucleic acids /21/, which leads up on the other hand to the same conclusion, and, namely, that one of the primal processes during radio-stimulation is the action of rays on the metabolism of nucleic acids.

As it was already said, biophysical examination of the form of the curve of the effect of the dose for mitotic activity tells about the fact that a certain optimum energy is needed for stimulation of mitosis. In connection with a larger effectiveness of radiations with a small linear ionization density one can assume, that for the realization of this reaction not a high energy is needed, which is concentrated in a limited part of space, but an accumulated energy of separate small "packages of energy". The existing facts do not contradict the "toxicological hypothesis" of radio-stimulation /14/, according to which in the irradiated cell arise, in very small concentrations, products of denaturation of protein and "foreign" molecules as a result of both the initial radio-chemical effects, as well as, possibly, of also primarily induced chain reactions, whereupon, as it is known, the proteolytic and, in general, the fermentative activity of the cell can increase. /Begin p.265/ At the same time the possibility is not excluded that, in the presence of stimulation, irradiation acts more specifically on certain intracellular organoids, for instance, the nucleolus. Clarification of the specific nature of these primary processes represents a further stage in studying the mechanism of radio-stimulation. Meanwhile, one can assume, with a sufficient definiteness, that the basic cause for the stimulation of growth of higher plants is the acceleration of cell division, and during the acceleration of cell division the primary effect is the stimulation of division of cell nuclei, at the basis of which lies the acceleration of synthesis of DNA. The described process appears very rarely in such a pure form as with a protracted soaking of seeds in solutions of hard beta-emitters. Often, beginning already with "stimulating" doses, an important role is played by cytogenetic effects, so that the total influence of irradiation on the growth consists of two different and oppositely directed processes.

In conclusion, one should make two more remarks of a general character. First, the existence of the phenomenon of radio-stimulation does not at all speak about the necessity of ionizing radiations for a normal existence of living organisms. Assumptions of such a sort do not have any real ground and their groundlessness was recently shown very clearly by A. P. Vinogradov /22/. Secondly, there exist, up to the present time, "opponents of radio-stimulation", who do not recognise the fact itself. Objections usually proceed along one of the three directions: either the stimulating effect is explained by a chemical action of radioactive substances or of accompanying admixtures, or, having established in precise experiments an absence of stimulation, they assume this as proof of the absence of stimulation in general, or, finally, they issue from a preconceived opinion about ionising radiation as an agent, which causes only destructive action. One should say, as regard this, that radio-stimulation is observed not alone after a contact with radioactive isotopes, but also after irradiation from without /23/. Further on, the manifestation of radio-stimulation depends not only on the dose, as it follows from the principle of Arndt-Shultse, but also on many other factors. Thus, under fully similar conditions alpha-rays, in contradistinction to beta-rays, usually do not produce any stimulation. Therefore, one cannot expect stimulation under all conditions of the experiment. Finally, it is hard for many researchers to admit the fact of radio-stimulation since in the majority of theories of biological action of radiation there does not seem to be any room for it, and the authors of work on radio-stimulation rarely give a theoretical explanation to the obtained results. Exactly for this reason in this report we tried to draw the main attention not to the fact itself of radio-stimulation, but to the possibility of its theoretical explanation, whereupon we tried to show, that the phenomenon of radio-stimulation not only does not contradict the basic principles of biophysics, but receives its clearest interpretation exactly owing to biophysical analysis.

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Zbarskii, I. B.

Problemy biokhimii kletki.

/Problems of cell biochemistry/.

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The contemporary period in science is characterized not alone and not so much by development and deepening of special narrow fields of knowledge, as by attraction of different methods of research, by combination of different approaches for solution of one or another problem.

At the present time studies of mechanisms of the most important biological phenomena, such as growth and development, variability and heredity, processes which lie at the base of various forms of physiological activity, have advanced very far. Explanation of these mechanisms required the combination of morphological and biochemical methods, which permit the studying of the unity of structure and of chemical basis of function on the most elementary levels of life. Biochemistry already does not satisfy even the detailed knowledge of individual reactions of processes of glycolysis and oxidation or reproduction of these reactions with purified enzymes outside the organism. The strictly well regulated sequence of biochemical transformations in the cell is connected with spatial separation or, on the contrary, combination of separate enzymes, or of their groups, with the absence or their very high concentration in certain sections of the protoplasm. Biochemical representations cannot therefore be full without taking into account the localisation of chemical substances and biochemical reactions

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in the cell without a clarification of the structural bases of metabolism, of synthetic processes, of such reactions as conjugate phosphorylation, as transformation of free energy, which is enclosed in chemical compounds, to muscular contraction and other forms of the physiological work of the cell.

Exactly so also modern cytology cannot be satisfied with only the morphological research proper. A morphologist tries to study the structures, invisible under the usual microscope, which exist on the submicroscopic level, and here he invariably meets the biochemist in as much as these submicroscopic structures are none other than macromolecules of biologically important substances (proteins, nucleic acids, polysaccharides, lipids), which especially interest biochemists, or aggregates and complexes of such macromolecules.

Thus, biochemistry of a cell is one of those boundary fields of knowledge a swift development of which has been prepared by successes in disciplines, which have produced them, and is conditioned by the development of old and appearance of new methods of investigation, that became possible owing to a rapid growth of technical advances.

Biochemistry of the cell enters into many sections of biological and medical science; in its development are deeply interested not only morphologists and biochemists but also representatives of such disciplines as physiology of animals and plants, microbiology, embryology, genetics and selection, mechanics of development, pathological physiology, oncology, and others.

Exactly the cytobiochemical methods lead us to the closest /Begin p.27/ mechanisms of formation of form and function in their unity in various organisms, beginning with viruses and ending with the higher forms of the plant and animal world.

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At the outset of development of biochemistry, during the second half of the past century, many attempts were made to determine the chemical composition of different organs and tissues taking in consideration the interstital and intracellular localization of chemical components. An important place among these works is occupied by classical research of proteins of muscular and nervous tissue, which were prepared by A. Ia. Danilevskii and histochemical and physiological works of F. Misher. Nevertheless, a breaking away from elucidation of the morphological structure of the studied biological object was characteristic to biochemical research, directed to a deeper study of chemistry of substances of biological origin, and their conversion in the organisms. Although during this period morphologists penetrated deeper into the structure of the cell and discovered in it new formations, the chemical nature of such structures remained vague and only individual biochemical works refer to the chemical structure of the cell.

But already in the thirties of the present century one can observe the revival of interest in interstitial and intracollular locialization of chemical substances and of their conversions. A tendency arises to pass over from biochemical studies of extracts to the examination of "insoluble" proteins, in which a structural basis of tissues is found. Attempts appear to interpret the mechanisms of contraction of protoplasm. The most important role in this respect were played by the works on isolation and study of the nature of proteins, which form the muscular fiber, and, namely, the obtaining by G. Veber of myosin fila and, especially, discovery by V. A. Engel'gardt and M. N. Luibimova of adenosinetriphosphatase activity of such filaments, their capacity to active elongation in the presence of adenosinetriphosphate. This research, which began a scientific trend - mechanochemistry of muscles - received a further development in the works of A. Szent-Gyorgyi, F. Shtraub and I. L. Ivanov. Subsequently the contraction protein complexes were isolated from cell nuclei (I. B. Zbarskii and K. A. Perevoshchikova) and from other formations of the cell (G. Veber).

Along with contraction proteins from various tissues it became possible to isolate difficultly soluble proteins, particularly nucleoproteids of a filar character, for instance "plasmosin", obtained by R. Bensley from liver, "procollagen" by V. N. Orekhovich and A. A. Tustanovskii, "structural proteins" by "A. Szent-Gyorgyi," and others.

If one succeeded to conduct these works by old methods, then the new stage of cytochemical investigations, which combine the chemical studies with studies of intracellular structure, is indebted to the improvement of methods of research work. First of all, these are the successes of microscopic technique, introduction and distribution of phase-contrast ultraviolet and electron microscopy, development of microsurgical methods, which permit manipulating individual cells and even parts of cells.

Histochemical methods of staining microscopic sections played a large role in determining the chemical components of cells and tissues. Nevertheless, one cannot fail to take into account, that with all the great value of these methods for localization of chemical components, the results obtained through them are not always correct in virtue of many artifacts, which arise during the process of treating; this refers especially /Begin p.28/ to quantitative evaluation of the contents and assignment of many substances.

In reference to the chemical composition and metabolism of individual organoids of the cell, the most important results were obtained after their isolation and subsequent chemical study; this required development of a technique of homogenizing the tissues in various media and differential centrifugation of homogenates. Methods appeared for isolation of cell nuclei using citric acid, salt media, as well as saccharose, glycerine and anhydrous systems. Saccharose media proved to be especially productive, inasmuch as from such homogenates one succeeded in obtaining much finer cell particles-mitochondria and other granules of the cytoplasm in an almost unchanged state.

After fractionation of homogenates of tissues into cell components, a serious mistake in the interpretation of obtained data can be introduced by the heterogeneity of the initial material, the presence in it of cells of different types, as well as of non-cellular components. The recently emerged method of preparation of cell suspensions (N. Anderson) and separation of such suspensions into groups of homogeneous cells has good prospects for overcoming this difficulty. Interesting results of the work on studies of the inner structure of various cells of one and the same organ were recently obtained by a group of Belgian authors (C. Deduve and others), who have successfully utilized saturation of reticuloendothelium by iron, introduced with the food in order to separate reticuloendothelial cells of those of the liver proper, and a subsequent division of cells with the aid of an electromagnet.

One of the serious difficulties which biochemistry of cells meets, especially when studying growth and development, is the very small quantity of the material for research. The usual micromethods of biochemistry prove to be insufficiently sensitive for chemical analysis of such specimens as individual cells or their small groups. At the same time, in many cases, particularly when studying oogenesis, fertilisation and embryonic development, the possibility for analysing individual cells is of great importance.

Special apparatus for these purposes and several suitable, original ultra-micromethods were developed by Danish biochemists K. Linderstrom-Land and G. Holter. Of late there appeared reports about differentiation of protein substances with the aid of microimmunological reactions, which are conducted under a microscope, as well as about the application to the smallest objects of contemporary methods of chromatographic analysis, which will permit, for instance, determining the nucleotide composition of nucleic acid of an individual nerve cell.

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The nucleus, as the largest part of the cell served as an object of chemical and histological research prior to other cell components. Yet, in the last century one succeeded, although by very imperfect methods, to isolate nuclei from animal cells of certain types and subject them to chemical analysis. Already these first works led to discovery of new biologically important chemical compounds-nucleic acid and comparatively simple proteins of a basic character, protamines (F. Misher) and histones (A. Kossel'). These chemical components, which are characteristic to the nuclei, later on underwent deep studying. It seemed that the nucleic substance possesses a comparatively simple and at the same time peculiar composition, which distinguishes it from other parts of the cell and represents almost exclusively a complex of nucleic acid with protamines and histones. At the same time the cell nucleus was regarded /Begin p.29/ as a bearer of several functions of active life, yet not one of them can as yet be held to be inherent to the nucleus alone.

The question about the function of the nucleus in the activity of the cell cannot be solved without a minute cytochemical research in the composition and metabolic activity of nuclei and their interrelation with cytoplasm. Experimental data point to the very considerable role of the nucleus, which is expressed not in quickly occurring changes in the metabolism of cells and tissues but usually in slowly developing and long acting manifestations of nuclear function. The nucleus produces a considerable influence on the organisation and inner structure of the cell and thus acts, probably, not so much directly as through protoplasmic structures, mainly cytoplasmic reticular network and minute ribonucleic granules of the cytoplasm. To the nucleus, apparently, belongs a very important role not only in processes of fertilisation, of cell division and heredity, but also in the differentiation of various cells and tissues, in ontogenesis of specific functions of differentiated organs.

Mechanisms of such kinds of complex and diverse functions of the nucleus - is one of the most important and interesting problems of cell biochemistry. Attraction of methods of contemporary physics must help in the solving of this problem. Of great interest in this respect are the models of the structure of desoxyribonucleic acid (DNA), obtained on the basis of X-ray analysis. Not without interest also are the attemps in applying the theory of information to the mechanisms of synthesis of specific proteins with the assistance of nucleic acids.

Experimental data on biochemistry of such chemical components are permissible for considering as bearing relation to possible mechanisms of functional activity of one or another cell organoid. However this does not permit yet to reduce the functional activity as such to one or another individual chemical component. Thus, the very interesting data about the rigidity of the DNA structure, its specificity and importance in factors of transformation and transduction in microorganisms and bacteriophages is yet insufficient in order to reduce, for instance, the processes of transfer of hereditary features, in all their complexity, to the specific structure of DNA or exclusively to the nuclear function.

It is necessary also to take into consideration that the features and composition of cell nuclei of various tissues and organisms, especially at different stages of development, with their relative similarity, can be heterogeneous, and that even such a characteristic component of the nucleus as DNA, in some cases, for instance during the development of fish eggs, appears practically fully not in the nucleus, but in the cytoplasm of the ovicell.

If the nucleus accomplishes such complex and manifold functions, it is hard to imagine, that into its composition enter only the comparatively simple proteins (histones and protamines). Indeed, contemporary data show that the protein composition of the cell nucleus is not that simple and inculdes the highly organized proteins of the complex amino acid composition.

Proteins of the usual (acid) type were discovered by A. N. Belozerskii in the composition of nuclear nucleoproteids, which were isolated from bacteria and plants. Subsequently, it was shown, that nuclei, isolated from animal cells, always contain a lot of protein of acid character ("chromosomin" according to E. Stedman). This acid protein considerably differs, according to properties and to amino acid composition, from protamines and histones; particularly it contains tryptophan, which is lacking in basic proteins. The acid protein contains about 10% of lipids, is homogeneous during electrophoresis and can be regarded as lipoproteid (D. Mayer, T. Wong and L. Thomas). Into its /Begin p.30/ composition enters a considerable part of RNA of the nucleus, forming, apparently, a complex which is present in the nucleoli (G. P. Georgiev and S. M. Saidov).

In the composition of cell nuclei was detected a special "residual" protein which was insoluble in the usual solvents (I. B. Zbarskii and

S. S. Debov). This protein is free from nucleic acids, does not contain tryptophan and suggests collagen by its features. The residual protein comprises about 5% of the dry substance of nuclei of normal cells, and after isolation from them of nucleiproteid and the acid protein, remains as a silhouette of the nuclei, retaining the form. According to more detailed research of the Czech authors, D. Soudek and L. Benes, the residual protein forms the sheath of the nucleus.

Experiments with tagged amino acids pour some light on the functional importance of nuclear proteins. In our experiments, which were conducted in vivo, radioactivity of tagged amino acids was detected mainly in the fraction of the acid protein, as well as in the tryptophan containing protein of the nucleiproteid fraction which, apparently, has mostly to do with biosynthesis of proteins in the nucleus and with biosynthesis in the cytoplasm, connected with it. Corresponding research, conducted by A. Mirskii and his co-authors in Vitro, led them to similar results, which are regarded by them as an evidence of a strong link of these proteins with DNA, and its participation in the biosynthesis of specific nuclear proteins.

In this process of particular importance are the protein-nucleic complexes, in which the most essential are, apparently, the compound proteins, which are stongly linked to nucleic acids. On the other hand, the basic protein components-histone or protamine - which are easily isolated from the nucleoproteid complex, are comparatively inert in respect to inclusion of amino acids and can play only the role of a factor, that is blocking and regulating synthetic processes in the nucleus. From this point of view the bond of nucleic acids, particularly DNA, with proteins in a living cell can be different than in the isolated nucleoproteids, and is capable of enduring considerable changes in processes of biological development.

The expressed considerations are insufficient for passing judgment about the metabolic function of the nuclei without qualitative and quantitative information about the enzymes of the cell nucleus. This question, nevertheless, requires a further detailed research, whereupon one should take into consideration, that the results of determination of enzymic acitivity depend, to a great degree, on the method of nuclei isolation and must be controlled by methods of histochemical staining. Besides this, nuclei, obtained from cells of different tissues, are similar to each other only to a certain degree, and can differ greatly from one another in the contents of many enzymes. The cited data refer mainly to nuclei which were isolated from the liver.

Many enzymes were detected in cell nuclei. Nuclei are relatively rich in phosphatase-adenosinetriphosphatase, which is activated by calcium, adenosine-5-phosphatase and, especially, by alkaline phosphatase. The high content of arginase is characteristic for the nuclear fraction, as well as for the enzymic systems of synthesis of nucleic acids and of certain coenzymes, particularly, diphosphopyridine nucleotide (Codehydrogenase I) from ATP and nicotinamidemononucleotide. At the same time oxidizing enzymes, such as succinodehydrogenase, cytochrome oxidase and others, are detected in very small amounts; and there are foundations for thinking that even these small amounts get into the nuclei from the destroyed mitochondria.

Such a type of research has shed some light not only on the chemical topography of the nucleus, but also on its function as the organoid of the cell. The notions about a great role of the nucleus in oxidizing processes did not find any confirmation. Nevertheless, the nucleus takes part in the reactions of biosynthesis, especially in synthesis of specific proteins and nucleic acids. There is a basis /Begin p.31/ to suppose, that this stage of synthesis of nucleic acids from nucleotides (A. K. Belousova), as well as of synthesis of certain coenzymes, for instance, codehydrogenase I (U. Shneider and co-workers) are connected with the nucleus only.

Histochemical observations lead to similar conclusions also. In cells of various tissues are described tiny basophil lumps, detected on the nuclear membrane and attesting about the transfer of material, rich in nucleic acids from the nucleus to the cytoplasm. This phenomenon of "nuclear secretion", which is especially clearly demonstrated in the nerve cells, speaks about the passage of RNA and of proteins from the nucleus to cytoplasm. Nevertheless, in order to ascertain the chemical nature of the secreted material it would be very important to isolate these tiny lumps and subject them to chemical examination.

Explanation of the mechanism of such processes as fertilization, cell multiplication, heredity and so on, depends to a considerable degree on detailed studies of the chemistry of the cell nucleus. Nevertheless, the already available data permit to suppose, that the nuclear apparatus plays a directing and regulating role in the organisation of the protoplasm structure and can accomplish this function by means of synthesis of specific nucleoproteid granules, placed along the system of reticular network, which is closely connected with nuclear membrane and perinuclear layer. Such a mechanism would be able to accomplish the regulating function of the nucleus not only in the general processes of development, but also in the specific differentiation of certain organs and tissues. In this connection certain pathological processes, especially such as tumor growth and radiation injury can be caused by disturbance of the nucleoproteid complex of the nucleus and of the nuclear function.

If the nucleus is connected mainly with prolonged changes of processes of development, then in the cytoplasm, apparently, prevail the rapidly proceeding reactions of glycolysis, oxidation, and so on. These processes are localised both in the undifferentiated cytoplasm and in various granules, the majority of which are placed in a certain way and oriented in the cell. Of special interest is the circumstance, that biochemical processes, which are much later ontogenetically, for instance, oxidation or specific reactions, which are characteristic to a given tissue, are to a greater degree connected with structural formations, than the more primitive processes, such as glycolysis, which proceeds mainly in the structureless hyaloplasm.

Thus, complication of the morphological structure of the cell is accompanied by the complication of biochemical processes also. Such a correspondence is achieved both by the linking of specific group reactions in these or other granules and their safeguarding from the interference by other enzymes, as well as spatial distribution of enzymic systems when biochemical reactions can be accomplished in a required volume and continuity.

One of the most interesting problems, which as yet was almost not touched upon, is the problem about the origin of the cited structures and granules, correlation of chemical and morphological differentiation in the ontogenesis of the cell.

Different granules of the cytoplasm were obtained and purified comparatively recently. Studies of such granules by a method of fractionation of homogenates of tissues (W. Schneider and G. Hogeboom): led to further, more precise, definitions of our information both about the structure of cytoplasm, and about the position in it of many chemical components. Granules of cytoplasm of the mammals' liver are studied in greatest detail. The conclusions, cited below refer to this research. Undoubtedly, /Begin p.32/ many properties of the granules and the presence of granules of certain types are characteristic for these or other cells; yet mitochondria and microsomes, apparently, could be obtained from most diverse animal cells and perform in them more or less similar functions.

Mitochondria are the larger among these granules (0.5-1μ in diameter). It is possible to isolate them from finer granules and obtain them in a purified, almost unchanged form, from tissue homogenates in isotonic saccharose solution. Mitochondria contain many lipids, but very little RNA. They are rich in enzymes and center within themselves mainly the oxidizing systems. In them is contained practically all the succino-dehydrogenase, cytochrome oxidase and cytochrome system of the cell, and, apparently, almost the whole enzymatic system of the citrated Kreb's cycle. Mitochondria provide oxidation of fatty acids as well as of keto and oxyacids, which are the intermediate products of exchange of carbohydrates, fats and proteins. Thus, mitochondria represent a very complete apparatus, which includes certain complexes of enzymes in a spatial and functional combination with each other.

In isolated unimpaired mitochondria one succeeds to reproduce both the complex, multistage oxidizing processes as well as individual reactions, which testify about a high content of such enzymes as dehydrase of glutamic acid, oxidases of oxalacetic acid, capryl acid, choline oxidase, and others. The activity of certain hydrolytic enzymes is also referred to the mitochondria fraction. There are a lot of data in literature also about other enzymes, contained in mitochondria. Nevertheless, owing to the imperfection of methods, data can be incorrect and require thorough investigation. These doubts do not refer to the oxidizing processes and, already now, there are reasons to think that the chief function of mitochondria oxidation and oxidating phosphorylation, and they, thus, are the organella, which provide the cell with energy and resynthesis of "vysokoergicheskikh" [high-ergal] phosphoric combinations.

This function of mitochondria is confirmed by the fact that the cells, in which glycolytic processes prevail, for instance, cancerous cells are poor in mitochondria, and, on the contrary, development of the mitochondrial apparatus, up to a certain degree, correlates a high differentiation of cells and development in them of the structure and of the oxidizing type of metabolism and energy. Thus, the nerve cells are especially rich in mitochondria, whereupon, in contradistinction to Nissl's substance, they are met in different parts of the cell; nerve terminations in tissues and in synapse are especially rich in mitochondria. Examination of isolated mitochondria of nerve cells permits to conclude that these large granules are most closely connected with the nervous activity, particularly with the transfer of nervous excitation. The main mass of cholinesterase and choline-acetylase is concentrated in them. About this testify for instance, the latest data showing that acetylcholine synthesis in nerve tissue can be successfully reproduced in mitochondria isolated from the brain of a rabbit (S. Hebb and B. Smallman).

Mitochondria can be seen well under an ordinary microscope, but through an electron microscope it is possible to discern their inner structure of pectinate character, which is included in a general sheath, which protects mitochondria from destruction and extraction of enzymes contained in them; Thus "insolubility", which is usually ascribed to the oxidizing enzymes of the cell, in essence depends on their organisation in mitochondria. In a certain sense mitochondria is a closed system, which represents the result of morphological and chemical differentiation.

The fraction of microsomes or the small granules is not as well determined as /Begin p.33/ mitochondria. Usually to them belong particles from 50 to 150 mμ in diameter. Microsomes are very rich in RNA and lipids, which compose up to 40% of their dry substance. Their enzymic apparatus is poorer and not as variegated as that of mitochondria; nevertheless, certain enzymes, namely, esterase, glucose-6-phosphatase, diphosphopyridinenucleotide-cytochrome c reductase are mainly connected with this fraction. What concerns the functions of the microsomes, they are as yet not sufficiently clear; yet the high content of PNA in them, as well as the intense inclusion into this fraction of tagged amino acids, permit to suppose that they play an important role in synthesis of protein in the cell.

Besides mitochondria and microsomes other types of granules are also described in literature, which are obtained during fractional fractionation of homogenates of the liver and of other tissues. Some authors (M. Petermann, A. Novikov and others) describe five, seven and even eight types of cytoplasmic granules, which were isolated from homogenates of liver and tumors. One can consider only the fraction of "light" or "pink" mitochondria as more or less determined, which has relationship to secretory granules, and, apparently, playing an important role in the synthesis of enzymic proteins. Works of C. Deduve and co-authors merit attention; they, having improved the method of fractionation of liver homogenates, have found that the enzymes ribonuclease, desoxyribonuclease, cathepsin, β-glucuronidase and acid phosphatase are connected with granules intermediate between mitochondria and microsomes, for which the authors suggested the name of "lizosom". These authors express an interesting hypothesis, that each type of granule is homogeneous enzymatically, that is, it has a definite physiological function, and each enzyme is correspondingly connected with one type of granule, that is, it has a definite intracellular localization.

Fraction of "supernatant fluid" remaining in the centrifugalized deposit after the settling of mitochondria and microsomes, contains yet a considerable amount of RNA and many "soluble" enzymes. In this soluble fraction the system of glycolysis remains practically completely, there too can be detected hexokinase, phosphorylase, phosphoglucomutase, aldolase and dehydrase of lactic acid; here also were discovered many other enzymes; but it still remains unclear to what extent they can be referred to nonstructural hyaloplasm and to what extent they proceed from these or other structures. The fraction itself is far from being homogeneous. Of late, from centrifugal machines of high centrifugal power from the supernatant fluid of homogenates were isolated very fine granules about the size of 10-30 mμ, which are large nucleoproteid molecules (about 50% RNA) and containing all the RNA of this fraction (M. Petermann).

Comparison of electron-microscopic picture of the cell with results, obtained by methods of fractionation of homogenates of tissues and isolation of cell components permits, for instance, to identify nucleoproteid granules with basophil granules of the cytoplasm. In conformity with the method of fractionation these nucleoproteid macromolecules are also detected through the electron microscope in differentiated cells mainly on endoplasmic network (reticulum, ergastoplasm), while in nondifferentiated they are distributed more diffusively.

Nevertheless, there yet exists a rift between data of the electron microscopy and fractionation of homogenates. Especially great difficulty is presented by microsomes, which are not visible through the electron microscope as separate formations. Nevertheless, a detailed electron microscopic examination of the sediment of microsomes shows that they are fragments /Begin p.34/ of a single endoplasmic network, they include the sheathings of a "cistern", their contents and nucleoproteid granules.

A more precise characteristic of these formations, which will permit to establish their localisation in the cell, is one of the important problems of cytobiochemistry.

In general, there is yet much in the interpretation of cytobiochemical data which is unclear. Thus, the origin of several types of intermediate and minutest granules, which are described in literature also remains vague. Of great interest is the question if such a postulated variety of different types of granules is an artifact, is it connected with different parts of the endoplasmic network or with some peculiarities of cell formation, which as yet were not detected by the microscopic technique.

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Isolation and biochemical characteristic of cell components have played a large role not alone in the elucidation of functions of cell organoids and studies of the many sides of cell metabolism, but they also led to the revision and progress in many problems of biochemistry and enzymology. Together with bacteria and viruses of plants, animals and bacteria, the isolated mitochondria and other morphological formations of the cell are utilized for the clarification of details of enzymatic processes, especially of such where there takes place a combined course of two or several reactions (for instance combined phosphorylation). These same isolated cell fractions permit not only to determine the distribution of these or other biologically important substances in the cell, but also to detect unknown or formerly undetermined chemical components.

Thus, it is known to all biochemists, that results of studies of these or other biochemical processes or component parts of tissues depend to a great degree on the method of obtaining a tissue preparation. Usually the examined microscopic sections, pulps or extracts from tissues gave dissimilar results. Many different solvents and methods of treatment were suggested for the extraction of various enzymes. According to the capacity for isolation, the enzymes were subdivided into soluble (lyo-enzyme) and insoluble (desmo-enzymes); and very often that part of the tissue,which failed to dissolve, was then neglected.

The situation was considerably simplified, when it became clear that the "insoluble" components were simply fixed with larger morphological formations of the cell, and the phenomenon itself of "solubility" of many substances often depends on the fact of which cell fractions enter the preparation.

Precisely owing to utilization of many simple models and methods of fractionation of the cell studies of the mechanism of protein biosynthesis moved forward, this being one of the central problems of biochemistry. At the present time the question about localization of protein synthesis in the cell is discussed very widely. T. Kaspersson developed a theory, according to which proteins of the basic character (histones) are synthesized in the nucleus with the assistance of heterochromatin and of the nucleolus; these later on migrate to the nuclear membrane, where, in combination with RNA, they form more complex cytoplasmic proteins. This theory did not find any confirmation in many points, and now the point of view of Zh. Brashe seems more probable; according to it the role of the nucleus consists mainly in resynthesizing the material of granules of the cytoplasm and of coenzymes, whereas synthesis proper of protein takes place in cytoplasmic granules.

Indeed, experiments with inclusion of tagged amino acids have shown, that the most intensive protein synthesis is connected with microsomes. In general, the inclusion of amino acids into various granules of the cytoplasm is the higher /Begin p.35/ the more RNA they contain, and vice versa; treatment of granules with ribonuclease lowers, or altogether destroys, their ability to include amino acids.

Further studies of the intracellular localization of this process, which lies at the basis of the active life, growth and development undoubtedly, will shed light also on its mechanism. Already now it can be safely said that biosynthesis of protein occurs both in the nucleus and in the granules of the cytoplasm, whereupon in different parts of the cell, apparently, various proteins are synthesized which also, probably, play a different biological role.

Cytochemical direction permitted in many cases not only to localize, but also discover and define more accurately the phenomenon itself of structural interlinking of biochemical reactions. To such reactions refer first of all the processes of biosynthesis of proteins and other substances, for which the participation of cell structures since long ago was acknowledged necessary (A. I. Oparin, A. L. Kursanov). Here too can be referred the role of structures in processes of oxidation and of oxidizing phosphorylation (O. Varburg, V. A. Engel'gardt). Research has shown the disturbance of processes of oxidising phosphorylation and mechanism of Pasteur effect during the breakdown of cell structure (V. A. Engel'gardt, I. F. Seits, N. V. El'tsina), which will, undoubtedly, serve for a further cognition of the mechanism of these most important biological reactions.

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Studies of biochemistry of the cell play the most important role in solving many problems of general biological importance. Thus, research of

Zh. Brashe and of several other authors made it possible to approach the explanation of the role of the nucleus, of the cytoplasm and its organoids during the processes of embryonic development. Embryochemical research of enzymatic processes are also interesting which point to the substantial, although not yet quite clear, role of phosphatases in the process of growth and development and biosynthesis of protein. Studying enzymatic reactions, one can observe changes in the processes of metabolism, connected, apparently, with definite stages of development, and which often reflect, similarly to morphological changes, also the phylogenesis of the given species.

Similar transfers in an accelerated form can be observed during regeneration of organs (for instance of rat's liver after partial hepatoectomy). Here appear characteristic changes of glycolysis and respiration, as well as the activity of the cellular nucleus, which are characteristic to both the nondifferentiated and a later differentiated stages. Cytochemistry promises an elucidation of regularities, which govern the processes of growth and development by studying the given problems. It is difficult to overestimate the importance of perception of these regularities. One of the most interesting objects for such a type of research is the metamorphosis of insects, during which it is possible to observe during short periods of time the breaking up of old cells and tissues and the appearance of a large number of new, more differentiated formations.

The yet unexplained problem of the mechanism of mitosis, the theory of which is yet constructed on unsteady foundations, requires detailed cytochemical studying. A substantial role was played here by the intracellular localisation of sulfhydryl groups (L. Rapkin), influences of several inhibitors, atmospheric oxygen and other substances on mitosis (H. Lettre), changes of nucleic acids of the nucleus at its different stages.

It is quite possible, that mechanical shiftings in cells (changes and movement of chromosomes, contraction of the pulling threads of the spindle, and so on) can be connected with contractile protein complexes, which were uncovered in the cell nucleus and in the protoplasm of various cells.

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There is no doubt that cytochemical research will play a role in solving the problems of heredity, genetics and selection. The ever more clearing up strict specific specificity of DNA and many peculiarities of the composition and activity of the nuclear substance, its exchange with the cytoplasm and with the environment can also give very important information also for this field of knowledge.

Scarcely less important is the study of pathogenesis of the tumors growth. Among thousands of examinations in biochemistry of cancer ever more place is given to cytochemical works. One should point out, that it was exactly the studying of individual cell components that led to discovery of certain peculiarities of tumor growth, which could not be detected by other methods. Comparative poorness of tumor cells in mitochondria and different distribution in them of RNA (its comparative contents in cell nucleus and in the finest nucleoproteid granules of the supernatant fluid) can have a bearing on the characteristic nondifferentiated type of metabolism of tumors and their tendency to a high, including aerobic, glycolysis and disrupted respiration. In his last works O. Warburg connects all these facts with a lowered structure of the cancer cell, its primitive composition, lack of development of highly-organized structure, which are characteristic of ndifferentiated protoplasm.

Changes of correlation of protein fractions of cellular nucleus, which are characteristic to tumors, and which are not met in normal organs were detected in our laboratory. Nuclei of tumor cells contain a comparatively low percentage of the nucleoproteid fraction and a very high percentage of a fraction of the residual protein. Abundance of residual protein is explained not simply by increased contents of the residual protein, which is peculiar to normal nuclei, but by the presence of a special fraction, containing tryptophan, which is characteristic to tumors and which accumulates during the process of the tumor growth. This phenomenon, probably, reflects an injury in the nucleus apparatus in the tumor cell, which shows conclusively also in the comparatively decreased ability of nuclei of tumor cells to synthesize protein, as it was demonstrated by the inclusion of tagged amino acids.

Differences in the tumor protein were detected also in the supernatant fraction, which was obtained after sedimentation of nuclei from the homogenate and of the greatest part of granules of the cytoplasm (L. A. Zilber and G. I. Abelev, S. Sorof).

Elucidation of characteristics of the tumor growth can be of a fairly great importance also for the pathology of growth and development in a wider sense. First of all it refers to pathological regeneration, which occurs during radiation injury, and to other violations of the activity of the cell and of cell metabolism, which is caused by the action of radiant energy.

The brief review, cited in the present article, of cytochemical methods and role of biochemistry of cells in the study of certain problems of cytophysiology, biochemistry, general biology and pathology does by no means exhaust the possibilities and importance of cytobiochemistry or, encompassing this trend still wider, of biochemical and biophysical cytology. Methods, which are connected with such type of research, are as yet in the stage of development and improvement, therefore the obtained results up to the present time are classified more depending on the utilized method, than on the object and problems of research. Nevertheless, now these methods have attained or are attaining a sufficient degree of efficiency, in order that their comparison would lead to mutually supplementary conclusions.

Berg, R. L.

Soveshchanie po primeneniui matematicheskikh metodov v biologii.

/Conference on the Application of Mathematical Methods in Biology/.

Bot. Zhur. /Moskva/, vol. 43, no. 11, p.1654-1657. Nov. 1958. 451 R923.

(In Russian)

In May of 1958 the Biological Institute of Leningrad State University /LGU/ imeni A. A. Zhdanov conducted a Conference on the Application of Mathematical Methods in Biology. Professor P. V. Terent'ev was the initiator and chief organizer of this meeting of mathematicians and biologists, the first in our country; he is Head of the Chair of Zoology of Vertebrates at LGU. In the organizational committee of the Conference took part: P. V. Terent'ev (Chairman), V. S. Ivlev, L. S. Kaminskii and R. L. Berg (Secretary). The Conference proceeded under solemn conditions with a great gathering of people; over 500 persons visited it. Improvement of methods of evaluation of the authenticity of experimental data was not the aim of the Conference. Its object was to point out the specific fields of biology and of biological reguliarities, the cognition of which is impossible without the application of mathematical methods. Seventeen reports, which were read at the Conference, were dedicated to various aspects of application of mathematics in systematics, physiology, cytology, business and demography.

The audience listened with the greatest of interest to those reports at the Conference which threw light on the connection of biology and mathe-

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Leningradskii Gosudarstvennyi Universitet imeni A. A. Zhdanova /Leningrad State University imeni A. A. Zhdanov/.

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matics from philosophic positions.

A. I. Popov in the report "Possibilities for Utilizing Mathematical Methods in Biology from the Point of View of Dialectical Materialism" has shown, with full persuasiveness, that in biology are used both the quantitative methods, as well as the qualitative processes of research, which come in contact with mathematical logic and with the theory of information (cybernetics).

These ideas were developed also in the report of A. A. Kvasov "About the Nature of Statistical Laws". Kvasov has demonstrated the fruitfulness of utilizing mathematical logic in the field of evolutionary theory on an instance of theory of natural selection of Charles Darwin. Darwin was the first to establish that a correlation of the combination of organisms and of environment bears a statistical character and that the survival of the most adapted is then such a mechanism, with the aid of which the simple accidents in the changes of organisms are converted to a rigidly directed necessary process of evolution. A clear understanding of the statistical character of evolutionary conversions permitted Darwin to overcome the abstract determinism of the dynamic approach, which comprised the very essence of Lamarck's teachings about factors of evolution. At the beginning of our century the base for utilizing and development of statistical mechanisms were: the mutation theory, studies of regularities of distribution of discrete hereditary inclinations in the offspring (Mendelism) and, finally, chromosome theory of heredity. The speaker pointed out, that the first steps of development of genetics, which preceded the formation of the chromosome theory of heredity, coincided with the period of gnosiological crisis in natural science. The first attempts to link Mendelism and the mutation theory with the evolutionary teaching took a form of Antidarwinism (de Vries, Johansen, Batson), but later on in genetics the materialistic approach to the studied phenomena has triumphed, and to the moment of the formation of the chromosome theory of heredity genetics entered the channel of Darwinism.

The presence of individuals, or of comparatively independent isolated objects, introduces certain limitations in the use of statistical mechanisms in biology. Examination of a strong interaction among the particles of the ensemble requires development of a special method of statistics. But all this by no means implies a rejection of methods of mathematical statistics when studying life.

In the report "Prospects for the Use of Exact Methods for Studying the Facts of Evolution" by I. I. Shmal'gausen threw light upon the application of principles of the new field of mathematics - "cybernetics" - in biology. Use of principles of cybernetics has already received a sufficiently wide spreading in biology. N. Viner (1948) generalized the basic /Begin p.1655/ principles of the working organism of automatically regulated mechanisms not only in machines, but also in living organisms. The ideas of Shredinger (1945) about the organisation of chromosomes includes the conception of hereditary information. The first attempt to interpret the hereditary code on the basis of the model of desoxyribonucleic acid, suggested by Watson and Crick belongs to Gamov (1954). The information theory is widely applied to the analysis of regulatory processes, which are realized in the organism through the nervous system (Shannon, Ashby, McCarty and others). Regulatory systems, and particularly endocrine apparatus, playing the role of homeostatic structures, which sustain the stability of life functions of the organism as a whole, are also embraced by the new point of view; A. A. Malinovskii (1957) utilized the idea about the controlling systems for describing processes of individual development.

I. I. Shmal'gauzen was first to apply the theory of information to the examination of mechanisms of the evolutionary process. Interaction between the population of the given species and the environment, including both its living and inanimate components (biogeocenosis) represents an example of a directing apparatus. From biogeocenosis, which, of course, includes also the parental population of the given species, a flow of information is transferred along a direct channel of the bond to the daughter population. Transformation of this information occurs during the process of independent development of individuals. Interaction of the daughter population with biogeocenosis - this is the transfer of information along the channel of the reverse bond from the population to biogeocenosis. During the transfer of this reverse information occurs its conversion. The process of conversion of reverse information in biogeocenosis represents then the regulating mechanism of evolution. Precisely this process is responsible for the adaptive character of evolution.

The new point of view permits to put into practice the differential approach to the role of external factors both in individual development, as well as in evolution.

External facts are divided into: 1) essential factors, or vital resources, in a broad sense, and 2) occasional factors, obstacles, which to a greater or smaller degree disrupt the transfer and conversion of information along both channels of the bond.

Emerging in the role of obstacles in the channel of the direct bond, the external factors help in the appearance of mutations, which disrupt the transfer of information from parents to the offspring. But precisely by this they create the material for the activity of the basic regulating mechanism of evolution - natural selection. Stepping forward in a role of obstacles in the channel of reverse bond, the external factors help in the elimination of the bearers of harmful mutations from the population, decreasing the volume of transferable information, but at the same time raising its quality.

Progressive evolution is accompanied by the emergence of obstacle-resistance in both channels of the bond. Regulatory mechanisms are created, which provide a high reaction threshold on the cytological level, as well as on the ontogenetical and the population levels. Transfer of information along both the channels of the bond becomes ever more secure. At the same time the rate of evolutionary transformations grows.

R. L. Berg in her report "Ecological Interpretation of Correlative Pleiades" suggested to divide the external influences into the forming and the controlling (selecting). Such a division will permit to find out the general evolutionary principle of origination of programming of hereditary transmission. Programming is not directly connected with the fact itself of the existence of all the living. Reproduction of the simplest living structure is a process which occurs without any programming.

The code of hereditary transfer exists there where the parental organism generates a being, which differs from itself, that is, ~~there~~ where there is an alternation of generations or individual development, no matter how small is the chain of ontogenetic transformations leading from the zygote to the individual, which can start the whole cycle anew. Non-coincidence of the forming and of the controlling factors appears to be the condition for origination of hereditary coding. Hereditary coding, according to common sense, is indissolubly connected with a certain autonomy of the living forms and, in particular, of dimensions in respect to the quantitative expression of the forming factors.

Autonomy of dimensions of some parts in respect to sizes of other parts finds its expression in the presence of correlative pleiades, as P. V. Terent'ev has first called this phenomenon in 1931. A strong example of non-coincidence of the forming and of the controlling influences is the correlation of entomophilous plants, which have specific pollen carriers and insects transferring the pollen. Insects, in the given case, emerge in the role of factors strongly controlling the sizes of those parts of the flower, which take part in the strict localization of the pollen on the specific section of the insect's body. The insects take no part in the formation of the flower. It was found out that the plants, which enter with insect - transporters of their pollen, into specific correlations, including the localization of the pollen lump, have flowers that do not depend in their size on the dimensions of their vegetative parts and inflorescences. The size of such flowers are programmed with the aid of signals, which lie within the basis /nucleus ?/ itself, most probably with the aid of an intracellular mechanism. The cause of appearance of correlative pleiades in the given case is quite clear. It /Begin p.1656/ consists in non-coincidence of the forming and the controlling (selecting) influences.

P. V. Terent'ev in his report "Method of Correlative Pleiades "has demonstrated, by the example of a frog, the existence of sharp differences in the size of coefficients of correlations between the dimensions of various parts. Groups of characteristics, the dimensions of which are connected one with another by high coefficients of correlations, in the presence of low coefficients of correlations or in the absence of correlation between the dimensions of those same characteristics with dimensions of other properties, he called correlative pleiades. The method of correlative pleiades gives a basis for qualitative analysis of the combination of characteristics on the basis of their quantitative ratio. Terent'ev pointed to the value of the method of correlative pleiades for systematics. Members of a pleiad, the average correlation of which with other members of the given pleiad proves to be the greatest represent a characteristic - indicator. Opinions of systematists, particularly when applying the method of "Geinke", must be based on characteristic-indicators, which are the real characteristics of the system. "Taxonomic coefficient" (Vitenberg, 1923) is a combination of characteristic-indicators.

A. A. Liubishchev in his report "Biometric Methods in Systematics" recommended for evaluation of the significance of characteristics a criterion, independent of the number of examined individuals, namely, a coefficient of discrimination:

$$K = \frac{(\bar{x}_1 - \bar{x}_2)^2}{s_1^2 + s_2^2},$$

where s_1 and s_2 are standard deviations, $\bar{x}_1$ and $\bar{x}_2$ are corresponding mean values. The method of Fisher's discriminant functions permits to increase the coefficient of discrimination. The fruitfulness of application of these methods was demonstrated by A. A. Liubishchev on the instance of three species of fleabeetles: Haltica oleracea, H. issykulensis and H. carduorum.

The fruitfulness of application of statistical methods in systematics of ticks was demonstrated in theses of the report of the late V. B. Dubinin, which were read during the concluding session of the Conference, and in the report of A. F. Tumka "Results of Biometric Studies of Ameba of Human Gingiva in Connection with Intensity of Nutrition and Conditions of Residing in the Organism of the Host".

V. S. Ivlev in the report "Mathematical Analysis of Dynamics of Population of Fishes" spoke about the applicability of mathematical methods for studying the changes in the number of populations. Construction of theoretical models of fish populations, caught in their entirety, permitted to plan ways for practical solving of the problem of intensification of the fish industry.

Report of L. L. Vasil'ev "Utilization of Biometry in Neuromuscular Physiology" attracted much attention. Vasil'ev approached the basic object of neuromuscular physiology - an isolated frog's neuromuscular preparation - as a certain combination of elements (nerve and muscle fibers), each of which possesses its individual characteristics (excitability and the rate of conducting the impulses of excitation). The properties of individual elements vary, forming the Gauss distribution curve. Dependence between the strength of the irritating agent and the magnitude of the physiological response, caused by it in the nerve and muscle, in all cases is expressed by a more or less symmetrical sigmoid curve, which coincides with the cumulative curve of the variational series. Variability of the excitation threshold and a reaction according to the principle "all or nothing" of individual fibers must produce on the basis of theoretical reasons a cumulative curve of dependence for the whole set of fibers - of the entire neuromuscular preparation.

The report of P. O. Makarov was given over to the use of biometry in the physiology of the analysers of sense organs.

M. S. Navashin in his report "Certain Instances of Utilization of Mathematics in Cytology" attracted attention to the change of dimensions of the organism during changes in the size of cells, which occurs as a result of polyploidy. Double increase of the cell volume of the organism is not accompanied by a double increase of the volume of the organism. The organism becomes larger only by 1.6 times. This value can be predicted on the basis of the simplest mathematical calculation. The matter is that during a double increase of the volume of the cell its surface does not increase twice, but proportionally $\sqrt[3]{2}$. The intensity of metabolism and speed of cell divisions is slowed down exactly to this rate. A polyploid form has a smaller amount of cells than the diploid, and, correspondingly, its size is greater than the size of the diploid not twice but by 1.6 times. The other instance of use of mathematics in the field of cytology is connected with studies of configurations of chromosomes in all the cells of a certain tissue. There where it is possible to follow the real cell generations or the degree of relationship of cells of one organism, one succeeds to show that the degree of this relationship and similarity of configurations of chromosomes in mitosis are in direct relation. The closer the relationship, the more alike are the chromosome configurations during mitosis. Any other explanation of this direct relation, besides the preservation /Begin p.1657/ of the continuity of chromosomes in interkinesis, is excluded on principle. The "ravnoveroiatnost'" /equal probability/ of proximity of various chromosomes of the chromosome collection in the equatorial plate of mitosis is also proved with the same degree of reliability. Navashin illustrated his report with the richest of experimental material.

Reports of L. S. Kaminskii, L. E. Poliakov, S. F. Baranov and S. I. Stebakov, which were dedicated to the use of mathematical methods in medicine, as well as the report of Z. G. Frenkel' "Problem of Prolonging Life and Gerontology" were heard with live interest.

Lively discussions unfolded around the reports of A. A. Kvasov, I. I. Shmal'gauzen, V. S. Ivlev, L. L. Vasil'ev, P. V. Terent'ev, R. L. Berg and A. A. Liubishchev; both biologists and mathematicians took part in them. G. I. Egudin, when discussing A. A. Liubishchev's report set out a course for the formation of criteria for distinction of populations. Iu. V. Linnik and M. V. Vol'kenshtein mentioned the novelty and fruitfulness of the application of theory of information to the evolutionary process. Linnik pointed out several problems which await their solution in the frame of mathematical methods of research.

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Shkliar, T. N.

Predupredit' opasnost' golovnevykh epifitotii na tselinnykh zemliakh.

/To prevent the danger of smut epiphytotics on virgin soils/

Zashchita Rastenii ot Vreditelei i Boleznei, vol. 4, no. 1, p.18-19. Jan/Feb., 1958. 421 Z1

(In Russian)

In the summer of 1958 the students of the Section of Plant Protection of the Agricultural Faculty of Timiriazev Agricultural Academy during the period of production practice on virgin lands in Kustanaisk oblast' have conducted an accounting of smut infection of spring wheat and of other grain crops.

Large areas were investigated, for instance: at the Krasnopresnensk sovkhoz - 38 thousand hectares (ha.), at the Borkovsk - 6.5 thousand and at the Stalinsk - 25 thousand ha.

Results proved to be very serious. Thus, in the Mendygarsk raion, at sovkhozes Stalinskii, Khar'kovskii, Tenizovskii and Kamenets-Ural'skii from 1 to 3% of plants were infected on the examined plantings; in the Uzunkol'sk raion: at sovkhozes Kuibyshevskii, Ershovskii, Kievskii, Borkovskii, Krasnopresnenskii - from 2 to 10%; in the Ordzhonikidze raion: at sovkhozes Batalinskii, Pokrovskii and "Put' k kommunizmu" - 4%, at Prirechenskii - 5%, at sovkhozes "imeni Dzhangil'din" and the Ordzhonikidzevskii - 8%, and in sovkhoz "imeni Sverdlova" - 10%, at the Tobol'skii - 13% and Komarovskii - 18%.

Title of the figure: Student, A. Gorshkov, of the Timiriazev Agricultural Academy conducts an accounting of infection of wheat with wheat smut, Ustilago tritici, at the Krasnopresnenskii sovkhoz.

These data signal a serious danger of smut epiphytotics on virgin lands which fact must urge the leaders of sovkhozes and the agircultural establishments to take measures for organization of works on freeing the seeds from diseases. Such measures can be the exchange of seeds, thermal disinfection, sun "obogrev" /heating/, isolation of seed sections to fields, which are free from smut, pre-winter planting. For accomplishing the latter it is sufficient to isolate only 1% of the total acreage on the farm. These plantings can provide the farm's needs in seeding material. In many raions on sections, which are protected by birch pickets, the snow covering is sufficiently stable and wheat overwinters safely. Plant thinness can be overcome by doubling the norm of sowing.

The cause of strong infection of wheat with smut is the lack of its control, the seed material is not disinfected as there are no installations for thermal treatments on these farms (treatments of Khodskovskii, of the Belorusskaia Experiment Station and Karabalyk Experiment Station). Among other species of smut were mentioned: covered wheat smut (T. tritici) (sovkhozes Kuibyshevskii and Prigorodnyi) and species of oat smuts. At Arshalinsk sovkhoz the infection of oats reached up to 6%, while at Dzhetygarinskii on some fields up to 30%.

Control of covered wheat smut and of the smuts of oats is simpler. On some farms the seeds are teated with granosan, but the mechanization of the treatment is not up to the mark, and this makes it impossible to cope /Begin p.19/ with a large volume of work. There where spring wheat from year to year follows wheat, and there are nc crop rotations it is especially important to raise the quality of the seeding material and to study the resistance of the regionalized varieties (Tsesium III, Smena, Akmolinka, Gordeiforme 189).

At the present time, during the evaluation of the resistance of plants to phytopathogenic organisms, among them also to the smut species, it is necessary to consider the presence of geographical populations and races within the parasite species. Studies of the zonal distribution of aggressive races and evaluation of resistance of individual varieties to them makes it possible to conduct a variety-change or variety-rotation, that is temporarily to substitute in this or that region the varieties, which are strongly infected by the most prevailing races, by varieties which are more resistant to them.

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Muige, S. G.

Vzaimodeistvie fitogel'mintov i
nizshikh gribov v rasteniiakh.

/Co-operation of phytohelminths
and lower fungi in plants/.

Zashchita Rastenii ot Vreditelei i
Boleznei, vol. 4. no. 1. p.34-35.
Jan./Feb. 1959. 421 Z1.

(In Russian)

Damage, which is caused to agriculture by phytohelminths, is clearly underestimated. This is explained, first of all, by the fact that the pathogenic effect, caused by them, is often ascribed to the accompanying mycosis and bacteriosis.

Indeed, many phytohelminths can parasitise the higher plant only in the presence of fungi. They do not antagonize the putrescent (saprobiotic) medium, they do not produce in plants any specific symptoms of infestation and on the basis of this Professor A. A. Paramonov refers them to the group of phytohelminths of nonspecific pathogenic effect. The other group - of the specific pathogenic effect - can do without the accompanying mycosis and is in antagonism with saprobiotic medium. Nevertheless, the presence of fungi proves to be a stimulating factor for many of these nematodes. But in literature there are indications also on the linking of mycoses with helminthiasises. Thus, citrus trees, infested by citrus nematodes undergo a much stronger fungal infection (Thomas); cotton fusariosis is linked to Heterodera radicicola infestation (Zaitsev); potatoes infested with Heterodera are more intensely infected

Junior Scientific co-worker of the Helminthologic Laboratory of the Academy of Science of USSR.

with fungi (Triffit); cotton wilt is connected with the activity of the meadow nematode (Kur'ianova) and so on. Most of the researchers link it with the inoculating role of nematodes. It was established by us that in the excretions of digestive glands of the second group of phytohelminths are contained amylase-enzymes, a proteolytic enzyme (of papainase type), and in the onion nematode there was also found the protopectinase. Thus, the representatives of this group can lyze the tissue of healthy plants, consume the products of the lysis and cause in plants a specific pathogenic effect.

In the excretions of the representative of the first group (Hexatilus viviparus) are contained only the proteolytic enzyme and glycogenase. Consequently, the representatives of this group cannot lyze the starch, contained in the higher plants and utilize it fully for nutrition. On the other hand, fungi, which contain proteins and glycogen, are the basic nourishment for the group in question. Therefore these phytohelminths are always in symbiosis with fungi and do not produce any specific pathogenic effect.

Nevertheless, many representatives of phytohelminths of the specific pathogenic effect also often consume the mycelia of lower fungi, since they are capable to lyze both protein and starch, as well as glycogen. This especially refers to the stem nematodes of potatoes, which parasitize potato tubers, which are rich in starch, and are comparatively poor in protein. Thus, Ditylenchus destructor, obtaining from the fungus mycelium additional "protein nutrition", and possibly also some biological active substances (bios), multiplies much more intensely in the presence of mycosis and increases the infestation. It is thought that the development of mycosis diseases is caused by the inoculating role of phytonematodes. However, it is possible that here another factor may be playing a role, namely the stimulating action of phytonematodes on the development of fungi.

According to the conception of Sukhorukov (1952) "the parasitic organisms in their nutrition are adapted to the metabolism of the plants and are 'served' by their system of enzymes". Thus he shows that Phytophthora, which does not contain enzymes, which break up starch, depresses the inhibitor (sisto-amylase) of potatoes, thus stimulating the hydrolysis of starch in the tuber. Whereupon the degree of inhibition of amylase depends on the ability of the variety to resist Phytophthora.

Grechushnikov and Klimova (1940), hydrolyzing the starch by preliminary cooling the potatoes down to 0°, caused the infection with Phytophthora of a resistant variety of potatoes.

As the hydrolyzis of starch can be accomplished both by fixing the inhibitor of amylase, as well as by adding enzyme from without, we made an assumption, that the phytohelminth, which secretes amylase and causes intensified starch hydrolysis, can assist in the infection of potatoes with Phytophthora. In order to ascertain this we conducted the following experiments. Tubers of Phytophthora resistant variety of potatoes were separately inoculated with root-knot eel-worm and stem nematode. After such infestation became clearly expressed, the tubers were infected with Phytophthora. Five days after in those which were infested with root-knot eel-worm we detected Phytophthora mycelium, and in those infested with stem nematode-traces of mycelium at a distance of about 0.5 cm from the focus of infestation. We could not cause any Phytophthora infection in places where nematodes were present. This can be explained by the fact that Phytophthora can parasitize only on healthy cells, but since nematodes move faster than a fungus mycelium can grow, then the latter cannot withstand competition and cannot get acclimatized. It is also possible that phytohelminths swallowed the mycelium of Phytophthora.

Noninfested tubers (in the control) were not infected with Phytophthera.

Still more marked was the stimulating role of the onion stem nematode in the development of foot rot of onion, caused by Botrytis allii. Usually this fungus infects plants at the end of winter in large quantities. But during the vegetation period the infection weakens as the outside scales dry up and then dwindles to the moment of harvesting. But the onions which were infested with stem nematodes, were always infected with mycoses, among which B. allii occupied a prominent place. We conducted such an experiment - we kept a large number of stem nematodes in water in order that they excrete into it enzymes of the digestive glands. After that, with the aid of a capillary we introduced into one onion bulb the water, containing the nematodes' enzymes, and into another one - pure tap water (for a control). All the onions were infected with foot rot; those, which were preliminarily treated with nematodes' enzymes, were strongly infected by the fungi, but from among the 10 controls only 3 became infected and the infection was far weaker than in the experimental ones.

Here we meet two factors. First, the enzymes amylase and protopectinase, which are contained in nematodes' excretions, while assisting in the accumulation of sugars, disrupt osmoregulation in /Begin p.35/ the cells and assist in increasing the volume of the latter, as well as cause the maceration of tissue, which leads to cracking of the bottom of the onion and opens the gate to infection. Second, protein hydrolysis under the influence of nematodes' enzymes assists in the accumulation in the onion of free amino acids, which serve as a nutrient substratum for B. allii. In the same way the infection of cabbage leaves with B. cinerea fungus is intensified, if, with the aid of a capillary nematodes' enzymes were applied to them preliminarily.

Thus, nematodes not alone inoculate the infection, but also create favorable conditions for the fungi, by stimulating their development. Fungi, on the other hand, stimulate the development of infestation. In this way, mycoses and phytohelminths are closely connected among themselves.

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Chugunin, Ia. V.

O mikrobiologicheskom metode.

/About the microbiological method/.

Zashchita Rastenii ot Vreditelei i Boleznei,
vol. 4, no. 1. p.36-37. Jan./Feb. 1959. 421 Z1.

(In Russian)

The microbiological method of control, while being very tempting in theory, proved to be hard to solve in practice. Experiments with various microbiopreparations usually give good results in the laboratory, but under field conditions they are little effective, since the preparations, apparently, lose their virulence. About 80 years passed since the time of Mechnikov's experiments in using green muscarine for extermination of larvae of beetles of genus Anisoplia, but as yet there are no reliable measures for microbiological control of this pest up to the present day.

We observed in Crimea (during July and August) a mass extinction of gypsy moths from various diseases; whereupon the corpses of caterpillars and of pupa dried out very fast, serving thus as a steady repository for an infectious source of episootic diseases. At the places of extinction of the pest there were so many corpses of the caterpillars that they completely covered the soil under the tree tops. There were from hundreds to several thousand of them over 1sq. m. All the trunks and branches in the lower layer were covered with cocoons with dried out caterpillars, which did not have time to molt, or with pupa.

These observations spurred us to utilize the insect corpses, which died from diseases, for the production of a microbiological preparation like the one that is being prepared in America at the present time using Japanese beetles, that perished from the milky disease.

The corpses were ground to a powder in a mortar and were preserved /Begin p.37/ in glass jars with ground glass stoppers.

Such a preparation was tested by us in 1948 against gypsy moths. It was fed once to the experimental caterpillars in a moistened form (in dilution 1:1,000). As a result of this the pests perished during the course of 30 days. Mortality in the control was equal to 33%. Similar data were obtained also in experiments with caterpillars of the satin moth, lackey moth and cabbage moth when utilizing the preparation, diluted 1:20,000.

In 1950 a similar microbiopreparation was applied by us for the liquidation of a focus of mass reproduction of gypsy moths in Mekenzievsk forestry of the Balaklavsk lumber camp on an area of about 1,000 ha. The focus was sprayed once during the period between May 17 to 22 from an airplane in a dilution of 1:5,000 and 1:10,000, expending 20 L/ha. of the liquid. In a week's time the examinations showed that 99.2% of the pests perished in the stage of caterpillars, and the rest in the stages of pupa and butterfly. In the control (340 caterpillars) the mortality was equal to 5.9%.

These experiments, as it seems to us, make it possible to understand the causes of failures, which overtake the researchers who use microbiopreparations, obtained in a pure culture on an artificial medium. There are no pure cultures in nature and all the pathogenic microorganisms live in a complex microbiocenosis. It was not without reason that V. P. Pospelov connected the development of "polyedrezy" /polyhedrons, producing the yellows or tree top disease/ with yeasts.

In a report at a Conference on Bio-method (Kiev, 1958), N. A. Telenga cited several examples, when after the use of muscadine insects were destroyed by bacteria. Consequently, some pathogenic microorganisms can prepare conditions for development of others. Reproducing microbes on artificial media, we lower their virulence. One should also point out that microorganisms, the most pathogenic and interesting for practical utilization, - Nosema, viruses and certain fungi do not develop in any of the artificial media and, consequently, they can only be cultivated under natural conditions on living insects.

Proceeding from these principles, we think that the basic key, which must open a wide path to the microbiomethod, is the preservation and utilization of insects, which perished from diseases in places of their mass reproduction in order to transfer the infection from the fading foci to foci which are just beginning. This method is quite sound economically, especially in forest economy. Our experiment in Crimea shows that during one day one worker can prepare from 70 to 120g of air-dried corpses of insects. In general, one kilogram of the preparation, counting pulverizing and packing, costs us 1,000 rubles. When using it from 2 to 4 g/ha. the treatment cost from 5 to 10 times cheaper than with DDT dust. Of course, this work can be done only in the presence of a fully qualified microbiological control.

For mass production of this preparation one can use the wastes of silkworm breeding, in particular, cocoons of China oak silkworm - "chkhara and karapachakh". Dried well and at a proper time (but not killed by high temperature, that is, which were not conducted through the "simplex") they pulverize properly and can be stored for several years in jars of dark glass with a ground stopper. The preparation, prepared from the cited material, has shown high effectiveness for the control of gypsy moth, lackey moth, satin moth, fruit moth, Bryobia redikorzevi and many other objects. One must mention that bombyx is not suitable for this purpose.

It would be expedient to organize a wide and thorough study of microbiocenosis of different groups of insects with the purpose of discovering specific resistance to diseases of some of them, as well as of selection of individual specific components of microbiocenosises when preparing microbiopreparations. Of course one should not stop also the work with pure cultures, cultivated on artificial media, but one has to take into consideration that so far this course did not bring anything but disappointments in practical application.

...ns. A-1014
(In full)
vg/M

Tishchenko, G. N., Vaganova, A. D., Khoptiuk, A. M.

Izuchena li priroda silikatnykh bakterii?*

/Has the nature of silicate bacteria been studied?/

Zashchita Rastenii ot Vreditelei i Boleznei, vol. 4, no. 1. p.33. Jan/Feb., 1959 421 Z1

(In Russian)

A 1014

The Agrotechnical Section of Nemeshaevsk Experiment Section of the Ukrainian Scientific-Research Institute of Agriculture, when studying the influence of silicate bacteria on the productivity of potatoes, in 1956, obtained a negative result, that is, treatment of seed tubers with silicate bacteria lowered the productivity of potatoes and deteriorated their quality.

Two additional experiments were conducted in 1957:

1. Influence of silicate bacteria on a background of manuring - 30 tons of manure $+ N_{45} P_{60} K_{75}$.

2. Influence of silicate bacteria on a background of manureless fertilization.

Area of plots of land - 79sq. m. Replication - fourfold. Experiments were conducted on medium-podzolic dustysandy soil. The precursor was winter wheat, which was planted over a lupine fallow. System of the autumn preparation of the soil consisted in shallow plowing of stubble and a following

* In the course of discussion. See journal "Zashchita Rastenii ot Vreditelei i Boleznei" nos. 3 and 5 for 1957 and nos. 2 and 5 for 1958.

Scientific co-workers of Nemeshaevsk Experiment Station.

Declassified and Approved For Release 2013/09/24 : CIA-RDP80R01426R010400020001-7

fall-plowing to the depth of 22-25 cm. Early in spring (April 4), the plots were harrowed by heavy harrows, and on April 6 and 8 were fertilised with superphosphate and potassium magnesia. Manure was spread on April 12. After this the plots were plowed to the depth of 20-22 cm and harrowed.

Planting of potatoes (variety Kornea) was conducted on April 25 according to scheme 35 X 70 cm. Preliminarily the tubers were treated with silicate bacteria, obtained from the Odessa Agricultural Institute. Ammonium nitrate was applied over the sprouts, on May 25.

Phenological observations did not show any difference among the variants of the experiment. Harvesting was done on August 29. Data of calculations in the first experiment have shown that potato productivity practically did not change. Thus, on the plot with bacteria-treated tubers the yield was 266.9 centner per hectare, while from non bacteria-treated it was 262.5 c.

Variant of experiment	Yield of tubers (c/ha)	% of starch	% of sick plants
Without fertilisation	155.2	19.1	14.1
Silicate bacteria	142.2	19.0	13.4
N_{45} P_{60} K_{75}	199.8	18.3	10.9
N_{45} P_{60}	172.2	18.7	13.3
N_{45} P_{60} ≠ silicate bacteria	170.9	18.3	13.6
N_{45} K_{75}	185.5	18.4	10.7
N_{45} K_{75} ≠ silicate bacteria	195.8	18.3	10.3

The table shows that bacterial treatment of tubers, in the absence of manure, did not produce any additional yield, but, on the contrary even lowered it. On the background of NP no additional yield was obtained. This fact does not confirm the opinion that silicate bacteria have an ability to form soluble forms of potassium in the soil, at the expense of the mineral wealth of the soil proper. On the background of NK the additional yield comprised 5.6%. In this case one might think that silicate bacteria activate phosphorus, in consequence of which the yielding capacity is increased. Seed qualities of potatoes, grown from bacteria-treated tubers, were not improved.

Summing up the conducted experiments, we cannot agree with the confirmations of individual authors about the fact that silicate bacteria give positive results on all kinds of soils. Their negative influence, which was observed in our experiments, requires the clarification of the nature of the activity of silicate bacteria and further testing under various soil-climatic conditions.

Trans. A-1015
(In full)
vg/M

At the Session of VASKHNIL on Problems of Vegetable Growing, Potato Growing, Cultivation of Orchards and Viniculture.

Zashchita Rastenii ot Vreditelei i Boleznei, vol. 4, no. 1. p.56-58. Jan./Feb., 1959. 421 Z1.

(In Russian)

In the work of the Session, which took place in Moscow from October 30 to November 3, many agricultural practitioners, representatives of leading kolkhozes and sovkhozes, took part along with a large group of scientists; in all over 700 persons.

A 1015

The Session was opened with the inaugural address of the President of VASKHNIL /All-Union Academy of Agricultural Sciences imeni V. I. Lenin/, Academician P. P. Lobanov, who pointed out to the extraordinary importance of the raised questions, especially in the light of decisions adopted of late by the Party and the Government about the increase of production of vegetables, potatoes, fruits, berries and grapes. Vice-President, Academician D. D. Brezhnev, in his report about the problems of scientific establishments pointed out that along with many others, the one important problem of scientists is to give aid to agricultural agencies in drawing up scientifically based plans for effective allocation of production of vegetables, potatoes and fruits, according to natural-economic zones of the country, taking into consideration their concentration around cities, manufacturing centers, in waste zones of reprocessing industries as well as in southern regions of early ripening of fruits and vegetables; to take part in carrying out soil and hydrogeological research, development for kolkhozes and sovkhozes of recommendations about the system of measures, which foresee also the control of pests, plant diseases and weeds; basic improvement of seeding and planting material, as well as to suggest varieties with different dates of ripening, increased keeping qualities, resistant to drought, disease and pests.

Over 100 addresses were heard and discussed at plenary conferences and sections, including 62 reports. In these much attention was paid to the questions of plant protection. Doctor of biological sciences, D. L. Tverskoi, in the report "Complex of measures for the control of pests and diseases" pointed out that science and practice have developed effective methods for control both of individual species, as well as of whole groups of pests, diseases and weeds, and their realization produces on the farms a serious economic effect. Thus, for instance, timely chemical protection of cabbage provided an increase in the earning capacity from 1 hectare of 2,500 rubles and even more, while expending about 100 rubles. At a Moscow suburban sovkhoz "imeni Gor'kii", for instance, additional profits from an area of 162 ha comprised about 1 mln rubles. In this same sovkhoz protective measures are well carried out also for hothouses and hotbeds, and this also produces good returns for the farm.

Interesting data are available on the control of potato late blight. Thus, the yield of tubers increased by 75-87% after spraying with Bordeaux mixture.

Aerosols are of great importance in the control of fruit crops from sucking and leaf-chewing pests. Treatment of fruit plantings with them returned about 49 rubles for each one ruble spent.

Yet, notwithstanding the possibilities for considerable increase of yields of vegetables, potatoes and fruits, and improvement of the quality of production with the aid of correct organization of protective measures and application of the most effective methods, this has been as yet paid very little attention, according to reports. Propaganda about achievements of science and leading experience is carried out very slightly, as well as introduction of prophylactic and agrotechnical measures for control of pests and diseases; work on development of varieties, resistant to diseases, is not being conducted sufficiently; not enough poison chemicals are produced by the industry, as well as equipment, including the powerful machines for fine-drop spraying.

F. A. Karpov, Director of the sovkhos "Bolshevik" (Moscow oblast') shared his experience in applying kerosene for the control of weeds. On carrot plantings, which were treated with kerosene, no weeding was required, which gave the possibility to economise thousands of man-days, as well as money.

The problems of plant protection were more thoroughly /Begin p.57/ discussed at the Sections. In resolutions, adapted by the Session, it was agreed to wider elucidate in the press the achievements of science and of the leading experience; to organise model sections for demonstration of leading methods of plant protection; to widen the preparation of specialists; to increase the production of the most effective poison chemicals for the protection of potatoes, vegetables, fruit-berry crops and grapes; to attract attention of the chemical industry to the preparation of combined chemicals of a complex action against pests, diseases and weeds; of prepared aerosols and concentrated preparations, speeding up the production of new poisons; to develop research on the biological method of control of pests and diseases in combination with the chemical and agrotechnical methods; to study the influence of poison chemicals not only on pests, diseases and weeds, but also on the cultivated plants; to introduce widely into production the zonal systems of methods, based on the application of agrotechnical, chemical, biological and other methods of control of pests, diseases and weeds.

At the Section of Potato Growing

In many reports it was convincingly shown that simple and available measures for freeing potatoes from diseases provide an increase in gross yield and moreover the cost of production is reduced (by 15-30%). The VASKhNIL Session paid much attention to these problems. In reports and addresses during plenary conferences (Academician S. M. Bukasev, Academician N. V. Tsitsin, Professor N. V. Saburov, Professor D. L. Tverskoi, and others) it was shown the enormous economic importance of selection-seed growing, chemical and other methods and means. The same questions took much time also in the works of the Section.

Doctor of Agricultural Sciences, P. I. Al'smik, and Candidate of Agricultural Sciences, A. Ia. Kameraz, gave an account of the main results and described the problems and methods of further selection, and partially also of seed growing work for the purpose of developing and introducing into practice of disease-resistant varieties.

Reports of Member-Correspondents of the Academy of Science of White Russian SSR, N. A. Doroshkin and Professor M. N. Balashov, Professor M. S. Dunin, were dedicated to the analysis of the effectiveness of methods for rendering potatoes healthy (spraying with microdoses of copper sulfate, 1% and 2% of Bordeaux mixture, zineb and other fungicides, summer plantings, spring plantings in combination with early summer harvesting, growing of two crops during one summer, hardening by light of seed potatoes and others) under production tests on large areas, up to 500 ha. Spraying the potatoes with fungicids sharply reduced the infection with potato blight and increased the harvest by 40-63 c/ha, reduced the cost of potatoes by 15-31%. General expenditures for these works in a sum of 15-34 rubles guaranteed to sovkhozes and kolkhozes the obtaining of additional profit in the amount of 600-1,000 rubles per hectare. Noninfectious pathological processes are of great importance. They are not alone harmful in themselves, but they increase the susceptibility of plants to many infections, as well as to pests. In this respect the leading role must be assigned to the introduction of disease-resistant varieties and application of developed methods for rendering the planting material healthy.

The attention of the Section was drawn to the alarming figures of increase in numbers of stem and potato nematodes, as well as the spreading of the Colorado beetle and potato canker. Thus, if in 1946 on the territory of the USSR (in western republics) there were 4897 foci of potato canker, then in 1958 they grew to 68,400, that is 14 times more, and moreover they were already found in Moscow oblast'. These facts testify about the immediate necissity of a serious improvement in the organization of potato enterprises and first of all - liquidation of foci of potato canker on personal plots of collective farmers.

The existing data spoke also about the growing spreading of helminthiasis of potatoes. In England, for the control of these diseases of great promise is the utilisation of a special group of fungi - helminthophages.

The resolution, adapted by the Session, pointed out the importance of strengthening the development of methods of control of nematodes, Colorado beetle and potato canker, of studies of the possibility of antibiotic application, of growing and propagation of healthy planting material, of development of varieties immune to diseases, paying special attention to a creative participation of phytopathologists in selection work. The Session also mentioned the necessity of strengthening the structural work on improvement of high production machines, as well as the expansion in the production of poison chemicals and anti-pathogenic sera for rendering seed potatoes free of disease.

At the Section of Vegetable Growing

In her report "News in the Control of Diseases of Vegetable Crops", E. A. Osnitskaia (NIIOKH /Scientific Research Institute of Vegetable Growing/), paused on results of studies of certain most harmful diseases of carrot seeds, in particular, phomosis, its biology, ways and sources of spreading, interrelations with the plant-host. For the control of the cited diseases a method was developed for disinfestation of seeds by the preparattion TMTD /Tetramethylthioram disulfide/, while for phomosis - also spraying of plants with 1% Bordeaux mixture or suspension of TMTD before harvesting the crop.

For the prupose of increasing the resistance of root crops to diseases it was recommended to use phosphorus-potassium and potassium fertilizers. A system of measures was suggested for the control of onion foot rot - flame drying of onions at the early dates, preplanting disinfection of seeds, and others. As means for control of powdery mildew of cucumbers in hotbeds and hothouses it was recommended to use the new effective preparation "Phygon" instead of the presently used colloidal sulfur or copper sulfate. An important role in the control of anbury clubroot of cabbage was disclosed in planting the seedlings in peat cube-shaped blocks without any addition of humus or earth, which may be infected; of great importance is also the utilization of resistant cabbage varieties.

In the report "News in the Control of Pests of Vegetable Crops" B. A. Gerasimov (NIIOKH) pointed to the specific requirements demanded of poison chemicals by vegetable growers: insecticides must be nonpoisonous to men and animals, or must quickly lose their poisonous properties, must be used at times and by methods by which the taste qualities of vegetables will not be impaired. Wide application must be found for prophylactic treatment of seeds, cabbage seedlings and onion sets by poison chemicals; it would also be expedient to substitute DDT and Hexachloran with phosphoroerganic preparations (thiophos, malathion "Vofotox"). In the system of protective measures, under conditions of hotbeds and hothouses, an important place must be assigned to disinfestation of hothouses and hotbeds by the aerosol method with the aid of smoke spots, as well as by utilizing new promising preparations for spraying the plants (methylethylthiophos, malathion, "efirsul'fonat" /4-chlorophenyl-4-chlorobenzelsulfonate/).

Professor S. M. Tupenevich (VIZR /All-Union Scientific Research Institute for Plant Protection/) in his report on prophylactic measures for protection of vegetable crops from diseases paid attention /Begin p.58/ to great losses (up to 15%) of the yield from diseases of vegetable crops and to the important role of agrotechnics in their lowering. In the system of prophylactic measures, in the opinion of reporters, the essential point is - to grow healthy seeds and sprouts (in nutrient pots of peat-manure mixture with the addition of cultures of the bacterial fertilizer AMB), to introduce efficient crop rotations, correct use of fertilizers, control of weeds, system of soil tillage, which helps in the development of saprophyte fungi-antagonists.

I. D. Shapiro (VIZR) pointed to considerable losses of vegetable crops from pests, which come up to more than 20 mln of centners annually in the open ground in the Soviet Union as a whole. For cabbage and cucumbers alone they comprise 25-30% of the yield, while a chemical protection, with its correct organization, gives an increase in the yield of cabbage, in different zones, from 65 to 300 c/ha. Under conditions of the north-west zone dusting of seedlings with DDT and HCH is being conducted systematically, also introduction of HCH into the mass of peat-humus pots, watering of seedlings with a Hexachloran suspension during the period of transplantation and later on.

At the Horticultural Section

Along with other important questions measures were discussed that are directed to the improvement of plantings' protection. The First Secretary of the Crimean Oblast' Committee of the Party, V. S. Komiakov, has informed, that in the oblast' as a result of wide application of leading measures of agrotechnics and chemical substances, including the newest ones, gardens on large areas are almost entirely free from fruit moths, mites and other pests and diseases, owing to which total harvests of fruits of the highest quality were considerably increased, and additional profits, to kolkhozes and sovkhozes, in 1958 exceeded 21 mln. rubles.

Agriculturists I. V. Shilov (Liptsk oblast') and I. V. Nikolaenko (Moldavia) told about the experience of growing high yields of fruits and its protection from pests and diseases. In the report of Professor E. E. Savzdarg an analysis was given of the existing achievements and suggestions were introduced about effective measures for the control of pests of fruit and berry crops.

Among the resolutions adapted at the Session it was recommended to scientific-research institutions to make more precise and further on to improve the protective measures in the nurseries, and in young and in fruit-bearing orchards, including also the new methods and means, applicable to local conditions. Particularly, it was pointed out, that spraying the fruit trees during early spring with strong emulsions of mineral oils must be regarded as an extraordinary measure, which is needed only during liquidation of especially dangerous foci of overwintering pests, for instance of the San Jose scale. At the same time it is better to use dinitroorthocresol (or its mixture with petroleum oils) as a poison of a more universal action. Serious attention was paid to the prevention of bringing from without, as well as to spreading of many dangerous local pests and diseases, with the planting material on the basis of improvement of the output of healthy plants from the nurseries.

It was recognised as necessary to increase the production of powerful blower sprayers and a wider use of aerosols, utilising also the helicopters, to sharply increase the provision of individual orchards with chemical substances packed in small containers, as well as providing more perfect apparatus for individual orchards.

Delay by medical-sanitary organizations in giving conclusions about permissible residual amounts of the new effective poisons as well as about hygienic conditions of their application, which delay their introduction into practice was mentioned. It was recommended to speed up the testing of new chemical substances, the development of biological and agrotechnical methods, development of resistant varieties, and studies of virus diseases of fruit and berry crops.

At the Section of Viniculture

Two reports were made: by Professor D. D. Verderevskii "About Protection of Grapes from Pests and Diseases in USSR" and by Professor Ia. I. Prints "About Effective Measures of Control of Pests of Grapes". Questions about the protection of grapes to one or another extent was touched upon in another addresses also. Exclusive importance was stressed about control of phylloxera, grape berry moths, moth Theresia ampelophage, grape scale, golden weevil, spider mite, mildew, fungus Erisyphe oidium, leaf spot, berry rot, caused by Botrytis fungi, and others.

D. D. Verderevskii pointed out that mildew infection alone during some years in certain localities cuts down the yield of grapes up to 50%, and fungus Erisyphe oidium - up to 10%. The speaker suggested the use of a complex of measures for the control of mildew: destruction of the overwintering infectious source, control of the primary and secondary infections of plants during vegetation, spraying and dusting with copper oxychloride instead of the Bordeaux mixture (lime should be omitted) or dinitrorodanbenzene together with copper oxychloride, or zineb in a 0.5-0.75% concentration; spraying the vineyards on dates which are established according to data of observation of the signalization service; cultivation of vine varieties that are resistant to the predominant pests and diseases.

In the report of Professor Prints attention was drawn to the importance of protection of vineyards, from infection with phylloxera, which are yet free from it; to conducting chemical control in regions of its spreading, complete liquidation of small foci, and in case of further spreading - utilization of a method of its liquidation, while preserving the bush, by means of one-two layer introduction of fumigants into the soil. One can recommend for these latter ethylene chloride or clarified heel of ethylene chloride, together with para chlorobenzene, and new preparations (hexachloro-butadiene, DD /mixture of 1.3-dichloropropene $CHCl = CH - CH_2 Cl$ (50-70%) and 1.2-dichloropropane $CH_3 - CHCl = CHCl - CH_2 Cl$ (30-50%)/*); it is also necessary to intensify the work of cultivation of varieties, which have a group resistance to phylloxera, mildew, Erisyphe oidium, Botrytis fungi, which would be winterhardy and high yielding.

* Translator's note: DD formula taken from P. V. Popov's "Handbook on Poisonous chemicals", page 229.

The chief agriculturist of the sovkhoz "imeni Lenina", in Anapa raion N. T. Panych told that on the farm there are 1,000 ha of vineyards, and that they are systematically and successfully protected from diseases and pests.

The resolutions made by the Session oblige VIZR together with professional institutions for viniculture to develop during the next 2 years a system of anti-phylloxera methods applicable to different zones; it is necessary to liquidate phylloxera in 1959-1960 in the Anapa region in order to prevent the danger of its spreading to new plantings and also to preserve from infection the scion-rooted grape crops; to liquidate in 1959-1961 all the plantings of hybrids - direct producers on the territory of North Caucasus, to introduce together with the grafted crops the scion-rooted, utilizing sand and sandy loam soils for all standard varieties, and on light and medium clayey soils to cultivate the comparatively phylloxera-resistant varieties with a periodic fumigation of the soil.

(in full)
vg/M

Zhukovskii, P. M., and Rodionova, N. A.

Sintez kul'turnykh tipov 42-khromosomnykh pshenits, ustoichivykh k bolezniiam.

/Synthesis of cultivated types of 42-chromosome wheat resistant to diseases/.

Trudy po Prikladnoi Botanike, Genetike i Selektsii, vol. 30, no. 3. p.271-277. 1957. 451 R92.

(In Russian)

At the present time among the varieties and species of wheat the overwhelming majority of them are nonresistant to such diseases as species of rust, smut and powdery mildew.

All the countries on earth, which cultivate wheat, are engaged in stubborn struggle while breeding resistant varieties; nevertheless, as a rule, such varieties prove to be only temporarily resistant owing to the appearance of new, more aggressive physiological races of parasitic fungi. But the matter stands far better with some species of wheat. It is known, that such species as Triticum Timopheevi, Tr. fungicidum, Tr. carthlicum, Tr. monococcum stand out by their natural resistance to diseases. This characteristic is inherent to them as species. However, these species, except Tr. carthlicum, are not the cultivated types of wheat, and Tr. carthlicum has poor baking qualities. The remaining three species are distinguished by the brittleness of the spike's stalk and their grain is difficult to thresh out. The most valuable species of wheat is the 42-chromosome soft wheat. As are all the other 42-chromosome species of wheat, it appears, as a species on the whole, to be nonresistant to diseases. As the problem of VIR /All-Union Institute of Plant Industry/ is to accumulate as wide initial material as possible for selection, we resorted to an artificial creation of immune material in

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42-chromosome wheats of the cultivated type that is to synthetic introduction.

Widening of the initial material in 42-chromosome wheats (nonresistant, as a rule) for their selection for immunity can be produced by a method of remote hybridization, since the history of plant growing on earth did not provide humanity with immune 42-chromosome wheats. The above cited four resistant species do not belong to the group of 42-chromosome wheats. In order to create really cultivated types of 42-chromosome wheats, which would have a sharply expressed resistance to diseases, it was necessary to resort to a complex hybridization with truly immune species of wheat (Tr. Timopheevi and Tr. fungicidum), but which, unfortunately, are not characterized by a cultivated structure (they have a brittle spike during ripening, and the grain is very hard to remove from the spikes). Tr. carthlicum is a comparatively cultivated species with a rugged spike and the grain is easy to beat out. A new genus in cereal systematics, Haynatricum was also utilized; it is monotypical, synthetic, quite uncultivated, but it is a 42-chromosome type and resistant to diseases. The following species and forms took part in crossings:

1) Tr. fungicidum Zhuk "griboboinaia" /fungicidum/ wheat, 2 n = 56) (fig. 1) a new synthetic type, amphidiploid, obtained from crossing the most immune species of wheat - Tr. Timopheevi Zhuk. (2 n = 28) and Tr. carthlicum Nevski, variety fuliginosum Zhuk., /Begin p.272/ wheat carthlicum (2 n = 28); the latter is resistant to powdery mildew and is only slightly infected by leaf rust.

Plants of "fungicidum" wheat are of spring type, late-ripening, with sturdy straw. The spike is awned, feathered, black; the grain is large, hyaline, very elongated, the absolute weight up to 70 grams; it is crumpled often, but it is possible to make a selection for well filled grains; hard to beat out; fertility is slight in the south under dry conditions, and good in non-chernozem zone. Resistance to disease is expressed very clearly.

2. Haynatricum Zhuk. genus novus (2 n = 42). It is a new genus of cereal, a natural amphidiploid between einkorn /"polba"/ and Haynaldia (Tr. dicoccum farrum Al. X Haynaldia villosa Schur.). These are spring plants early-ripening, strongly covered by a wax coating, gray; the spike is long, narrow, awned, yet before ripening it breaks up into spikelets. The grain is long, slim, hyaline; is hard to beat out. It is of interest in selection for immunity owing to its resistance to powdery mildew and a slight susceptibility to leaf rust.

Title of figure 1. Species of "griboboinaia" /fungicidum/ wheat (2n = 56).

Title of figure 2. Ball-grained /sphaerococcum/ (a) and broad-leaved (b) wheats.

3. Wheat Tr. sphaerococcum Perc., variety globosum Perc. (2n = 42, figure 2a) is cultivated in /Begin p.273/ India. Only spring forms are known. Plants are undersized, non-lodging, with exclusively strong straw. Leaves are short, sticking up. Spikes are thickset, of an inflated type; grain is spherical, very well filled out. It is infected by fungus diseases, especially by powdery mildew.

4. Tr. aestivum L. ssp. amplissifolium Zhuk. (2n = 42, figure 2b). It is a broad-leaved wheat, cultivated in Central China. It is spring wheat, early-ripening. Attracts attention by the width of the leaf blade, by the sharply expressed clavate type of spike, multiflorousness of spikes and resistance to lodging. Is infected by fungus diseases.

5. Tr. aestivum L. (2n = 42): is a soft wheat: a) barrel-shaped wheat. Obtained by means of crossing the ball-grained and soft wheats (Tr. aestivum L. var. submeridionale X Tr. Sphaerococcum Perc. var. echinatum Perc. 2n = 42). Is characterised by a resistance to lodging and large, barrel-shaped grain.

is infected by diseases. b) Lutescens 62 (Tr. aestivum L. var. lutescens cv. 62; 2n = 42) is of known standard, widely prevailing in production.

Thus, in the work of creation of varieties of wheat, resistant to disease, were utilized both the immune species and the susceptible, but which were characterized by many other valuable properties in the economic respect (resistance to lodging, high yielding capacity and others).

Interspecific hybridization of the "griboboinaia" /Tr. fungicidum Zhuk./ wheat with the soft, ball-grained and broad-leaved, and intergeneric hybridization of Haynatricum with the soft wheat, were conducted with the aim of joining in hybrids of high resistance to diseases, peculiar to Tr. fungicidum and Haynatricum, and the productivity of the soft and broad-leaved wheats and nonlodging ability of the ball-grained. In the following generations backcrosses were utilized, that is, repeated pollinations of hybrids with the pollen of the paternal species.

Studies of the resistance of plants to diseases were conducted under conditions of natural and artificial infection; besides this a provocative date of sowing was applied (14 days later than usual). The susceptibility of plants was determined according to the N. I. Vavilov's scale. Intensity of spreading of diseases was compared with phases of plant vegetation. In case of individual variability in one family only the least infected plants were utilized for further work.

The strongly susceptible variety - Tulun 70 was planted on both sides of each tested specimen. This provided a uniformity in the infection's hitting the plants and gave a possibility with a greater authenticity to compare data on the degree of plant infection. This is especially characteristic for the early phases of plant development. Therefore individual hybrid families were additionally tested for age resistance to diseases under conditions of artificial infection.

Rust for inoculation of plantings was collected in the field by means of shaking infected wheat leaves over a funnel in a test tube or by carefully removing the pustules with a lancet. Directly before inoculation a small amount of water was added to the test tube containing rust uredospores, and carefully stirred. Before the application of the spore suspension the plants were copiously sprayed and watered with water. The spore suspension was applied with a small brush or a lancet to the center of the upper leaf of each plant. After the application of the inoculum a repeated spraying with water was conducted; after this the boxes with plants were covered up for 48 hours with booths made of cellulose film, which were preliminarily moistened inside with wet paper. High temperature and moisture /Begin p.274/ created good conditions for infection, which began to appear already on the 8-9 day after the application of the inoculum. The plants were inoculated twice: during the formation of the second leaf and at the beginning of the heading stage. Evaluation was conducted 10-12 days after inoculation when on all the plants a visible demonstration of the disease took place.

Inoculation of plants with fresh conidia of powdery mildew were conducted during the booting stage and the phase of milk ripeness of the grain. In order to classify the hybrid material, according to economically valuable properties, the resistance to lodging, bushiness and height of plants, form, length and compactness of the spike, number of spikelets and grains in the spike, form and fullness of grains, fertility of the spike and weight of 1,000 seeds were evaluated. Individual selection of best plants was conducted annually.

For cytological analysis the experimental material, after sprouting, was cooled on ice; this provided for the contraction of chromosomes; fixation of the seed roots was conducted according to Navashin; cuts on the microtome had a thickness of 14 millimicrons; staining - by iron hematoxylin, according to Heidenhain. Further treatment of the material was conducted by usual means of microtome technique.

Results of research have shown, that the majority of hybrid families of the combination *Tr. fungicidum* X *Tr. sphaerococcum* var. *globosum*; in F_1 backcross pollin /sic/ *Tr. sphaerococcum*, under conditions of natural and artificial infection, showed either full resistance to rust species and to powdery mildew or were infected by them only slightly (Figure 3).

Title of figure 3. Immune hybrids of "griboboinaia" /*Tr. fungicidum*/ wheat X ball-grained /*Tr. sphaerococcum*/ wheat during the first generation in backcross with pollen of ball-grained /*Tr. sphaerococcum*/ wheat.

Families, in the formation of which took part the *amplissifolium* wheat, had a different degree of susceptibility to diseases. Among them were met both the resistant families as well as those highly susceptible; often /Begin p.275/ a considerable differentiation in resistance (from 0 to 4 points) was observed in the limits of one family. A diverse susceptibility to diseases was shown by families of the combination (*Haynatricum* X *Tr. aestivum*, variety *Lutescens* cv. 62) X *Tr. durum* ssp *horanicum*. The majority of them were strongly infected, especially after the provocative time of sowing and artificial infection.

All the families of the combination *Haynatricum* X *Lutescens* 62; F_1 X *Horanicum*; F_3 repeatedly X *Lutescens* 62, and the combination *Tr. fungicidum* X barrel-shaped, were infected to a great degree (to 3-4 points).

Group resistance to rust species and powdery mildew was shown by families 7-12, 15 and 55 of the combination *Tr. fungicidum* X *Tr. sphaerococcum* variety *globosum*; in F_1 backcross with pollen of *Tr. sphaerococcum*. During artificial infection in individual plants of these families, on the place of inoculum application, either necrosis appeared or single, weakly developed pustules of leaf rust and tufts of powdery mildew, the latter disappeared quickly and did not recommence later on. Testing these families at different geographical points[1] has shown that the majority of them, under conditions of Krasnodar krai, show a small degree of infection to leaf rust (from 0 to 1 point). A stronger infection (from 1 to 2 points) was observed at the Derbent Control Point after a pre-winter planting. No infection of these families with powdery mildew, stripe and stem rusts was observed in any of these places.

Hybridological analysis of plants of the combination _Tr. fungicidum_ x _Tr. sphaerococcum_ variety _globosum_, in F_1 backcross with pollen of _Tr. sphaerococcum_) has shown that the majority of them in many of properties and characteristics swerved to the side of parental species and components of the amphidiploid.

Length of the vegetative period of hybrid families of this combination does not show substantial divergencies, when compared with the initial species. Thus, for most of them the number of days from sprouting to heading is greater than for the ball-grained /_Tr. sphaerococcum_/ wheat, but is smaller than for the _fungicidum_; but the duration of phase of development from heading to ripening is shorter than for the ball-grained /_Tr. sphaerococcum_/ and the _fungicidum_, it is rarely more or equal to the latter.

Single early-ripening plants, which gave rise to new families (7b 8 and 11a) with a shorter period of vegetation than both parents, were isolated during the process of work.

In the size of leaves most families swerved to the side of the ball-grained /_sphaerococcum_/ wheat (short, wide); there were also families with long slim leaves as in the _fungicidum_. Individual families combine the close hairiness of leaves, natural to the _fungicidum_, with the width of leaves of

(1) At the Krasnodar State Selection Station studies of resistance of hybrid seeds were conducted in the laboratory of P. P. Luk'ianenko; at the Kuban Experiment Station and at the Derbent Control Point by the co-workers of VIR.

the ball-grained /sphaerococcum/. In toughness of the straw many families swerved to the side of ball-grained wheat and thus do not lodge; in height - they take a medium position between the ball-grained and the fungicidum. Coloration of the spike is either black, as of the fungicidum, or white as of the ball-grained; but the most often seen is the smoky gray. In all hybrid families the form of the spike is either cylindrical or spindle-like, whereupon the front is considerably wider than the side. It is interesting that the parental species have a reverse correlation of sides. Consequently, according to the characteristic in question, hybrid families fully swerved to the side of carthlicum wheat, the influence of which was visibly seen also in the formation, of an awned barb or awn on the spike's scale in most plants. /Begin p.276/

It is necessary to mention a specific type of segragation in the offspring from crossing with interspecific amphidiploid. As it was already mentioned the fungicidum wheat is an amphidiploid from crossing carthlicum with Timopheevi whereupon the phenotype of the carthlicum wheat was fully absorbed in the amphidiploid (2n = 56). Meanwhile, in hybrid offspring of the studied combination the majority of resistant and homozygote families are of a clear type of the carthlicum wheat, but the number of chromosomes (2n = 42) (figure 4) corresponds to the sphaerococcum, what, in our opinion, can be explained by backcrossings.

Title of figure 4. Chromosomes of a resistant hybrid of the "griboboinaia" /fungicidum/ wheat with the ball-grained /sphaerococcum/, backcross with pollen of the ball-grained /sphaerococcum/.

The form of grains in hybrid plants does not correspond either to the fungicidum (long), or to the sphaerococcum (ball-grained). It varies from lanceolate to barrel-shaped; sometimes grains are met that are angular, ribbed or with a hump. Seed vessels of many families have at the top a slight wrinkleness and a light amalgamated lustre - properties characteristic to grains of the carthlicum wheat. The coloration and consistency of grains in most cases corresponds to parental species (red semi-hyaline).

Together with a swerving of individual families, in many properties, to the side of parental species and components of the amphidiploid, new growths also took place, to the number of which refer: 1) characteristic horizontal placement of leaves; 2) red coloration of the spike; 3) white grains.

In their resistance to diseases the best families of the given combination stand above the fungicidum and approach the Timopheevi wheat.

Combinations Tr. amplissifolium X F_6 (Tr. fungicidum X Tr. sphaerococcum variety globosum; in F_1 backcross with pollen of Tr. sphaerococcum), and the combination reverse to the given: F_6 (Tr. fungicidum X Tr. sphaerococcum variety globosum; in F_1 backcross with pollen of Tr. sphaerococcum) X Tr. amplissifolium - is more complicated since five specific genotypes are combined in them. Their families are characterised by a large range of both biological and of morphological properties. Length of the vegetative period in hybrid families of the combinations in question originally was greater, than in the amplissifolium and corresponded to the fungicidum. During the succeeding years, owing to selection for early-ripeness, the period of vegetation of most families was shortened, compared with the fungicidum, by 3-4 days. This was accomplished, basically, because of a much faster passing by the plants of phases of development from heading to ripeness.

Individual hybrid families have much in common with plants of the preceding combination (Tr. fungicidum X Tr. sphaerococcum variety globosum; in

F_1 backcross with the pollen of Tr. sphaerococcum): red semi-hyaline grain, presence in somatic cells of 42 chromosomes and others. Nevertheless, unlike them, the majority of families of the combinations in question has either a wide lateral side of the spike (deviation to the side of the fungicidum) or an even width of both sides, as in the amplissifolium, which is explained by the multiflorousness of the spikelets. The influence of amplissifolium has been told visibly also on the formation in most plants of wide and long leaves, in the clavate form of the spike and the inflated spikes. /Begin p.277/

In the compactness of the spike the individual families swerved to the side of the sphaerococcum, in multiflorousness - to the side of amplissifolium. Many families are resistant to lodging and have a high bushiness. In resistance to diseases - a large diversity even in the limits of one family (individual variability).

Individual families of the three cited combinations were brought to homozygosity, they are fertile, with comparatively large seeds. Weight of 1,000 grains of best hybrid families ranges from 34 to 54 grams; length of the main spike from 6-12 cm, number of grains in the spike from 29-72, productive bushiness from 2 to 6. The majority of isolated hybrid families is resistant to lodging and to fungus diseases; selection has fully removed the brittleness of the spike stem and the difficulty in threshing out the grains.

Real cultivated forms of 42-chromosome wheats were obtained, which are resistant to diseases. Their utilisation as components for crossing will considerably facilitate further selection work for immunity, since hybridisation with resistant to disease, but little cultivated, species of wheat as Timopheevi, spelt and others is connected with the appearance in the offspring of many negative characteristics, which sharply reduce the productivity of hybrids, not speaking about the fact that the crossing proper of diverse-chromosome varieties is accomplished with great difficulty.

Work on developing, testing and propagation of best families of interspecific hybrids of wheat is being continued.

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Povyshenie plodorodiia pochvy-vazhneishaia zadacha sotsialisticheskogo zemledeliia.

/Increasing soil fertility - an important task of socialistic agriculture/.

Vestnik Sel'skokhoziaistvennoi Nauki, vol. 4, no. 1. p.62-70. Jan. 1959. 20 V633.

(In Russian)

The publication "Controlling figures for the development of the national economy of USSR for the years 1959-1965" projects a grand program of works for a sharp rise of agriculture in our country. It is planned, at the end of the next seven years, to provide a yield of grains of 10-11 billion pood /pood = 36 pounds/ of sugar beets - 70-78 mln tons, cotton fibre - 5.7 to 6.1 mln tons, seeds of oil crops - up to 5.5 mln tons. Total yields of agricultural producttion will be increased by 1.5-2 times. "Now, when the Soviet people, under the leadership of the Party, have carried out a great work of reclamation of virgin and waste lands, of equipping agriculture with the newest technique and providing it with qualified workers, when seed growing has been considerably improved and the production of chemical fertilizers is being increased, the most important national economic problem has arisen in its full magnitude, namely, increasing the yielding capacity of all agricultural crops"**.

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** From the "Controlling Figures for Development of National Economy of USSR for Years 1959-1965". (Theses of the report of Comrade N. S. Khrushchev at the XXI Convention of the Communist Party). Gospolitizdat, 1958, p.53.

In the theses of the report of Comrade N. S. Khrushchev it is further said: "During the forthcoming seven years a sharp improvement in the utilisation of land is planned as basic means for production in farming".** /See second footnote on preceding page/.

In USSR of late, a great work has been carried out on reclamation of virgin and waste lands. This work will be conducted in the future also. Nevertheless, at the present time the main problem of agriculture in USSR is to sharply increase the yielding capacity of agricultural crops.

It is necessary to utilise all the resources on which the yielding capacity depends in order to sharply increase the productivity of agricultural plants: correct agricultural technique, good seeds, fertilizers and many others. Among these methods of foremost importance are the procedures, which are directed to the increasing of soil fertility.

The question about soil fertility has an ancient history. People, yet at the dawn of agriculture, have noticed that the yields of plants depend on the quality of the soil. Interesting thoughts on the questions of fertility were expressed in ancient Rome. The eminent agricultural writer of ancient Rome, Columellia, argued about problems of fertility with his contemporary, Tremelius, who demonstrated that the soil can become impreverished in the course of time, /Begin p.63/ that it, like men, must become old, and, like a woman, becomes barren with time. Columellia did not share this point of view. He wrote in a rich and descriptive style: "The earth is not an elderly woman. No - it is a virgin, always young, beautiful, always fresh, youthful, always able to be fruitful, if only one knows how to cherish her youthfulness, to preserve, to maintain its tender, vivacious life"*. In order to preserve

* Ia. A. Linovskii. "Critical Review of Opinions of Scientists about Conditions of Fertility of the Earth with an Application of the General Deduction to Agriculture. "Published by Moscow University in 1844.

the fertility of the soil Columellia recommended to fertilise it and to break it up (plow).

It is possible to judge from the attention, which was paid to this question by the classics of Marxism-Leninism, how great is the importance of soil fertility. Karl Marx wrote: "Together with the development of natural sciences and of agronomy the fertility of earth changes also, since the resources change with the aid of which the elements of the soil become suitable for immediate utilisation"**. Developing this thought, Karl Marx wrote: "With a quick development of the productive strength all the old machines must be replaced by more profitable ones, that is must be discarded altogether. The soil, on the contrary, is being improved constantly, if one handles it properly".***

In the history of agronomical science the opinion about the fertility of the soil has changed many times. There was a time when it was thought that plants live on humus alone. During the forties of the last century this wrong theory was refuted. The German scientist Liebich, in 1840, put forward a theory of mineral nutrition instead of the humus theory of plant nutrition. According to this theory fertility depends on the amount of mineral nutrient substances, that are contained in the soil in a state accessible to plants. For many years in all countries of the world soil fertility was measured by the stores of nutrient substances in it. The Soviet scientist, Academician V. R. Vil'iams, attracted attention to the fact, that soil fertility depends not alone on the presence of nutrients but also on the reserves of moisture. V. R. Vil'iams understood under fertility of soil the ability of the soil to provide requirements for the plants' life by a simultaneous and joint presence

** Karl Marx. Capital, vol. 3, p.783
*** Karl Marx. Capital, vol. 3, p.794, 1949.

of two factors of their existence - water and food. Such an understanding of fertility was a considerable step forward.

Up to the present time science has accumulated new data, which give a basis to think that soil fertility depends not alone on the presence of nutrients and of moisture. Many cases are known when there is a sufficient amount of nutrient and of moisture in the soil, but the yields obtained are very low. For instance, in saline soils, by means of introduction of fertilizers and of water through irrigation, it is possible to provide plants with nutrients, but still it is impossible to obtain a high yield. Consequently, such a soil provides the plants with nutrients and water, but does not possess high fertility. The same phenomenon can also be observed in the non-chernozem zone of USSR. On highly acid soils, regardless of the provision of plants with nutrients and water, it is impossible to obtain a good yield of sugar beets, barley, wheat, clover and other crops. In the present case the soil has a sufficient amount of nutrients and water, but low fertility. The low yield of sugar beets, barley, wheat, clover and of other crops is explained by excessive acidity of the soil and other unfavorable properties. /Begin p.64/

The richest in the world and the thickest chernozems are to be found in USSR. With artificial watering these soils have quite a sufficient amount of nutrients and moisture. But under such conditions such plants as tea bushes will not grow. This is explained by the fact that a tea bush grows well only on acid soils. Such plants as flax "dolgunets" L. indenisceens, var. elongata Vav. et Ell. and lupine also do not grow well on chernozem soils. Soil fertility is closely connected with the peculiarities of plants. One and the same soil is fertile for one kind of plants, and nonfertile for others. Thus, highly acid soils of the non-chernozem soil are fertile for spruce, pine tree, alder, horsetail, sheep sorrel, spurry and other plants, but are nonfertile for sugar beets, alfalfa, esparsette, and many other agricultural crops.

It was seen from one experiment, which we conducted on an acid turf-podzol soil with plantings of clover and timothy to what extent the soil fertility is connected with biological peculiarities of cultivated plants. In this experiment, in order to increase the fertility, many different fertilizers were introduced into the soil. Under the influence of the nitrogen fertilizer the yield of timothy increased by 40%, while clover was fully destroyed under the influence of the nitrogen fertilizer (without the nitrogen fertilizer clover grew poorly, but survived nevertheless). Thus, one and the same soil, containing similar amounts of nutrients and moisture, when planted over to a grass mixture, with an introduction of the usual dose of nitrogen fertilizer, proved to be fertile for timothy and nonfertile for clover.

For our other experiment on highly acid turf-podzolic soil, during the course of four years we introduced a similar amount of different mineral fertilizers under oats, turnips and lupines having all other conditions identical. Soil and climatic conditions for all the crops were similar, but results were entirely different. On the poor turf-podzolic soil, after introduction of nitrogen fertilizers, the yield of oats, under the influence of nitrogen has increased by 60% and the yield of turnips was sharply reduced. It is clear from data cited above that soil fertility is connected in the closest way possible with the peculiarities of the plants and depends not alone on the stores of nutrients and water in the soil but also on the combination of all these properties, which produce an influence on the development and growth of the given plant.

The level of the yield is the indication of soil fertility: the greater the yield the higher the fertility of soils. The soil fertility depends also on the reaction of the environment. Excessive acidity, as well as excessive alkalinity, lower the yield of plants. In many soils there are substances poisonous to the plants. Thus, in turf-podzolic soils with high acidity there are free forms of aluminum, manganese and iron, which are also poisonous at high concentrations. In the southern regions of the Soviet Union there are many saline soils; an excessive amount of salts in them makes these soils infertile.

Soil fertility depends not only on the general amount of nutrients, but also on their correlation. At a full provision of plants with nutrients an excessive amount of one or several of them reduces the fertility of the soil.

At the time when V. R. Vil'iams wrote about soil fertility, under nutrients, which proceed from the soil, were understood to be the ash substances and nitrogen. At the present time the Soviet scientists have ascertained that plants utilize carbon dioxide not alone from the air, but also from the soil. Consequently, the plants' yield depends also on carbon dioxide present in the soil.

Microorganisms influence soil fertility to a large degree: they convert nutrients, inaccessible to the plants, making them accessible. Microbiologists have ascertained that around the plant roots accumulates /Begin p.65/ a great amount of microorganisms. They settle around the plant roots for the purpose of utilizing the discharges of plants as food. Reciprocal advantage is obtained from such symbiosis: microorganisms receive the food, and the plants are freed from wastes, which were formed as a result of metabolism. From this point of view microorganisms, in respect to plants, play a role of waste removers.

During the latter years it was established that certain microorganisms secrete such substances which stimulate the growth and development of plants. Among the products of metabolic activity of microorganisms, which sharply stimulate the growth and development of plants one should mention gibberellic acid. Experiments of the latter years have shown, that stimulators of plant growth are secreted by a whole series of microorganisms. Nevertheless, not all the microorganisms are of benefit to the plants. Among soil microorganisms there are such that are harmful to the plants and they reduce the fertility of the soil. The negative activity of certain microorganisms consists of the fact, that they enter the plant roots and cause various diseases. Other microorganisms, in the process of their vital life, secrete substances that are poisonous to plants. Thus, microorganisms produce a twofold influence on soil fertility when: converting nutrients of the soil to a state available to the plants and removing the products of plants secretions they increase the fertility, but secreting poisonous substances during the process of their own metabolism, they decrease the soil fertility.

Soil fertility depends also on the physical properties. In structural, cultivated soils, where there is a sufficient amount of air, the plant roots obtain an adequate amount of oxygen. In a structureless, compact soil the plant roots lack oxygen; the presence of the compact horizon in solonets hinders the growth of the root system of plants; dissimilar coloration of the soil produces influence on its thermal characteristics. Thus, the determination of soil fertility, which existed to the present time, as its ability to satisfy the requirement of plants in food and water, must be held to be antiquated, since the fertility of the soil, that is, its capacity to produce a harvest, depends not only on the presence in it of food and water, but on the whole combination of characteristics, which produce an influence on the growth and development of plants. Therefore, when increasing soil fertility, it is necessary to improve not only the nutritive and water regimes of the soil, but also other properties of the soil.

Until recently, it was thought that on low productive soils the poor harvest was conditioned by the fact that plants of small size grow there: the cereals have a weakly developed straw, fine spikes and sickly grains; cabbage - small heads, beets - small roots, and so on. Meanwhile the research of latter years has shown, that low fertility of soils is accompanied not only by small sizes of individual plants, but also by their total loss: for instance, on acid peat-podsolic soils, which are characterized by insufficiency of nutrients, by excessive acidity and excess of free forms of aluminum and manganese. Under the influence of the acid reaction of the environment and of other unfavorable characteristics of the soil winter rye, winter wheat, clover, alfalfa and many other crops are lost not only during winter but also during the spring-winter frost-free period.

At the present time the main problem of agriculture is to obtain a maximum harvest from each unit of the area with minimum expenditures of labor and money. Intensive agriculture is impossible without a high soil fertility. A high level of mechanization, good varieties of agricultural plants, correct cultivation /Begin p.66/ of soils and nursing of plants and other measures of agrotechnics produce a proper effect, when they are applied on highly fertile soils.

Vegetable crops bear the name of kitchen garden crops not by accident. They were cultivated from time immemorial in gardens, on soils, which have high fertility that was achieved by systematic introduction of large doses of manure into the soil. When cultivating vegetable crops on field lands it is necessary first of all to look after a sharp increase of the fertility of soils.

At the present time the yielding capacity of vegetables is yet low in many regions. The main reason is that vegetable crops have been "taken out" from kitchen gardens to field low-yielding soils. Vegetable crops must be set out on bottom lands, on reclaimed peat bogs, and the like, that is on soils which have high natural fertility. Nevertheless there are not enough of such lands in our country. Therefore, at the present time, it is necessary to create large blocks of soils of kitchen garden type, having,in view the utilisation of mechanisation when cultivating vegetable crops and obtaining high yields.

The above said about the creation of highly fertile soils for vegetable crops fully refers also to the formation of fertile soils for such a crop as corn, which gives good results also in the non-chernozem zone but only on fertile soils.

Care about preserving and increasing the fertility of soils is needed in all zones of the Soviet Union. Even on former virgin and waste soils it is necessary to take care in preserving and increasing the soil fertility. Earlier the fallow system of agriculture prevailed in regions of reclamation of virgin and waste lands, but at the present time the chief means for increasing the soil fertility in this region is the accumulation and preservation of moisture.

Decrease in yielding capacity is often observed after several years of cultivation of cereals on virgin and waste lands. In the past this phenomenon was explained by deterioration of the soil's structure. Experiments in latter years have shown that this is far from so. Formerly it was thought that only water stable crumb, larger than 0.25 mm, is valuable for agriculture. Research of V. A. Frantsesón has shown that the crumb from 0.25 to 0.05 mm, that forms after lengthy plowing of virgin lands, is also valuable for agricultural purposes. The main cause of fertility reduction of virgin and waste lands, after its cultivation in the course of many years, consists in the fact that a great number of weeds develop as a result of improper agrotechnics. Control of weeds, by way of introduction of clean fallows, of proper agrotechnique and application of herbicides, is a powerful means for the preservation of soil fertility.

On soils, reclaimed 5-10 years ago, in regions of virgin and waste lands, is observed a large accumulation of nitrogen nitrate at a slight provision of them with phosphorus. It would be effective to introduce phosphoric fertilizers on such soils. At a present level of provision of agriculture with fertilizers it would be wise to use small doses (0.5 c/ha) of granulated superphosphate into the rows. Thus, for preservation and increase of soil fertility in regions of reclamation of virgin and waste lands, it is necessary to provide for the accumulation and preservation of moisture, for the control of weeds and application of phosphoric fertilizers.

In the Soviet Union solonets occupy over 50 mln of ha. Natural fertility of these soils is low. As much as the saline soils are very diverse, it is necessary to use various methods for their improvement. Experimental research in USSR has shown that /Begin p.67/ for a sharp increase of solonets fertility is required not alone the substitution of exchange sodium with calcium, but also cultivation of the packed horizon, removal of water-soluble salts, increase of stores of organic substances in the soil, elimination of re-salinization and conducting of other measures.

Introduction of gypsum into the soil is obligatory when reclaiming soda solonets. As the experiments of A. M. Grinchenko, O. M. Sambur, S. V. Zonn, and others have shown, the dose of gypsum can be utilized at a rate of half of that quality which is needed for the displacement of all the exchange sodium. Best results were obtained when application of gypsum was done on the background of deep tilling. According to data of M. A. Grinchenko and V. A. Pelipets, good results were obtained when introducing small doses of gypsum (2-4 c/ha) into the rows.

In solonets of Northern Caucasus, lands along Volga river, Kazakhstan, Siberia, and other regions of USSR there is often observed a high stratification of the carbonaceous horizon. On these soils it is possible to utilize self-amelioration by means of utilizing the carbonates of the soil. For this purpose the "plant-ashnaia" /deep plowing/ tilling should be utilised to the depth of about 50 cm. Deep plowing substantially increases the fertility of solonets soils. To the disadvantages of this method should be referred the fact that a biologically low-active layer of soil is brought to the surface. In connection with this it is necessary to introduce organic and mineral fertilizers, and in the presence of water-soluble salts a washing of the root-inhabited layer of soil is required.

In order to remove the disadvantages of this deep plowing the All-Union Scientific-Research Institute of Fertilizers and Agricultural Soil Science (N. K. Baliabo) suggested a new method for increasing soil fertility of medium and deep solonets by means of plowing with a three-storied plow of V. P. Moselov and T. G. Botov. The essence of the work of the three-storied plow is in that the horizon above the solonets remains basically on the surface, and the solonets and the subsolonets are stirred up and become mixed. Whereupon the solid, packed solonets horizon disintegrates and is attenuated by the soil of the carbonate layer. After the storied plowing the water characteristics of solonets are sharply improved while the fertile layer of soil remains on the surface. The experiments of N. K. Baliabo, B. S. Gatina and N. I. Elinov, under conditions of dry and irrigated agriculture, have shown that the storied plowing increases the fertility of solonets considerably greater than do the deep /plantazhnaia/ plowing and deep mellowing of the soil. According to data of these authors, the yield of hard wheat on the Malouzinskii base, Piterak raion, Saratov oblast', in 1958, after the usual plowing, comprised 12.8 c per ha, and after the three-storied plowing - 19.3 c per ha. At the kolkhoz "imeni Chapaeva", Piterak raion, Saratov oblast', after a usual plowing 8.1 c per ha were harvested, and after the three-storied - 13.1 c per ha. Still better results were obtained from the storied plowing during the experiment with irrigation, which was conducted in the sovkhoz "imeni Mikoian", Cherneiarsk raion, Astrakhan oblast' in 1953 (table 1).

Table 1.

Influence of the storied plowing on the harvest of tomatoes and cabbage

Variants of the experiment	Tomatoes 1954 c/ha	Tomatoes 1954 %	Tomatoes 1955 c/ha	Tomatoes 1955 %	Cabbage 1956 c/ha	Cabbage 1956 %
Control (plowing to 22 cm)	182	100	557	100	254	100
Three-storied plowing with plow PT-2-50 to the depth of 45-50 cm	410	225	634	114	440	173

/Begin p.68/

It is seen from table 1, that under the influence of the three-storied plowing the harvest of tomatoes, in 1954, increased by 125%, and the yield of cabbage, in 1956, - by 73%. Experiments shown that the three-storied plowing represents a fundamental amelioration of solonets.

In the zone of chernozem soils the solonets often are met in the form of small sections, around which the fertile soils are situated. In such cases one can use successfully the method of "zemlevanie" /covering with earth/ of solonets, which consists of throwing the soil from neighboring sections over the solonets. As a result of this on the solonets spots conditions are formed that are favorable to the growth and development of plants. On the whole the solonetz soils represent a vast reservoir for a further widening of planting areas.

In USSR chernozem soils, which have a very high potential fertility, occupy vast areas. The problem is to convert the potential fertility of these, the richest soils, to an effective one. Together with the correct tilling, the effective fertility of chernozem soils must be increased also by means of utilization of organic and mineral fertilizers.

Non-chernozem soils occupy about 50% of the USSR territory. Of especially great importance is the European part of the non-chernozem zone. In this spacious zone with a thick population, large cities and industrial centers, there are large blocks of cereal crops, flax "Dolgunets" /Linum elongata Vav. et Ell./ is cultivated, the planting areas of which comprise here over 80% of all the plantings of flax in the country. In the European part of this zone there are over 50% under potatoes, and under vegetables - over 30% of all areas occupied by these crops in USSR. Animal husbandry plays a large role here also. Great vegetable-potato and animal husbandry bases are being created around Moscow, Leningrad, Perm', Gor'kii, Sverdlovsk and many other cities and industrial centers. Climatic conditions in this zone are quite favorable for cultivation of a large amount of agricultural plants; there are no destructive droughts here.

Kolkhozes and sovkhozes of the non-chernozem zone obtain high and steady harvests of cereal and other crops, utilizing the attainments of science and leading practice. But the average yields of cereal and other crops are still low in this zone. Meanwhile, it is possible to obtain in this zone yields that are higher than in the chernozem zone of USSR. This is explained by the fact that in the chernozem zone and in other southern and eastern regions of the country there are not sufficient atmospheric precipitations and droughts occur very often; together with productive years, there are years of real crop failures. This does not happen in the non-chernozem zone.

In this connection one should recall D. N. Prianishnikov's opinions about the significance of the non-chernozem zone in the agriculture of USSR. In his work under the title "Reservnyi milliard" /Reserve billion/, D. N. Prianishnikov wrote: "If previously the enlargment of our plantings moved to the south and south-west, to the side of lands that do not need fertilizing, then now the greatest interest represents another direction in the spreading of the cultivated area, which is connected with a new factor - chemicalization of agriculture". "And if already the whole chernozem has been plowed, which lies in the belt of sufficient moisture, then we have to pay attention to that climatic region and to those soils solely on which Western Europe has built its intense economy, namely: to non-chernozem, which does not know any droughts and is capable, with fertilization, to give steady yields of a Danish type, that is 30c of grain per hectare."* /Begin p.69/

These thoughts of D. N. Prianishnikov have not yet lost their importance at the present time. Destructive droughts in southern regions of our country are possible now also.

The question about increasing soil fertility is of an exclusively great importance for regions of the non-chernozem zone of USSR. At the present time we have all the possibilities of radically improving the properties of peat-podzolic soils. When accomplishing the said measures, it is possible to obtain annually not one but at least two reserve billions of grain and of

* D. N. Prianishnikov. Selected Works, vol. 14, 1955, p.167-168.

other agricultural products. It is possible during a short time, to additionally obtain about 50 puds /1 pud = 36 pounds/ per hectare. In the non-chernozem zone of the European part of USSR it is possible to additionally obtain 2.25 billion puds of grain and of other agricultural products from the 45 mln ha of planted areas.

Now, when the work, enormous in its scale and economic effect on reclamation of virgin and waste lands in the East, has been accomplished it is necessary to proceed with the raising of agriculture in the non-chernozem belt. In this zone the measures for the raising of agriculture are of vast economic importance. Reclamation of this "virgin soil" must become a public job.

In order to prove that it is possible to obtain good yields in the non-chernozem belt we are citing data about productivity of cereals in Russia during the period from the year 1883 to 1912 (table 2).

Table 2.

Mean yielding capacity of cereals in the European part of Russia (in puds per "desiatina" /a unit of land measure = 2.70 acres/)

Years	Chernozem zone	Non-chernozem zone
1883-1892	34.34	37.9
1893-1902	44.39	44.8
1903-1912	46.45	46.2

It is seen from table 2, that in 25 districts of the non-chernozem belt on the average for 30 years the yielding capacity of cereals was not lower, but rather somewhat higher than the productivity in the 25 districts of the chernozem zone. The six-year experiment on varietal plots (see table 3) is just as strong a proof about the possibilities of raising agriculture in the non-chernozem zone.

As it is seen from table 3, the productivity of cereal crops in the non-chernozem belt was fairly high, and what is especially important, it was quite steady. During all the years the productivity on varietal plots in the non-chernozem belt was considerably higher than on varietal plots in the chernozem zone. On the average for six years the harvest of cereal crops in the non-chernozem zone comprised 17.37 c per ha, and in the chernozem - 13.30 c per ha. Moreover, one should point out that high yields were obtained with comparatively modest expenditures: elementary agrotechnics were maintained and for each hectare of the plowland were applied 3-4 tons of manure and 2-2.5c of mineral fertilizers.

For a radical increase of soil fertility in the non-chernozem belt it is necessary to utilize not separate measures, but their complex combination. The most important elements of this complex are: liming of acid soils, planting of perennial grasses, application of organic and mineral fertilizers, sowing of legume crops, deepening of the plowing layer and other ameliorative works.

Liming plays a great role in the increase of fertility of acid soils. This measure provides the obtaining of high yields of perennial grasses, sharply reduces the loss of winter crops, increases the effectiveness of fertilizers. During the next Seven-Year-Plan we propose to lime not less than 20 mln of ha of acid soils. /Begin p.70/

Table 3.

Productivity of cereal and legume crops on State varietal plots during years 1951-1956 (in c/ha)

Oblast'*	1951	1952	1953	1954	1955	1956	Average
Non-chernozem zone:							
Volegodskaia	19.0	19.7	17.6	15.0	20.5	18.8	-
Leningradskaia	17.2	15.8	14.4	14.6	14.6	14.1	-
Moskovskaia	16.2	20.5	13.9	13.9	21.3	17.6	-
Kalininskaia	19.3	22.2	15.8	15.3	18.4	21.5	-
The average	17.9	19.5	15.4	14.7	18.7	18.0	-
The chernozem zone:							
Voroneshskaia	16.9	17.0	14.5	12.5	25.2	15.3	-
Orlovskaia	16.0	15.4	13.2	14.5	19.9	14.5	-
Kuibyshevskaia	13.8	13.9	14.5	7.5	8.6	13.9	-
Stalingradskaia	7.6	11.8	7.3	3.7	14.5	7.5	-
The average	13.6	14.5	12.4	9.5	17.0	12.8	-
Non-chernozem zone in % to the chernozem	131.6	134.5	124.2	154.7	110	140.6	130.6

* In the table data are cited of mean productivity from the whole area of varietal plots, of which there are in each oblast' from 8 to 15. The area of a varietal plot is 100 ha.

The proper crop rotations with the planting of perennial grasses are of great importance. Unfortunately, in many kolkhozes and sovkhozes the role of grasses is underestimated. One of the causes of this was their low productivity.

During the next seven years mineral fertilizers will play an enormous role in increasing soil fertility and productivity of agricultural plants. In the year 1965 the USSR agriculture will receive, annually, over 30 mln tons of mineral fertilizers. Together with the mineral fertilizers, the organic ones will also play a large role. If at the present time we utilize about 300 mln tons of manure, then in the next years its amount will be brought to 450-500 mln t, utilizing a considerable amount of peat. Peat-manure, peat-fecal and other composts can play a great role in increasing the soil fertility. Wastes of the communal economy of cities and industrial centers are of great importance in increasing the soil fertility, so are also the green fertilizers, especially the plantings of sweet lupine, utilizing it as fodder and fertilizer. As a result of the accomplishment of the cited measures the soil fertility and the productivity of all agricultural crops will be sharply increased, what, in turn, will entail also a steep rise in animal husbandry.

Methods for increasing soil fertility represent the most important problem of socialistic agriculture of the Soviet Union.

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Trans. A-1018
(In full)
vg/M

Litvinenko, S. N.

Vysokoaktivnyi rostovyi stimuliator.

/Highly active growth stimulant/.

Vestnik Akadem. Nauk SSSR, vol. 29, no. 1,
p.81-82. Jan. 1959. 511 Ak14V.

(In Russian)

As it is known, N. A. Krasil'nikov, Member-Correspondent of the Academy of Science of USSR comparatively recently obtained and tested a preparation, similar in action to the gibberellic acid - a vigorous stimulant of growth and development of plants[1].

Just recently Doctor of Biological Science, V. I. Bilai (Institute of Microbiology of the Academy of Science of the Ukrainian SSR), and Candidate of Technical Sciences, D. A. Verner (Institute of Organic Chemistry of the Academy of Science of the Ukrainian SSR) have, for the first time in the Ukraine, obtained crystallised gibberellin from native strains of Fusarium moniliforme sheld (which were isolated from various plants, growing in Ukrainian SSR). The identity of obtained crystals with gibberellin was ascertained by the method of chromatography.

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We began the work of studying the action of this gibberellin on plants in the Botanical Garden of the Academy of Science of Ukrainian SSR.

Grassy plants were taken: short-day plants - aromatic nicotiana (Nicotiana odorata) and Chinese aster (Callistephus sinensis); long-day - gentian (Gentiana crassicaulus) and sea lavender (Limonium girardianum), as

(1) See: "Vestnik Akademii Nauk SSSR, 1958, no. 6, p.70-73.

well as shrubs - privet (*Ligustrum vulgare*) and *Pyracantha coccinea*.

The grassy plants were a week old and were in the phase of two true leaves, the shrubs - in the phase of two cotyledon leaves.

One part of the plants of each kind was treated daily with gibberellin solution in a concentration 0.0025%, and the other part - with a solution in a concentration 0.025%. The control plants received water instead of the gibberellin solution.

Treatment was conducted according to a method used by Professor M. Kh. Chailakhian: one drop of the stimulant's solution was applied daily to the point of growth with a pipette.

All the plants were kept in the hothouse.

Already at the end of the first week of treatment it became evident that the experimental short-day plants overtook the control in growth and development.

At the end of the second week the effect of stimulants appeared especially prominently in *Nicotiana odorata*: the control plants were yet in the phase of the rosette, while those treated with gibberellin had a stem 7-10 cm long with a mass of flower buds at the top. The leaf blades in experimental plants were larger, wider, their petioles longer than in the control plants.

Twenty eight days after the beginning of the experiment that is, at the end of the fourth week, the tobacco plants, treated with gibberellin, started blooming, having stems 15-20 cm long. /Begin p.82/ But the control plants were yet in the phase of the rosette.

It should be pointed out that the difference in concentrations of gibberellin solution (0.0025% and 0.025%) was not reflected in the tempos of growth and development of plants.

The long-day plants did not react to the treatment with the stimulant: during the course of 7 weeks there was no difference detected in the growth and development of experimental and control plants.

As regards the shrubs, gibberellin produced on them a noticeable effect: in both variants of treatment the plants were 10-12 cm tall and had 8 to 10 true leaves while the control plants only grew to 3-3.5 cm in height and had only two cotyledon leaves.

Thus, one can think that gibberellin, obtained by the Ukrainian researchers, proved to be a highly active growth stimulant. The technology of its production is being developed now.

At the same time it is necessary to continue the studies of the effect of gibberellin on the plants. It is necessary to establish the optimum doses and the best methods of treatment of various plants with this stimulant; the necessary agrotechnical background for the treated plants, which are developing under accelerated tempos. It is also important to undertake a comparative study of the effect of gibberellin and auxins on plants. And, finally, it is necessary to test gibberellin according to all indices under production conditions.

The study of mechanism of action of gibberellin in connection with the metabolism of plants will present a great theoretical and practical interest.

Title of figure: The experimental plant before and after treatment with gibberellin.

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Ierusalimskii, N. D.

Simpozium po nepreryvnomu kul'tivirovaniu mikroorganizmov.

/Symposium on continuous cultivation of microorganisms/.

Akad. Nauk SSSR. Vestnik. vol. 28, no. 11. p.73-74. Nov. 1958. 511 Ak14V.

(In Russian)

Czechoslovakia's Academy of Science organized the first Symposium on the Question of Continuous Cultivation of Microorganisms. In the work of the Symposium, which proceeded in Prague, June 23 to 28, took part 119 Czechoslovak scientists and 30 representatives of other countries, including USSR. The Soviet delegation was composed of N. D. Ierusalimskii, E. A. Plevako, M. Ia. Kaliuzhnyi, K. P. Andreev and N. S. Ternovskii.

Sixteen reports were heard at the Symposium.

As it is known, with the usual method of cultivation, microbes grow in an irremovable /nesmeniaemyi/ medium, the composition of which, under the influence of the metabolic activity of these microbes, gradually becomes worse; this retards their development, while a continuous renovation of the medium occurs during a circulating method of cultivation. When it is succeeded to establish a balance between the speed of the flow of the fresh medium and the speed of multiplication and biochemical activity of microbes, then the culture is all the time under steady conditions and, consequently, in one and the same physiological state. The means used for achieving such a moving balance, are based on several different theoretical principles. These general theoretical premises for cultivation of microorganisms in circulating media were examined in several lectures (I. Malek, Czechoslovakiia; D. Herbert and E. Powell, England; A. Novik, U.S.A; N. D. Ierusalimskii).

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The results of the use of the method of circulating cultures for solving various practical problems were set forth in another group of lectures; for instance, for growing bakers and feed yeasts, for alcohol and acetone-butyl fermentation, for production of vaccines, and so on (T. Holme, Sweden; K. R. Butlin, England; K. Beran, I. Kushka, I. Dir, Z. Frensel and M. Burger, Czechoslovakia; K. P. Andreev, M. Ia. Kaliuzhnyi, B. A. Flevako, O. A. Bakushinskaia and N. A. Semikhatova, USSR, and others).

And, finally, in many reports was elucidated along with other problems the technique of continuous cultivation of microbes under laboratory and industrial conditions. The lecture of Ia. Rzhichitsy (Czechoslovakia) was especially given over to this problem.

A lively discussion developed around the reported data and especially about the theory and technique of continuous cultivation. There are many varieties of this method. In some cases one fermentor is used for cultivating microorganisms, in other-- several fermentors are connected one after another in the form of a battery. Microorganisms can develop in a liquid medium, which is very carefully stirred, but it is possible to grow them on a solid surface, which is washed by a flowing medium. The solutions for methods of stirring the culture, aeration, regulation of the speed of the flow of the medium, construction of apparatus and so on vary also. Summing up the discussion it became clear that there cannot be /Begin p.74/ any one special universal system, and depending on the raised problem one should resort to different variants.

One of the most important results of the Symposium was the wide reciprocal in-formation about the works that are conducted in different countries. In our country, as well as abroad, the possibility for introduction of continuous processes is studied by various industries. In industrial practice these processes were often applied without sufficient scientific-theoretical grounds and therefore did not produce the required effect. And the theoretical research, which was developed after the Second World War (especially in USA, England and France) often was severed from production and served mainly for investigation of individual problems of genetics, physiology and biochemistry of microorganisms. The Symposium helped in establishing a contact between theorists and manufacturers, bringing to both much that was new and unexpected, and thus was, undoubtedly, useful to both parties.

Data, heard at the Symposium, private talks among its participants, as well as visits to scientific institutions of Czechoslovakiia, where the method of continuous cultivation is studied widely and from many angles, have shown that it has highly diversified prospects both in the field of scientific research and in industrial practice. And, as every continuous method, it is more progressive than the intermittent; nevertheless its rich possibilities were underestimated up to now.

At the present time the method of continuous cultivation is being prepared for introduction or already is practiced in a series of productions which utilize the activity of microorganisms, as, for instance, production of alcohol (from food wastes and hydrolyzates) baker's and fodder yeasts, products of bacterial fermentation (acetone and butanol, lactic acid, acetic acid, butylene-glycol, gluconic acid and others), enzymes of microbial origin, antibiotics (penicillin, streptomycin, and others), vitamins B_2 and B_{12}, intermediate product for vitamin C (sorbose), preparation of live vaccines of the intestinal group and of other, bacterial toxins, bacteriophages, several food products, and so on.

Those who addressed the Symposium pointed to the timeliness of such an international conference. An unanimous wish was expressed that the Czechoslovakian Academy of Science in the future also carry on the role of an international scientific-organisational center for the problem of continuous cultivation of microorganisms. In conclusion it is necessary to mention the good organisation of the work of the Symposium. The texts of lectures were printed beforehand and distributed to the delegates. All the addresses were immediately translated into three languages (Czech, Russian and English) and relayed by radio; this facilitated the discussion immensely. The actual accomodation of delegates was faultless.

(In full)
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Prokof'eva-Bel'govskaia, A. A., and Alikhanian, S. I.

Vazhnye problemy genetiki.

/Important problems of genetics/.

Akad. Nauk SSSR, Vestnik, vol. 29, no. 1.
p.98-100. Jan. 1959. 511 Ak14V

(In Russian)

At the Second International Conference on Peaceful Utilization of Atomic Energy (Geneva, September, 1958) an important place was occupied by the problems of radiation genetics. The increased interest in genetics and a sharp rise in research in this field of science are explained not only by the exclusive actuality of problems connected with the development of methods of evaluation of the genetic danger of ionizing radiation to man. This interest is also determined by great prospects, which are opening before biological science in connection with the utilization of ionizing radiation and of radioactive isotopes in the research of the formation and reproduction of structural bases of heredity (chromosomes and genes), selection of plants, animals and microorganisms.

The reports, relating directly to genetics or touching upon it closely, were grouped according to subjects. At separate conferences were discussed the genetic consequences of radiation, mechanism of the radiation effect and radiosensitivity, protection from radiations, use of tritium during scientific-research work, improvement of media and genetics.

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In reports, given over to the aftereffect of radiation, results of radiogenetic research, obtained on Drosophila and mice were generalized. These objects were regarded as test-organisms for judgment of genetic aftereffects of radiation in man. The most acute problems of modern radiation genetics were elucidated: dependence of the frequency of mutation on the dose of irradiation, differential radiosensitivity of cells of different type and stages of development, the problem of the "doubling" dose, mutating effect of small doses of radiation, mechanism of the "oxygen effect" in the mutation process, genetic aftereffects of irradiation of populations of organisms, mutation process under the influence of irradiation in polygenetic systems. An important place in several reports was allotted to the extrapolation of data, obtained with animals, to man and analysis of methods of evaluation of genetic danger to man (G. G. Muller, W. L. Russell, USA; G. Bonnier, E. Guyenot, Switzerland, and others).

On the basis of generalization of the world experience of radiogenetic research on Drosophila, G. G. Muller has shown, that radiosensitivity of sex cells, depending on the stage of development, varies in very wide limits. A colossal variation exists also for the "doubling dose", that is dose of irradiation when occurs a double amount of mutations, which arise spontaneously in organisms under the influence of the natural background of radiation and innate agents. A "doubling dose" for mature sex cells (spermatozoa) is by 8 times lower, and for the spermatid by 12 times lower than for the immature sex cells. /Begin p.99/

The summarizing report of W. L. Russell touched upon the results of vast research of the Oakridge National Laboratory (USA) on the effect of ionizing radiation on mice. A far higher radiosensitivity of the mouse as compared to Drosophila was established, and a much stronger, than it was supposed until the present time, mutagenic effectiveness of small doses of irradiation, the most dangerous for man. The problem of genetic danger of small doses of radiation, in connection with the increase of the general background of radiation on earth, occupied the central place at the scientific conferences, at press-conferences and the genetic symposium.

Serious attention was paid to the problem "Mechanism of action of radiation and radiosensitivity". In the report of N. P. Dubinin were outlined basic trends of work of the Laboratory of Radiation Genetics of the Institute of Biophysics of the Academy of Science of USSR and some results of research on plants and animals were generalized, showing that the degree of radiosensitivity of organisms in many cases is determined by the degree of injury to the cell nucleus. Materials were presented for the first time, which were obtained in our country, about the high radiosensitivity of the test-organism, nearest to man - the monkey. S. E. Ford (England) reported very valuable materials about the connection of leukemia in mice, caused by radiation, with the visually observable injuries to their chromosome apparatus. C. A. Tobias (USA) gave an analysis of the effect of ionizing radiation on yeast cells, pointing to the role of the degree of polyploidy in their radiosensitivity.

A summarizing report on the problem "Protection from the effect of irradiation "was presented by the Director of the Oakridge National Laboratory, A. Hollander. He studied aminoalkylisothiocarbomide and mercaptoalkylguanine as important protective substances against the genetic effect of irradiation. The effect of protective substances is conditioned, according to Hollander by their fixing in a certain short period after irradiation of free radicals. At the same time in many cases occurs a reunion of chromosomes which were torn by ionisation.

A special conference was set aside for the use of tritium in scientific-research work. Use of tritium-labeled thymine /timidin/ as highly specific marker for DNA chromosomes, together with autoradiography, opened a possibility for experimental attack on the most difficult and fundamental problem of genetics - the nature of the process of self-reproduction of chromosomes.

New data in this field were reported by the American scientist "V. L. Kh'uigs" /W. L. Hugues?/ (Brookhaven National Laboratory, USA) and "A. P. Gopal-Aisangar" (Atomic Center in Trombay, India). Tritium labeled chromosomes and mechanisms of their reduplication were illustrated at the USA exposition by excellent microphotographs, under the microscope and by a special film, which have received a high appraisal of biologists, physicists and chemists.

The research practice,brought to light at the Conference, has shown the possibility to utilise atomic energy for obtaining practically valuable mutations; wide prospects have been opened before the radiation selection of plants and microorganisms.

In the reports on radiation selection, problems were examined on the dependence of radiosensitivity of plants on the degree of injury to the cell nucleus,on differential radiosensitivity of various species and varieties of plants, connection of resistance of plants with a degree of polyploidy, on directed obtaining of useful mutations by way of utilisation of various types of ionizing radiation, on combined effect of ultraviolet and X-rays (A. G. Matardshian, K. S. Bora, /Begin p.100/ India; Gustafson, T. V., Sweden; A. N. Sparrow, USA). A series of purely practical problems were elucidated, connected with doses and materials for irradiation, the stages most favorable for irradiation, importance of water in seeds, and so on. T. V. Gustafson reported about a new radiation mutant of barley "Pallada Erektoid 32", which was released in 1958 by the "Svalof" Station. In India works on radiation selection of wheats and rice are expanding widely.

The report of S. I. Alikhanian was given over to successes in the field of radiation selection of producers of antibiotics (fungi and actinomycetes) in USSR.

Summing up the Conference, it is necessary to mention that in many directions, Soviet scientists work with the same actual problems as the scientists of other countries. At the same time Soviet geneticists also work on special problems, which were introduced by them (photodynamic effect of the visible light, protective substances against this effect, and others); they use for the solution of problems other, original objects (in particular, fish embryos) and already have attained big successes, for instance in the selection of antibiotic producers.

Nevertheless, works on some sections of radiation genetics proceed yet quite insufficiently. To such sections refer general theoretical genetics, radiation genetics of mammals, radiation selection of plants, research on structure and reproduction of elements of the cell nucleus, utilising labeled compounds.

During the Conference there occured friendly meetings, where problems of further development were also discussed of both the theoretical problems of radiation genetics as well as of practical means of application of ionising radiation in the selection.

Trans. A-1021
(In full)
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Chesnokov, E. N.

Filosofskie voprosy sovremennogo estestvoznaniia.

/Philosophic problems of modern natural science/

Akad. Nauk SSSR. Vestnik. vol. 29, no. 1,
p.132-138. Jan. 1959. 511 Ak14V.

(In Russian)

Modern natural science is experiencing a period of such tempestuous development the like of which history of science never knew. Since the beginning of the 20th century natural sciences were enriched by the greatest discoveries and theories, so many new scientific disciplines and fields of knowledge were created that one may rightfully speak about a scientific revolution, the greatest in history. Soviet scientists made a great contribution to the development of natural science.

Intense breaking of old theories and understandings, a progress unprecedented in past epochs, which the natural science experiences at the present time, raise especially sharply great and complicated philosophic problems; they show the more convincingly that it is impossible to do without appropriate philosophic generalisations and conclusions.

About this, in particular, testifies the fact that of late philosophic problems of natural science occupy one of the first places in the work of philosophic congresses, meetings; they are more frequently and thoroughly discussed on the pages of philosophic and natural-scientific journals and books, in newspapers and in scientific-popular literature.

A 1021

- Yet during the first stage of the revolution in natural history, V. I. Lenin has shown, that correct answers to the philosophic problems, raised by modern science, can be given only by dialectic materialism. Leaning on the fundamental ideas, developed by V. I. Lenin, the Soviet scientistis - philosophers and naturalists have performed during the past years a certain work of philosophic generalization of achievements in modern natural science and of exposing of idealistic misinterpretations in natural sciences. At the same time, one should mention that the development of philosophic problems of modern natural science remained, in many respects, as a tight place of our ideological front.

Ideologists of contemporary bourgeoisie, in their inclination to disprove the conclusions of dialectic materialism especially readily resort to false idealistic interpretation of the phenomena and regularities, newly discovered by the naturalists. Taking advantage of the hesitation and philosophic instability of modern great physicists and representatives of other fields of natural science, they pull them into the idealistic morass. It is known, that many prominent scientists in capitalistic countries, who are "stikhiinye" /elemental?/ materialists, as long as they stand on the ground of their specialty, passing over to the philosophic interpretation of the newest discoveries, which, if correctly understood, only deepen and widen the materialistic idea about the laws of life and development of nature, very often make deeply erroneous, idealistic conclusions from their discoveries.

Modern revisionists use the idealistic interpretation of achievements of the newest natural science as a means for revision of theoretical fundamentals of Marxianism-Leninism.

All this requires, from Soviet philosophers and naturalists, the most serious and constant attention to philosophical problems of modern natural science. The facts of a superficial attitutde of certain Soviet scientists toward the evaluation of attainments of natural sciences cannot be further tolerated, their peculiar philosophic "neutrality", attempts to ignore the philosophically difficult problems of modern science. Extensive experimental data from the field of studies of the atomic nucleus and /Begin p.133/ of elemental particles, valuable physical results of the quantum theory and of theory of relativity, attainments of cybernetics, physics and chemistry in biological researches, and many other problems of modern natural science require further deep studies and interpretations. A close co-operation of Marxian scientists, of the union of naturalists and of philosophers is needed for an effective work on the basis of principles of the Marx-Lenin theory. The All-Union Conference on Philosophic Problems of Natural Science, which took place in Moscow at the end of October of the last year and which was called by the Academy of Science and the Ministry of Higher Education of USSR, attracted over 600 of the most eminent specialists in the field of natural science and philosophy. Among them were Academicians and Corresponding Members of the Academy of Science of USSR, academies of science of union republics and of industrial academies, workers of scientific-research institutions and of higher education establishments. Representatives of Bulgarian, Rumanian, German, Hungarian and Czechoslovak scientists were present at the meetings as guests.

The problems of the Conference were formulated in the introductory addresses of the President of the Academy of Science of USSR, Academician A. N. Nesmeianov and the President of the organizational committee on the conducting of the Conference, Academician K. V. Ostrovitianova.

The Conference had as its aim the joining of creative efforts of Soviet philosophers and naturalists for dialectic-materialistic generalisation of achievements of modern natural science and raising of its theoretical level in order to help the speediest solving of the most important problems of the science.

The following lectures were heard and discussed: by Academician M. B. Mitin - "Materialism and Empiriocriticism" of V. I. Lenin the great "ideinee" /conceptual/ weapon for the perception and reforming of the world"; by the Academician of the Academy of Science of the Ukrainian SSR. M. E. Omel'ianovskii - "V. I. Lenin and philosophical problems of modern physics"; by Doctor of Philosophical Science, Corresponding Member of the Academy of Pedagogical Science of RSFSR, B. M. Kedrova, "About correlation of forms of movement of matter in nature"; by Academicism V. A. Fok "About interpretation of quantum mechanics"; by the Corresponding Member of the Academy of Science of USSR, A. D. Aleksandrov "Philosophical subject-matter and importance of the theory of relativity; by Academician S. L. Sobolev and Professor A. A. Liapunov - "Cybernetics and natural science"; by Academicism V. A. Ambartsumian - "Certain methodological questions of cosmogony"; by Academicism V. A. Engel'gardt and Corresponding Member of the Academy of Medical Sciences of USSR, G. M. Frank - "About the role of physics and chemistry in the investigation of biological problems"; by the Academician A. I. Oparin - "Problem of the origin of life in the light of achievements of modern natural science"; by the Corresponding Member of the Academy of Science N. I. Grashchenkov "Lenin's theory of reflection /otrashenie/ and modern physiology of sense organs".

As the work of the Conference has shown, the successes of modern natural science are revealing the basic ideas of Marx-Lenin philosophy, deeper and in more detail, about the material world and the possibility of its fuller perception. They inevitably lead the naturalists to the materialistic conclusion about the primacy of matter and the second position of consciousness, about the existence of objective reality, which is reflected by consciousness. Fundamental facts about the structure and properties of matter, which are discovered by modern natural science, receive proper philosophic interpretation only in the dialectic-materialistic teaching about the world as a regular movement of matter in space and time. Data of modern natural science confirm the idea of dialectic materialism the more clearly about thought being the function of the brain, about consciousness as the property of matter.

Owing to the newest natural science discoveries the ideas about the material unity of the world, about the variability of all forms of matter and of its movement, about the inexaustibility of matter in depth, about the objective character of laws of change of the world are filled with a new specific meaning. There is nothing in the world besides the moving matter in its multiform expression - to this conclusion must come every naturalist who is creating on earth a likeness of planets and stars, who obtains in accelerators streams of particles, which are similar to cosmic rays, who is solving the problem of artificial transmutation of the inanimate to the living, who transforms, in the interest of men, the hereditary nature of plants and animals. Data of modern physics, cosmogony and of other sciences offer additional arguments for confirmation of the idea /Begin p.134/ of dialectic materialism about the eternality, infinity and limitlessness of the world.

The ideas of dialectic materialism about universal continuity and development of the material world penetrate ever deeper into the modern natural science. Reciprocal transmutation of matter and light, conversions of chemical substances, as well as of elementary particles of matter one into the other are a clear confirmation of the universal continuity and development of the material world.

When describing the characteristics of objects of the microworld, as it is even acknowledged by certain bourgeois naturalists, one cannot find any other language, than the language of dialectics. The absolute and the relative in the theory of relativity, possibility and reality in the quantum mechanics, internal regularities of the organism and the environment, continuous and interrupted, qualitative and quantitative conversions in biology, and so on - these are the categories of dialectics without which the naturalists cannot do. "Dialectics as a living, many-sided perception(with an ever increasing number of sides), with a great number of shades of every approach, of approximation to reality (with a philosophical system growing into a whole from each shade) - this is the immeasurably rich subject matter"(1) to which modern natural science gradually proceeds.

M. B. Mitin mentioned in his lecture that the present Conference coincided in time with the 50th anniversary of the brilliant work of V. I. Lenin "Materialism and Empiriocriticism". All the following development of natural science has confirmed the correctness of Lenin's deductions made therein.

M. B. Mitin emphasized that the greatness of Lenin consists in the fact that he knew how to reveal the objective meaning and the essentiality of revolution in science, to give an answer to problems which were right and to foretell ahead for a long time the ways of philosophic solving of problems of natural science. Ideas of V. I. Lenin are today also a great weapon in

(1) V. I. Lenin. Philosophical notebooks. M., 1947, p.330.

the struggle against idealism, metaphysics and revisionism, illumining by an unfading light the ways of knowledge and of reconstruction of the world.

M. E. Omel'ianovskii also referred in his report the greatest importance of the heritage of Lenin's philosophy for modern physics. He has shown that the development of physics by Soviet and other progressive foreign scientists is accomplished with the fruitful influence of ideas of the dialectic - materialistic philosophy.

The lecture elucidated the formulation of such problems by modern physics as the problems of objective reality, causality, correlation of statistical and dynamic regularities, and others. Setting forth Lenin's opinions on these questions and showing their meaning for scientific philosophic deductions from the modern quantum theory, the speaker disclosed the unscientific opinions of various representatives of positivism, which are harmful to the development of physics. M. E. Omel'ianovskii has emphasised that facts compel even the modern physicists idealists to take the stand of "stikhiinyi" /elemental/ materialism and dialectics when conducting specific research. Nevertheless, many physicists, working under conditions of the capitalistic society, where the idealistic world outlook is predominant, trying to philosophically comprehend their new discoveries, undergo difficulties in the face of fundamental breaking of the customary ideas and representations.

In his appearance, A. Z. Zhmudskii, who pointed out that Lenin "began the liquidation of the crisis in physics", disputed the idea of the lecturer about the deepening of crisis of physics in capitalistic countries. A. Z. Zhmudskii said that the overcoming of the crisis in physics is facilitated by the presence of the socialistic system and the work of communistic parties in propagandising dialectic materialism in various countries, achievements of physics proper as a science, development of international scientific relations, the dialectic character of the processes of nature themselves, which are examined by modern physics.

Under modern conditions, when in capitalistic countries also dialectic materialism is being spread, the idea "crisis in physics" must, certainly, be defined more accurately. But, at the same time, one cannot forget, and M. E. Omel'ianovskii paid attention to it quite correctly when answering to A. Z. Zhmudskii in the closing address, that a considerable part of eminent physicists of the world in the sharpening struggle between materialism and idealism, in connection with the spreading of dialectic materialism in capitalistic countries, /Begin p.135/ remain on idealistic positions and irreconcilably persist in their tendency to disprove the deductions of dialectic materialism.

B. M. Kedrov in his lecture examined the problem about the relationship of forms of the movement of matter in nature on the basis of data which were obtained by natural science during the last 60 years. He has shown that, as in the general case of movement there is a mode of existence of matter, so too in each private case a strictly specific form of movement, appearing as a mode of existence of the given form of matter corresponds to a specific form of matter.

A wide discussion developed also in connection with the lecture of V. A. Fok on philosophic questions of quantum mechanics.

As it is known, there are different points of view among dialectic materialists on these questions. V. A. Fok, A. D. Aleksandrov and others think, that quantum mechanics is a theory of a single microobject and reflects its potential possibilities under the given outer conditions. The followers of this outlook recognise on principle as impossible the construction of a dynamic theory, on the basis of which it would be possible uniquely to forecast the movement of a single microobject. According to D. I. Blokhintsev quantum mechanics is a theory of quantum ensemble; the quantum statistical character is explained by the interaction of microobjects with microscopic environment, and the question about the construction of a dynamic theory of an individual microobject can be solved on the way of further development of theory and experiment.

The third point of view, which is developed by the French scientists de Broil and Vigier issues from the possibility of construction of a co-ordinated theory of a microobject, which, along with the statistic description, gives a unilateral definiteness of the conduct of an individual microobject.

V. A. Fok in his lecture especially emphasized these philosophical problems, arising in connection with the peculiarities of description of the finest objects of matter. He pointed out the important role that is played, at such time, by ideas of potential possibility and its realization as a reflection of dialectic categories of possibility and reality.

During discussions of the lecture in which D. I. Blokhintsev, Ia. P. Terletskii, D. D. Ivanenko, T. A. Lebedev, E. Ia. Kol'man, V. V. Perfil'ev, and others took part, it was mentioned that the Soviet scientists are unanimous in their materialistic approach to the solving of philosophic problems of the quantum mechanics, that even certain of the bourgeois scientists (Bor, Born, Geisenberg, and others) now withdraw from their positivist positions.

Participants of the discussion paused on questions for the formation of a modern theory of elementary particles. D. D. Ivanenko and Ia. P. Terletskii characterized the importance of nonlinear theories during research of microprocesses. D. D. Ivanenko and E. Ia. Kol'man appraised, as very promising, an attempt of the German scientist Heisenberg to create a single theory of the field - an opinion which found an objection on the part of V. A. Fok and D. I. Blokhintsev. V. A. Fok and D. I. Blokhintsev, from different positions, expressed their doubts in connection with the prospects of further development of the quantum theory in direction of ideas of de Broil-Vigier-Bom.

D. I. Blokhintsev pointed out in his address, that at the present time theoretical physics in general lack a rich creative phantasy. Physics has accumulated in the field of studies of the atomic nucleus and of elementary particles a great factural material, which it was not yet possible to unify into an orderly system.

A. D. Aleksandrov summed up some of the subjects of discussion on philosophic questions of the theory of relativity, which were conducted in both the natural science and the philosophical literature during the course of the latest decades, and on the basis of this tried to elucidate the philosophic meaning and importance of the theory of relativity. The speaker criticized the extremely biased positions - unfounded denial of the theory of relativity, on the one side, and a mechanical acceptance, together with the positive contents of its evident methodological flaws, on the other. The theory of relativity, said the lecturer, represents a physical theory of space and time, a teaching about absolute space and time as forms of the existence of matter. The name itself "theory of relativity" seems to be unfortunate, and it should be changed to the name "hypothesis of the absolute world"; the principle of relativity /Begin p.136/ ascertaining the invariant property of the laws of nature, their similarity in respect to all inertial systems, ascertains by the same token their irrelative character and is rather a "principle of irrelativity". The speaker denied the lawfulness of the general theory of relativity as a scientific theory. In his opinion, the general principle of relativity, which accepts "ravnopravnost'" /equality of rights/ of inertial systems, - is impossible in general. The general theory of relativity, which comes to the theory of gravitation, said he, remained as an extraneous layer, which covers up the essence of the theory of relativity of A. Einstein.

M. F. Shirokov did not agree with the negation of the general theory of relativity and reducing it to the law of gravity. Such a much narrower formulation of one of the basic principles of the theory virtually means, in his opinion, a denial of the objective reality of fields of inertial forces and of physical effects produced by them. This treatment is a step back, it returns us back to the Newtonian understanding of the inertial forces as unreal, fictitious. The geometrical explanation of gravitational forces loses its definite physical meaning, which is expressed in the well-known principle of local equivalence of fields of gravitation and of inertial forces, and, naturally, leads to an assertion of the existence of a peculiar pre-eminent system of "harmonious" coordinates against which many scientists objected quite correctly.

V. I. Sviderskii, A. L. Zel'manov, A. A. Tiapkin, and others also took part in the discussion of A. D. Aleksandrov's lecture. The lecturer, and those addressing the meeting, have shown that the theory of relativity, which is considered as a physical theory of space and time came close to the ideas of dialectic materialism about space and time as objective forms of the existence of matter, about the continuity of matter, movement, space and time.

Examining the qualitative differences in the structure of cosmic systems of different order, V. A. Ambartsumian has presented new facts, which dispute the ideas about the similarity of the universe. These ideas are placed as the basis of certain formal cosmogenic theories, which are utilized by the idealists for fideistic deductions. The speaker and those taking part in discussions, G. I. Naan, A. L. Zel'manov, and others pointed out that modern astrophysics, as a whole, confirms the materialistic theses about infinite variety of manifestation of the deep properties of matter, that the materialistic point of view conquers in scientific cosmogony.

A lively exchange of opinions was caused by the lecture of S. L. Sobolev and A. A. Liapunov about the position of cybernetics in modern natural science.

Critisizing the statement that cybernetics is a pseudo-science, the speakers brought to the fore the practical side of this new science, the birth of which, in their opinion, promises to humanity prospects that are, probably, not less important than the discovery of methods for obtaining intranuclear energy. During the Conference (in particular in the addresses of G. V. Nikol'skii, P. K. Anokhin, G. V. Platonov) doubts were expressed in connection with the possibility with the aid of cybernetics to solve the problems of heredity, directed evolution, and so on.

Important problems from the point of view of natural science and dialectic - materialistic philosophy were elucidated in the lecture of V. A. Engel'gardt and G. M. Frank. The authors of the lecture stressed, that referring to data of modern science, notwithstanding the qualitative difference between the living and the inanimate, the physical and chemical methods are quite applicable when studying the living. Modern natural science, along with concretisation of the qualitative character of the living and the inanimate, discovers ever more facts about their common properties and regularities, thus confirming and deepening the idea of dialectic materialism about the material unity of the world, about the interrelation of forms of movement of matter.

Participants in the discussion (V. L. Ryzhkov and others) joining the lecturers, emphasized, that understanding of the essence of life processes at the present time is impossible without taking into consideration data of nuclear physics and technique, as well as without the attainments of electronic apparatus construction and cybernetics. Various teachings about incomprehensibility of life processes were decidedly refuted both in the lecture and the addresses. /Begin p.137/

N. M. Sisakian said that "absolutisatsiia" /absolutism?/ of the character of life, exaggerated references to the character of biology sometimes hinder the application of physics and chemistry as important means for the penetration into the essence of biological phenomena.

The Bulgarian scientist, I. Panchev, showed the fruitfulness of physico-chemical methods for the examination of living processes on the lowest (cell) levels.

Great interest was evoked by questions raised in the lecture of A. I. Oparin. If yet quite recently the problem of the origin of life was almost never elucidated in the world's natural history literature, then at the present time great attention of wide circles of naturalists has been attracted to it.

Moreover it is thought to be generally accepted that this problem can be solved only in the light of studies of that gradual development of matter, which preceded the appearance of life on earth. A. I. Oparin, on the basis of data of biochemistry, citicized the idea about primary origination of the "living factorial molecule" and emphasized, that multimolecular systems, interacting with the environment (open systems) were the originals for the emergence of life.

The speaker touched upon certain problems of historic materialism. Criticizing the unscientific astating by bourgeois scientists of the problem of development of man only in the biological aspect, A. I. Oparin stressed that the wide high road of human progress proceeds not through the biological development of an individual human personality, but through perfecting of man's social life, through social progress.

In his report N. I. Grashchenkov cited forcible arguments for the refutation of the statement of the adherents of idealistic philosophy in natural science about the fact that the versatility and polychromy of the external world, of objects, existing outside of our consciousness, as though depend on our sense organs, and this world is created by these organs and their specific properties (seeing, hearing, smelling and other sensations).

The speaker demonstrated charts, which showed, that development itself of sense organs, both of the lowest and highest organisms, is connected to the affect of the external world of many qualities on the organism and on the sense organs. The sense organs are formed in accordance with the qualities of the external world, they perceive it adequately and reflect. These facts and their generalization, on the basis of the theory of development and dialectic - materialistic examination of the interaction of the organism and the environment, confirm the utter rightness of Lenin's theory of reflection /otrashenie/.

N. I. Grashchenkov also showed the role of the reflex theory and teaching of I. P. Pavlov about physiology of the higher nerve activity, which lies at the basis of interaction of the organism and the environment with the aid of sense organs or analyzers. Iu. P. Frolov, V. N. Kolbanovskii and others spoke about other problems in connection with discussions of the report. S. L. Rubinshtein raised a question about measures, that are necessary for increasing scientific-research works in the field of psychology and elucidated its principal purposes and ways of development.

When closing the Conference, P. N. Fedoseev, Corresponding Member of the Academy of Science of USSR, empasized its great positive importance for increasing the theoretical level of research of philosophic problems of modern natural science. Soviet philosophers and naturalists have shown considerable creative activity in the process of preparation and conducting of the Conference. Debatable questions were solved on principle, in friendly discussions, on the basis of analysis of theoretical ideas and factual data of science. Participants in the Conference have rightly criticized as unacceptable the methods for discussion of theoretical problems, such as are practiced by the editorial office of the "Botanical Journal".

Results of the Conference were discussed on January 2, 1959 at a joint meeting of the Presidium of the Academy of Science of USSR and the Board of the Ministry of Higher Education in USSR.

As it was pointed out at the meeting, the conducted Conference permitted the Soviet scientists to exchange opinions on a long range of questions, to share with one another the results of their research. It will help a further rallying of all scientists to positions of dialectic materialism, a new development of all the fields of science, in the struggle against the ideology of imperialism, against the modern philosophic revisionism. /Begin p.138/

Presidium of the Academy of Science of USSR and the Board of Higher Education of USSR planned some measures for the raising of development of philosophical problems of modern natural science and expressed confidence that Soviet naturalist-scientists and philosophers will attain new creative successes in solving the problems which were set before the science in the theses of the report of N. S. Khrushchev at the 21st Convention of the Communist Party of the Soviet Union.

(In full)
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Afrikian, E. K., and Kuchaeva, A. G.

Primenenie antibiotikov v rastenievodstve.

/Application of antibiotics in plant growing/

Akad. Nauk SSSR. Vestnik, vol. 29, no. 1.
p.142-143. Jan. 1959. 511 Ak14V.

(In Russian)

A Conference on the Application of Antibiotics in Plant Growing took place October 8 to 13, 1958, in the city of Erivan; it was called by the Institute of Microbiology of the Academy of Science of USSR, by the All-Union Institute of Agricultural Microbiology VASKHNIL /All-Union Academy of Agricultural Sciences imeni V. I. Lenin/ and the Sector of Microbiology of the Academy of Science of the Armenian SSR. Scientists, who are specialists studying antibiotic substances and their application in various fields of national economy took part in the work of the Conference, the purpose of which was to systematise the accumulated material and to develop more effective methods for utilization of antibiotics in plant growing. The Conference was opened by the President of the Academy of Science of the Armenian SSR, V. A. Ambartsumian.

N. A. Krasil'nikov made a report on the present state of the problem. It was established that soil microorganisms, in the process of their active life, produce different biologically active substances (vitamins, auxins, enzymes, toxins, antibiotics and others) which are assimilated by the root system of plants and are distributed in them, producing one or another effect. It is possible to influence the growth, development and the yielding capacity of plants by studying and regulating these processes. It was proved that metabolites of microbes can produce medicinal, prophylactic, toxic, stimulating

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and other effects on the higher plants.

M. Kh. Chailakhian gave interesting information about microbe metabolites, which stimulate the development of higher plants. His experiments with the effect of gibberellins (obtained from Fusarium fungi and other microorganisms) on plants have shown that one can produce vernalization and stimulation of blooming of plants with the aid of these substances.

N. M. Pidoplichko reported about the many years of work of Ukrainian mycologists in studying the soil fungi flora and its use for the control of diseases of agricultural plants. A series of lectures (of V. I. Bilai, S. N. Moskovets, and others) was given over to the utilization of Trichoderma fungus for the control of diseases of cotton, potatoes and some other agricultural crops.

Encouraging data were obtained when utilising cultures of actinomycete-antagonists for the control of various phytopathogenic diseases of plants. P. O. Mirzabekian reported about the isolation of actinomycetes cultures, which produce active antibiotics with respect to the pathogens of potato canker and dry-rot of corn. Individual cultures of actinomycete-antagonists were successfully utilised for the control of ringrot of potatoes (S. Orymbaev) and slimy bacteriosis of cabbage (V. N. Masunina). A high effectiveness of preparations from cultures of actinomycetes was discovered for preventing cotton from wilting (G. M. Kublanovskaia). Certain bacteria were successfully used for the control of diseases of vegetable crops (V. G. Tumanian, E. K. Afrikian, R. A. Bobikian), as well as for verticillium wilt of potatoes (E. T. Nikitina). Good results were obtained from the use of epiphytic microflora for the control of certain fungus diseases of plants (Iu. M. Vozniakovskaia, O. G. Shirokov, A. D. Nalbandian).

A group of lectures was given over to obtaining and use of new antibiotic preparations. D. M. Trakhtenberg, E. I. Rodionovskaia, L. P. Starygina, U. G. Oksot'ian, and others reported about results of studies of phytobacteriomycin and its application, as well as of other antibiotics for the control of gummosis of cotton and bean blight. A series of preparations of antibiotics was successfully tested as a disinfectant of tomato seeds for the control of bacterial canker (R. M. Galachian) and for the control of diseases of ornamental flowers (E. P. Pretsenko, A. G. Kuchaeva, B. A. Chelyshkina). E. Ia. Rashba and K. I. Bel'tiukova spoke about work on studying a plant antibiotic "arenarin", which was isolated from immortelle and which is successfully used for preplanting treatment of seeds and for spraying of plants in order to increase their productivity and for the control of bacterial diseases, as well as about certain synthetic antibiotics, which proved to be effective for the control of diseases of vegetable crops. Z. E. Bekker, A. B. Silaev and others reported about obtaining preparations of griseofulvin and trichothecin and about their effect on fungi, pathogens of such diseases as cabbage anbury clubroot, /Begin p.143/ wheat smut (T. tritici), anthracnose of watermelon, and others.

The lecture of A. G. Kuchaeva was given over to a new field of antibiotic application; she reported about results of research with antibiotics which are active against gypsy moth - a harmful pest of forest plants. Antibiotic substances were found, which cause death of from 35 to 100% of caterpillars of the gypsy moth on the third day of their development (a preparation, obtained from Act. violaceus 719).

At the Conference works on general and methodical questions of use of antibiotics in plant growing were widely represented. In particular, special attention was drawn to the studies of the appearance of resistance to antibiotics obtained from forms of phytopathogenic bacteria (V. P. Izrail'skii, N. D. Buianova, M. D. Kulikovskaia). In this connection a necessity was stressed for using simultaneously several effective antibiotics in order to utilize them more successfully for the control of certain plant diseases.

A possibility of formation of antibiotic substances by soil micro-organisms directly in the soil was established and research has been conducted on their detection, accumulation and preservation, as well as on the absorption by soils of various antibiotic preparations introduced from outside. A wide distribution of toxic strains of microorganisms in the soil has been disclosed as well as the accumulation of products of their metabolism. The cited circumstance permits to suppose a direct participation of these microorganisms in the change of soil characteristics, in formation of microbe cenosises and as a result of these processes their influence on the development of higher plants.

At the Conference reports were presented also on application of new methods when working with antibiotics in plant growing; in particular there was described a fast method of determination of the character of the effect of antibiotics on plants based on the growth of coleoptiles of wheat at certain concentrations of substances (K. A. Vinogradova and N. S. Agre).

Mentioning the priority of Soviet scientist in the development of principles of utilisation of microbe antagonism and of antibiotics in plant growing, the Conference stated the insufficient development of works in our country in this field, their lagging behind the real requirements of the vigorously developing agriculture. The Conference recognised the need to organise industrial production of antibiotics and of microbe preparations, which proved to be effective for the control of certain plant diseases (phytobacteriomycin, griseofulvin, trichodermin, preparations no. 150, 125 and others), in order to widely introduce them into the practice of agriculture. It is especially important to more quickly organise experimental workshops at the existing factories of bacterial preparations, and later on - factories of a simplified type for producing antibiotics against the specially injurious plant diseases. The Conference pointed to the extremely poor technical equipment of laboratories, which are occupied in studying and utilising antibiotics in plant growing, and recognised, as timely, the organisation of special experimental installations for obtaining antibiotics and microbe preparations.

Expecial attention of the Conference was paid to the necessity of increasing and development of plants of microbe origin (of the type of gibberellin and others), as well as conducting wide search for producers of these substances among the various groups of microorganisms. The necessity of coordination of scientific-research establishments in the work of studies of antibiotics and of other metabolites of microorganisms in plant growing was stressed in the resolutions of the Conference, as well as the necessity to call periodic conferences on the problem under consideration.

Trans. A-1023
(In full)
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Svetovidov, A. N.

O podgotovke nauchnykh kadrov v Zoologicheskom Institute Akademii Nauk SSSR.

/Training of scientific staffs at the Zoological Institute of the Academy of Sciences USSR/.

Akademii Nauk SSSR. Izvestiia. Seriia Biologicheskaia, vol. 24, no. 1, p.155-158.
Jan./Feb. 1959. 511 Sa2B.

(In Russian)

During the Great Patriotic War, the Zoological Institute lost many specialists at the front and in besieged Leningrad. The Institute was faced with the difficult problem of replacing these losses, which it proceeded to do already in war time. The basic group of its workers gathered in Stalinabad to which the Institute had been evacuated. The first aspirants were enlisted in 1942-1943. In the years 1944-1945, when the Institute found it possible to secure a considerable number of vacancies, the number of aspirants increased several times (fig. 1). During these years, especially in 1945, many pre-doctoral students were taken on immediately after the war. In subsequent years acceptances of aspirants and pre-doctoral students decreased somewhat, but the number of those working at the Institute continued to be large as a result of the acceptances in the preceding years. Many aspirants have been accepted since 1950; pre-doctoral students were not increased prior to 1953. During 1954-1955, the number of pre-doctoral students increased somewhat.

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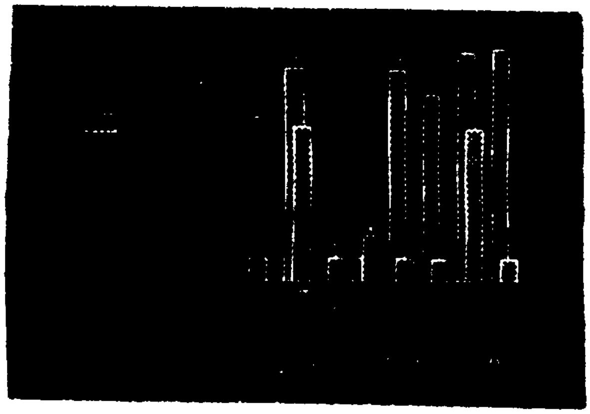

Fig. 1. Number of aspirants and pre-doctoral students taken on between 1930 and 1957.

/Diagonally lined symbol - Aspirants/
/Cross-hatched symbol - pre-doctoral students/

Essentially interesting is the distribution of aspirants and pre-doctoral students according to the different specialities (Fig. 2). In the postwar years, especially between 1950 and 1955, the largest number of specialists was allocated to vertebrates; /this number/ included also ichthyologists who had a preponderance over other specialists in the following years as well, and between 1945 and 1957 these specialists comprised 38.7%. Considerably smaller (on the average 23.7%), yet larger than in other specialties, was the number of hydrobiologists specialising in a series of groups of aquatic animals enrolled as aspirants and pre-doctoral students. Numerically, third to fourth place is held by aspirants and pre-doctoral students of entomology (average for the same years 19.4%) and parasitology (17.9%). It should be noted with satisfaction that in the past 5-6 years the number of aspirants and pre-doctoral students of entomology has increased considerably. This is important because the Zoological Institute has experienced the greatest shortage in specialists of entomology whose group had sustained the greatest losses during the war.

As the number of aspirants and pre-doctoral students increased, so did, naturally, the number of dissertations defended in the Scientific Council of the Zoological Institute; a preponderant majority of these dissertations were presented by persons who had completed graduate study programs. This did not only complete the training of aspirants and pre-doctoral students, but the Institute contributed also toward the raising of the qualifications of its own fellow workers as well as of outside specialists who did not undertake formal graduate study programs. /Begin p.156/. The number of dissertations defened by outside specialists was invariably large (fig. 3). The number of candidate's and doctoral dissertations increased sharply in the very first postwar five-year plan, as compared with the war and prewar years. In the following five years the number of defended candidate's dissertations increased even more.

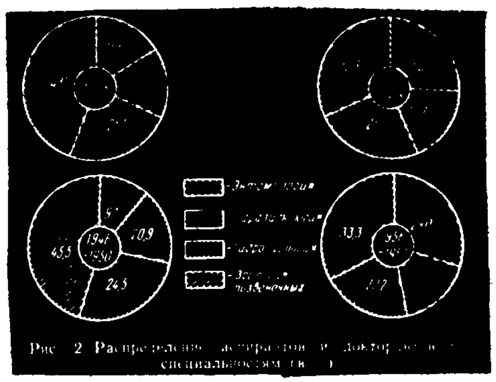

Fig. 2. Distribution of aspirants and pre-doctoral students according to specialty (in %)

Symbol a. - Entomology
Symbol b. - Parasitology
Symbol c. - Hydrobiology
Symbol d. - Zoology of vertebrates

Most dissertations (fig. 4), especially in the prewar and postwar five-year plans, were devoted to vertebrates, including ichthyology. The total number of dissertation on this group of animals defended in the last 20 years comprises approximately one third of all dissertations. Somewhat fewer dissertations for the total number of years were on entomology, because the largest number of these dissertations was defended only in the last two years. Third place for 20 years was held by dissertations defended in hydrobiology, in the main, on various groups of aquatic animals, in the last instance - on parasitology.

It is rather interesting to note that there was no essential difference in the number of men and women enrolled as aspirants (fig. 5) in the postwar years (50 men and 46 women). As far as pre-doctoral students are concerned, there was a sharp preponderance of men (33 and 5). Men who defended their doctoral dissertations were approximately just as many times more /than women/ (44 and 7). There were also more men among candidates with dissertations (104 men and 45 women), but /the percentage/ was considerably less than between those who defended doctoral dissertations (fig. 6).

The work conducted by specialists of the Zoological Institute with aspirants and pre-doctoral students made it possible to prepare a large number of scientific workers (beginners as well as those with higher qualifications) of those who had completed their experience as resident doctors. This was made possible to a large extent by training and defence of dissertations by workers of the Institute as well as by those of other scientific establishments who had not undertaken formal aspirant's and pre-doctoral /studies/. The Zoological Institute trained specialists not only for further work on its premises, but also for other scientific establishments. Not all of those who had completed their aspirant's work were retained at the Institute, because a group of them, preponderantly pre-doctoral students, were temporarily attached only for preparation of dissertations and after the students had defended them, they returned to their own establishments. Here, it must be noted that the selection of aspirants was carried out not only by announcement of acceptance and subsequent competition. A considerable portion of them was assigned to undertake their aspirants work upon recommendation of heads of faculties of higher scientific institutions, primarily of the Leningrad University, while they still had the status of a student. These students took part in expeditions arranged by the Zoological Institute on which their suitability for collective scientific work was determined /Begin p.157/; they accomplished their work for a degree with material collected on the expeditions. Upon agreement with the heads of faculties, they, in addition to the above, received training with a view to aquiring knowledge needed for their future specialty. Thus, in particular, were trained scientific workers for a series of deficient specialties that had been non-existent at the Institute heretofore.

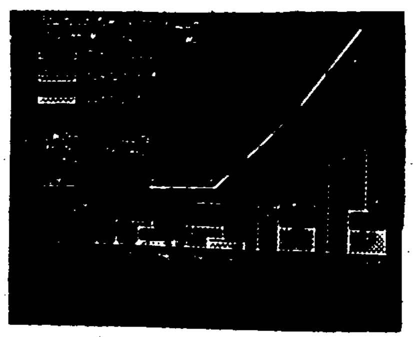

Fig. 3. Number of candidates' and doctoral dissertations defended between 1935-1956.

/Top line/: (Cross-hatched - number of dissertations defended by outside specialists)
Symbol a. - Total dissertations defended
Symbol b. - Candidates'
Symbol c. - Doctors'

Awarded without defense of a dissertation at the time degrees and titles were introduced /1935 and 1935-1940/.

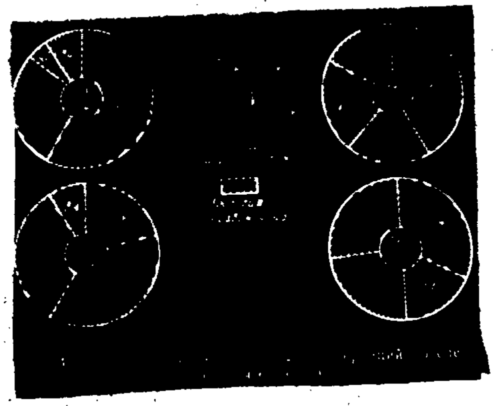

Fig. 4. Distribution of defended dissertations according to specialty (in %).

Symbol a. - Entomology
Symbol b. - Parasitology
Symbol c. - Hydrobiology
Symbol d. - Zoology of vertebrates

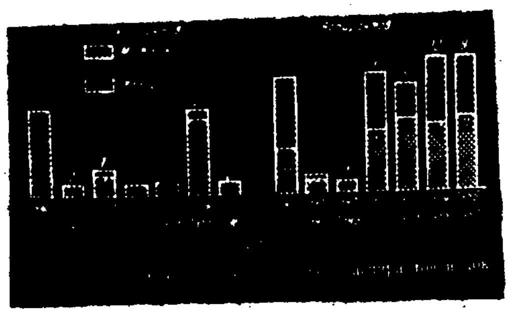

Fig. 5. Number of men and women aspirants and pre-doctoral students between 1945-1957.

Pre-doctoral students — Aspirants
Symbol a. - men
Symbol b. - women

Years.

Fig. 6. Number of men and women who defended candidates' and doctoral dissertations between 1935-1956.

Symbol - men Symbol - women

Doctors Candidates

Years.

As a result of this varied approach to the training of personnel, the Zoological Institute was able in a comparatively brief time not only to replace the losses of its specialists, but even to increase the staff of workers as compared with prewar time (fig. 7). Here, it must be emphasized that the majority of the new workers finished their training and received their degrees at the Zoological Institute and that only a few had come from other scientific establishments. It is especially important to note that the number of scientific workers performing the functions of entomologists who in prewar time were insufficient /Begin p.158/ and, as indicated above, sustained especially great losses during the war years, has increased considerably. At present, as in the year 1917, specialists in entomology at the Zoological Institute have numerically become the largest /group/ as compared with other specialists. It must be noted that there is a need for these specialists because of the large number of insects, the inadequate knowledge of them and the importance of their practical and scientific aspect. There have appeared specialists on scale insects and coccidia, on a series of beetle groups, on hymenoptera, diptera and on others that had been absent from the Institute earlier. The number (of associates in) ~~the fellowship~~ of hydrobiologists that in prewar time was unproportionally large as compared with that of other specialists has increased only a little and they numerically now hold second place. It is essential to note that among them now are specialists on some groups of animals (dendroceratida /Ceratidae - deep-sea pediculate fishes/, hydroida, sea mollusks) who were not there in prewar time. The number of specialists on vertebrates has grown considerably, but in proportion with the growth and number of the colleagues in other specialties in the years 1917 and 1940. The number of parasitologists has increased in approximately the same proportion as compared with prewar years, and here, too, specialists were trained for groups that had not been developed earlier (lower ticks /or mites/, lice, gadflies etc.). In the postwar years, there appeared at the Institute specialists on protozoa that had never been investigated at the Institute earlier. Finally, in 1948, specialists on comparative anatomy (laboratory of Acad. I. I. Shmal'gauzen) were added to the staff of the Institute. Their number increased in 1957 when part of the workers of the Institute im. Lesgaft was added to the staff of the Zoological Institute.

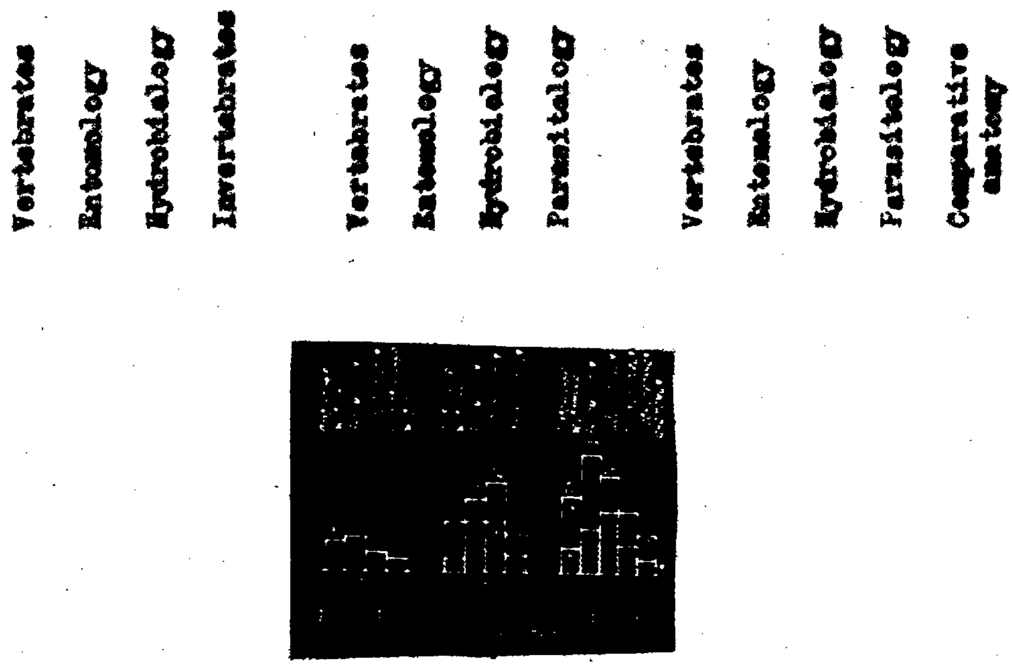

Fig. 7. Distribution of scientific workers according to specialty

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1024

Mirzabekian, R. O.

Antibioticheskie veshchestva aktinomitsetnogo proiskhozhdeniia protiv fitopatogennykh mikroorganizmov.

/Antibiotic substances of an actinomycete origin against phytopathogenic microorganisms/.

Akademii Nauk SSSR. Seriia Biologicheskaia, vol. 24, no. 1, p.103-110. Jan./Feb. 1959. 511 Sa2B.

(In Russian)

At present a great deal of experimental material found in literature confirms a series of advantages of antibiotic substances of microorganisms over chemical preparations: fungicides and bacteriocides.

Work accomplished in the past 7 to 10 years in our country and abroad leaves no doubt that microbe antagonists and antibiotic substances will from year to year be used more widely as disinfectants, in the prophylaxis and treatment of vegetative plants and also in the decontamination of soils from some soil infections.

The problem of the given work is to develop biological methods of control of two pathogenic fungi that are objects of external and internal quarantine - Synchytrium endobioticum (Schilb.) Perc., the causal agents of potato wart, and Diplodia zeae (Schw.) Lev., the causal agent of diplodia in maize.

It must be noted that the causal agents of the indicated diseases which we study vary distinctly /from each other/ as to their biology. One of them - the causal agent of potato wart, S. endobioticum - is an obligate

Institut Genetiki Akademii Nauk SSSR /Institute of Genetics, Academy of Sciences USSR/.

parasite, the other fungus, D. zeae - causal agent of diplodia in maize - is a facultative parasite.

Potato wart is a very harmful disease. The methods used at present to eradicate the foci of potato wart by means of chemicals are very expensive and require special safety measures when work is carried out with extremely poisonous substances, such as chloropicrin and caustic soda. Hence, scientific-research organizations are searching for more readily available and more effective measures against this disease.

The use of the cultures of microbe antagonists from the actinomycete group and their antibiotic substances against the causal agent of potato wart could be such a method.

As mentioned above, the fungus S. endobioticum, causal agent of potato wart, is an obligate parasite that does not grow on artificial culture media. This circumstance makes working with it difficult. The laboratory methods used in the selection of microbe antagonists are sufficiently developed with regard to phytopathogenic facultative parasites. But these methods cannot be used in work with obligate parasites, particularly with the causal agents of potato wart. The method which we developed involving contact of dormant /pokoiashchikhsia/ zoosporangia of the fungus S. endobioticum with the cultures of actinomycetes undergoing tests proved the most suitable and convenient for the given object. A detailed description of the method used and the results of the work will be found in our article (Mirzabekian and Sinitsyna, 1956). This method will make it possible to observe changes occurring in the protoplasmic content of the sporangia directly under the microscope. /Begin p.104/.

It must be noted that all the strains selected from the antagonists belong to the actinomycetes pigment group. The presence of antibiotic substances in these cultures was also checked against a series of causal agents of plant diseases (bacteria and fungi) and on Staphylococcus aureus 209. The pigments secreted by actinomycetes into the medium played an especially important role in the selection. By coloring the deformed protoplasmic content of sporangia, they produced the possibility of observing pathological changes and of establishing the mechanism of action exerted by antibiotic substances upon fungus sporangia.

Experiments described in literature (Glimme, 1926) /demonstrated/ how the author had been unable to establish the penetration of colors, generally recognised in mycological practice, through a solid membrane (the chitin layer) inside the sporangia of the fungus S. endobioticum. To counterbalance the experiments conducted by the indicated author with conventional dyes that failed to penetrate inside the sporangia, we, for the first time, established that there occurred a free diffusion of pigments (blue and red) of a biological origin that colored selectively only the internal protoplasmic content of the sporangia of S. endobioticum and left the membrane uncolored.

In a microscopic study of the sporangia of S. endobioticum the internal content of which was colored the color of either one or another actinomycete pigment strain, we observed various changes of deformation in their protoplasm. Thus, plasmolysis and coagulation were observed. During coagulation the entire protoplasm was concentrated in most cases in the center of the sporangium in the form of one coagulate deprived of its graininess.

There were sporangia with vacuoles the coagulated content of which appeared in the form of individually scatterred small clots and coagulates.

Similar phenomena were observed also in sporangia found in slices cut from the tissue of fresh outgrowths, except in these the penetration and coloring occurred later. During the contact of sporangia with the actinomycete culture 711, more empty sporangia - a membrane without a content - got into the preparations. This is an interesting phenomenon: the antibiotic substances of this strain, probably, stimulate the exit of zoospores from the sporangia, or the internal content loses its graininess under their influence, as if it were resolving.

In preparations made from control variants, nearly all sporangia were unchanged - with a normal graininess.

When sporangia with a colored coagulated or plasmolyzed internal content were placed into a drop of water, plasmolysis did not occur which, according to data by I. A. Doroshin and S. V. Gorlenko (1951) and other authors, serves as evidence of their inability to survive. We, however, consider that the biological method permits solving conclusively the problem of the reciprocal relations between the above indicated sporangial changes and their viability. In order to obtain active antibiotic substances against the indicated fungus, the selected actinomycete antagonistic strains 70, 103, 134, 167 and 711 were cultivated on different nutrient media: mineral, organic and natural. During the cultivation special attention was paid to the intensity of pigment secretion during the process of the growth and development of the procreants.

Observations have demonstrated that pigments were secreted more intensively on potato slices. On some culture media pigments were not secreted at all. The potato slices were colored throughout in the color of the procreant's pigment.

An intensive phenomenon was observed in the culture of strain 711. In the course of 20-25 days the small pieces were gradually liquefied into a thick, transparent liquid of a dark-brown color in mass with a greenish-yellow hue in a thin layer. The unliquefied portion of the slices remained in the liquid in the form of viscous, mucous coagulants of a dark-brown color. /Begin p.105/

The antibiotic activity of the cultural liquid of this strain against St. aureus was very high, reaching up to 60 thousand units per ml. The antibiotic substances were resistant to light and possessed thermostability: they do not lose their antimicrobial activity even after undergoing autoclave at 1 atm for 10 minutes. In this case the antibacterial activity decreases somewhat, but the antifungal activity is fully retained. In determining the antibiotic activity of the cultures against the sporangia of the S. endobioticum fungus in slices cut from tissues of fresh outgrowths, as well as in dormant sporangia (in suspended drops), the best results were obtained from the actinomycete strains of 70, 103 and 711 grown on potato slices and pigmented distinctly the color specific of the procreants' pigments. After the activity of the antibiotic substances of the indicated actinomycete strains grown on potato ~~chips~~ slices had been tested under laboratory conditions, it was tested /also/ by the biological method, i.e. in vegetative experiments. Wart infection is transmitted through the soil when potato tubers are planted. A mass exit of zoospores from the dormant sporangia in the soil begins when conditions are favorable (moisture, temperature); when the zoospores get into young potato shoots, they penetrate inside of them, multiply and form outgrowths. In setting up vegetative experiments an appropriate filler (component) was selected for the purpose of preserving the activity of antibiotic substances for an extended time after they had been introduced into the soil. The mixture of this filler with the actinomycete culture we named provisionally a "compost". The experiments were set up in soil artificially inoculated with winter sporangia of the S. endobioticum fungus at the rate of 250-300 sporangia per gm of soil. The susceptible potato variety Vale was used in the experiments. Composts were introduced into the soil by various methods. Experiments were conducted also in pre-seeding treatment of tubers with antibiotic substances which we obtained and with standard antibiotic preparations - penicillin, streptomycin, biomycin and grisemin with an activity of 1000 units per ml.

The best results were obtained when composts were introduced into the hill simultaneously with the tubers at the time of planting.

The results of this experiment have demonstrated that with nearly the same decrease in the number of sporangia in the soil, i.e. after the exit of zoospores from the sporangia, total infection in controls comprised 97.6%, of this incidence 82.8% was due to infection occurring at an early date, while in variants that had been /planted/ with composts the infection percentage was reduced to 16-25. In addition, the experiments disclosed late infection.

It is obvious from the above that upon introducing into the hills composts enriched with the antibiotic substances of the actinomycete cultures indicated above, the percentage of wart infection had sharply decrease. This can be explained by the fact: 1) that a protective zone - a barrier against the causal agent of potato wart, the fungus S. endobioticum - is created when composts rich in antibiotic substances are introduced /into the hills/. As

As zoospores leave the sporangia they get onto the compost zone before they come in contact with the young shoots of tubers and most of them perish from the antibiotic action of the compost; 2) apart from the above, a portion of the sporangia may, prior to the exit of the zoospores, lose their viability under the influence of antibiotic substances if they come in contact with them. Late infection of potatoes by wart observed in our experiments coincide with the inactivation of the antibiotic substances of the compost in the soil. In determing the duration of the activity of the antibiotic substances within the compost after it had been introduced into the soil, it was established that their activity lasts from 30 to 45 days, which coincides with the duration of the infection. This phenomenon indicates a correlative relationship between the time (late) of potato infection with wart and the retention of antibiotic activity of composts after they have been introduced into the soil.

In recent years, work conducted by a number of Soviet and foreign investigators has demonstrated /Begin p.106/ that in the presence of energetic substances in the soil, antagonists secrete /vydeliaiut/ antibiotic substances in the soil. These substances are capable of preserving themselves in the soil; the duration of their preservation depends on the properties of the antibiotics themselves and on the character of the soil (Gottlieb and Siminoff, 1952; Grossbard /or Grossbarb/, 1953; Stevenson, Lochhead, 1953; Krasil'nikov, 1954; Koreniako, Artamonova and Letunova, 1955).

We assume that the penetration of antibiotic substances into potato shoots and tubers plays a rather important role. We established in experiments in preseeding treatment and in the introduction of compost into potato hills that some antibiotic substances penetrated inside the tubers and retained their activity. In digging up the tubers (vegetative experiments) it was found that the maternal tubers /matochnye klubni/ had the coloring of the actinomycete procreants' pigments, which evidenced the penetration of the pigment complex inside the tubers. It is possible that this artificially increases the resistance of tubers to wart infection and creates a passive immunity.

Similar data are found in our work (Mirzabekian and Man'kova, 1955) on the use of antibiotic substances against the causal agent of bacterial wart in tomatoes.

Furthermore, we assume that some antibiotic substances, having spent a long time in the rhizosphere of plant roots and having penetrated through the roots into /the plants/ and taken part in metabolism are capable of changing the metabolism of the host plant. In this direction, data of our experiments carried out with tomatoes (Chudo rynka/Miracle of the market/ variety susceptible to bacterial wart) have preliminarily demonstrated that large doses of some antibiotics used in treatment of seedling roots prior to planting in the field provoke changes in plant organs: formation of many petaled, coalesced, fasciated flowers, and multichambered, deformed, ribbed fruits. It can be assumed that the useful doses that in our experiments provoked deformed alterations are capable also of changing plant metabolism. Consequently, the possibility of changing the immunobiological properties of the host plant is not excluded.

Experimental work conducted in this direction continues and is in the process of study.

As indicated at the beginning of /this/ work, the next object of study was the fungus D. zeae, the causal agent of diplodia in maize.

Diplodia in maize is considered one of the injurious diseases of this crop. Seed infected by the fungus D. zeae present the greatest danger. There is an indication in the literature that upon planting seed infected by diplodia, thin sprouts and poor development of the plants have been observed. In cases of internal infection in which the fungus has penetrated into the embryo, maize seed lose the ability to germinate. If the infection has not penetrated deep enough and the embryo has not been impaired, then the fungus grows simultaneously with the emergence of shoots from the seeds. It develops and penetrates into the shoots. In such a case the plants perish. Plants are likely to become infected even when they have reached a height of 15 cm and more.

Even though the fungus D. zeae is injurious, its biological and morphological properties render it nonetheless a convenient object for the elucidation of the problems that have been put before us in the given work.

As a facultative parasite, the fungus D. zeae grows rapidly and adequately on culture media. Pycnidia that are visible to the naked eye appear on the sterile grain of maize within a few days. The spores that develop in pycnidia measure 20mm-30mm x 6mm. These large sizes of the spores make it possible to investigate under a microscope (suspended drops) the changes occurring within them due to the action of antibiotic substances.

Antagonists were isolated from the same collection of actinomycete strains as in the work carried out with the causal agent of potato wart. They were isolated by means of obtaining /Begin p.107/ zones of inhibition of the fungus surrounding blocks of actinomycete cultures.

The character of antagonist action - fungicidal and fungistatic capacity - was determined by microscopic control. Often, when inspection was carried out with the naked eye or with a magnifying glass, the growth of a fungus mycelium was invisible, but under a microscope it could be seen in the form of thin, transparent thread-like silhouettes. Hence, after microscopy, when a small piece of agar was transferred from such zones onto an appropriate medium, we obtained a growth of the fungus D. zeae that was somewhate retarded as compared with that of the original culture (fungistatic capacity). We succeeded also in establishing the complete sterility of the zones, i.e. the fungicidal action of actinomycetes. Out of the 205 strains tested 104 strains produced an inhibition zone, of these only 7 strains exerted fungicidal action upon the D. zeae fungus. The inhibition zones of the latter proved to be sterile under the microscope, as well as during a passage in malt-agar /suslo-agar/. All the other strains exerted fungistatic action.

An especially great fungicidal activity was displayed by some actinomycete strains from the same pigment group that was used in tests against the causal agent of potato wart, to wit: strains 103, 134 and 711.

Results of experiments conducted to determine their activity have demonstrated that much activity was displayed by the actinomycete strains 103, 134 and 711 that had been grown on potato slices. The diameter of the inhibition zone of strains was 103 - 4-5 cm; 134 - 2-2.5 cm and 711 - 1-1.5 cm. The diameter and thickness of the blocks of potato slices were identical in all experiments - 0.7 cm. Similar data were obtained in determining the activith of the extracts of these strains from cultures on potato slices.

Table

Results of the germination of spores after treatment with antibiotic substances

Name of antibiotics and number of actinomycete strain	Antibiotic activity against *St. aureus*	Number of spores in preparations	Number of germinated spores within the following space of time (in 24 hours)										Changes in the protoplasmic content
			1	2	3	4	5	6	7	8	10	15	
Strain 103	27	123	0	0	0	0	0	0	0	0	0	0	Graininess, drops with a bright red coloration
Strain 134	243	118	0	0	3	10	12	18	19	19	21	21	Ungerminated, elongated, grainy spores, drop slightly colored red
Strain 711	60,000	121	0	0	0	5	11	12	15	16	18	18	Similar changes, graininess, drops
Strain 70	81	108	63	41	0	0	0	0	0	0	0	104	Mycelium well brached-out and has a blue coloration
Gri[illegible]in, a powder	2,000	112	0	0	0	1	3	8	13	15	15	15	Mycelium in germinated spores deformed: short, not branched out, inflated
Control	-	115	20	32	48	101	108	0	0	0	0	108	Normal mycelium

/Begin p.108/

We, however, consider that the sensitivity of the fungus mycelium and spores to antibiotic substances need not always manifest itself alike. Hence, to establish these, it was necessary to test the antibiotic action of the active actinomycete cultures on the viability of the spores of the *D. zeae* fungus.

The action exerted on the viability of the fungus spores was tested by the method of spore germination in moist chambers and by passaging treated spores on culture media favorable for their growth and development. For these experiments, pycnidia with spores of the fungus were obtained on sterile maize grains inoculated with the D. zeae culture. The inoculated grains were placed in an incubator at 26-27° /C/. In normal fungus development, pycnidia with spores that are in the process of separating from them begin to appear on the grain in the test tubes. Their presence and number were established under a microscope. The grains that were badly overgrown by the fungus D. zeae were treated with antibiotic substances by placing them (one grain at a time) into test tubes containing extracts of actinomycete cultures.

In addition to the antibiotic substances of the actinomycete strains 103, 134 and 711, tests were made of the antibiotic substances of the actinomycete strain 70, because in the process of determining its spectrum of action it was established that it exerted a stimulating effect upon the growth and spore formation of the fungus D. zeae. Standard preparations of antibiotics - biomycins, grisemin and terramycin - were also used for comparison. Spores used in all variations were taken from cultures of the same date of plating. Sterile water instead of antibiotic substances was used for controls.

Fig. 1. At left, maize grains infected by spores of the fungus D. zeae and treated with the antibiotic substances of strain 103, the maize grains were left sterile; at right, controls that were not treated - abundant growth and sporulation of D. zeae.

The results of the accomplished experiments demonstrated that only the spores treated with the antibiotic substances of the actinomycete strain 103 with a subsequent passage through malt-agar /suslo-agar/ nutrient media and the sterile maize grains lost their viability. For 6 months the fungus produced no growth on the indicated media. A very interesting phenomenon was observed while microscoping such spores (treated with antibiotic substances).

Their internal content had a bright red coloration of the preereant's pigment. The pigment penetrated unhindered through the membrane in this case as well, and gradually colored the internal content; as the exposure increased, the internal content of the spores was colored more intensively. Simultaneously with the coloring, the internal content of the spores underwent important changes: graininess, coagulation, formation of large drops in the form of fatty drops of a red color (fig. 1, 2, and 3). The results of determining the viability of spores treated with the antibiotic substances are cited in the table. Data of the table demonstrate that spores treated with the antibiotic substances of the actinomycete strain 103 lost their viability completely - not one spore germinated. In the other variants germination of spores is very poor as compared with controls. The mycelium in germinated spores is deformed: it is thick, short and branchless, with the exception of the variant of strain 70. /Begin p.109/. In this case a reverse phenomenon was observed: an intensive germination of spores, a normal, adequately ramose mycelium and with a blue coloration at that. Here, the penetration of the pigment complex inside exerted a stimulating action upon the growth of D. zeae. Similar data were obtained in treating seed infected naturally by the D. zeae fungus with the indicated antibiotics. In this experiment, too, the antibiotic substances of strain 103 exerted a fungicidal action upon the fungus D. zeae. The experimental material obtained in testing antibiotic substances against the fungus D. zeae - causal agent of diplodia in maize - confirmed the data on experiments conducted in a study of the action of antibiotic substances upon the sporangia of the causal agent of potato wart. The pigment complex plays an important role in this case as well. The pigments themselves possess antibiotic properties, or they determine the secretion /vydelenie/ of specific antibiotic substances that possess antifungal action.

/Inserted plate between p.108-109/.

Fig. 2. Controls - normal spores of the fungus Diplodia zeae.

Fig. 3. Spores of fungus Diplodia zeae after treatment with antibiotic substances of the Actinomycete strain 103 with a deformed internal content.

There are indications in literature (Imshenetskii, 1947) concerning the relationship between antibiotic properties of microorganisms and their secretion of pigments into the surrounding medium.

CONCLUSIONS

1. A new method has been developed for the selection of microbe antagonists against the fungus S. endobioticum - obligate parasitic agent of potato wart.

2. Microbe antagonists that belong to the pigment group of actinomycetes acting against the fungi S. endobioticum and D. zeae have been isolated. Active and stable antibiotic substances with a wide spectrum of action have been obtained. Some actinomycete antagonists grown on potato slices produce specific antibiotic substances with pigments of selective action.

3. The pigment complex plays an important role in the specificity of antibiotic substances. It is possible that the pigments themselves possess antibiotic properties, or that their presence determines the secretion of specific antibiotic substances by the procreants into the culture medium. Pigments of biological origin penetrate readily through the membrane inside the sporangium of the fungus Synch. endobioticum and inside the spores of the fungus D. zeae. This makes it possible to observe changes occurring in the

protoplasm - to elucidate the mechanism of the action of antibiotic substances.

4. The antibiotic action of the strains of actinomycete antagonists has been tested by the biological method in vegetative experiments and it has been established that the use of some antibiotic substances of these strains decreased sharply the infection percentage of potato wart from 96% in controls to 15-25% in experiments. Besides, infection in controls was observed at an earlier date.

5. A correlative relationship between the intensity of potato wart infection and the duration of activity of antibiotic substances after their introduction into the soil has been established. Some antibiotic substances (in vegetative experiments) have retained their antibiotic activity in the soil 30-45 days.

6. It has been established that antibiotic substances penetrate into potato tubers. This, possibly, explains the slight infection percentage of potato wart found in tubers in experiments as compared with controls.

7. The best methods for the introduction of antibiotic substances into the soil for the purpose of disinfection and for the protection of potatoes against infection have been established in vegetative experiments. Some of these antibiotic substances in native form may hold out prospect for the control of potato wart and diplodia in maise. /Begin p.110/.

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Shcherbakov, V. K.

Soveshchanie po poliploidii u rastenii.

/Conference on Polyploidy in Plants/.

Akademii Nauk SSSR. Izvestiia. Seriia Biologicheskaia
vol. 24, no. 1. p.151-154. Jan./Feb. 1959. 511 Sa2B

(In Russian)

The Conference on Polyploidy in Plants was held at the Moscow Society of Naturalists from June 25 through 28, 1958.

The Conference heard and discussed 36 reports on general and specific problems of polyploidy. About 200 delegates representing a number of research institutes from different cities of the Soviet Union took part in the work.

Polyploidy - a multiple increase in chromosome sets within a cell - leads to the enrichment of cells with nuclear material and, on the basis of this, to the appearance of new hereditarily fixed characteristics and properties. The large scope of variation inherent in polyploidy offers rich material for natural and artificial selection. Thus, polyploidy in nature is of great importance in the acquisition of new forms and species, and in cultivation it serves as a rich base for the creation of new and more productive plant forms.

The problem of polyploidy is in close proximity with the most important biological problems: the regularities of species formation, ontogenesis, physiology of cell division, the correlative role of nuclear and plasmic elements, overcoming of sterility, problems of oncology etc.

At the Conference, special attention was paid to problems of the development of polyploidy in tissues in ontogenesis, to the role of polyploidy in the emergence /stanovlenie/ and distribution of new species, greater resistance of polyploidy to various external influences, particularly with regard to ionizing radiation etc.

The Conference was opened by B. L. Astaurov who characterized the great, overall biological importance of the problem. Reports devoted to general theoretical problems of polyploidy were submitted by V. L. Ryzhkov, P. A. Baranov and T. S. Matveeva, L. P. Breslavets and others. /Begin p.152/.

In V. L. Ryzhkov's report "Quantitative-qualitative relation in Polyploidy" it was noted that there occur in polyploidy a series of phenomena of different biological directions. The study of an organism as a single whole in its development and quantitative relations within the genome permits investigating the limits of the capability of the organism to control its own chromosome apparatus and to regulate the anomalies that arise within it.

In the report "Importance of polyploidy in experimental botany", P. A. Baranov called for a profound /study/ of the theoretical aspect of the problem. As a method of experimental botany, polyploidy can and must be utilized in the solution of many general biological problems. In the opinion of the speaker, numerous experiments have demonstrated not only the possibility of increasing chromosome sets experimentally, but also the leading role of the nucleus in the activity of a cell, while the regularities of the manifestation of characters and properties in polyploid progeny serve as the best confirmation of the accuracy of the chromosome theory of heredity.

L. P. Breslavets (Moscow), in the report "Importance of polyploidy in the alteration of characters in plants" presumes that constancy in experimentally obtained polyploids depends on the speed with which the generations of polyploid plants adopt the polyploid state; this has been established on the basis of cytological investigations.

In the report "Embryology of some poloyploids obtained experimentally", by V. A. Poddubnaia-Arnol'di (Moscow) were presented the results of comparative embryological investigations of polyploid forms of kok-saghyz, tobacco and buckwheat. The report "Embryological investigation of an allopolyploid form of peppermint as compared with the original", by S. A. Admiral'skaia (Krasnodar) was also heard at the Conference.

Karyological investigations of tissues conducted during the last two decades have demonstrated that polyploidy has an essential role in the ontogeny of a plant during its differentiation. Development of polyploidy in differentiating cells occurs by menas of endomitosis - division of chromosomes in a "quiescent" nucleus not accompanied by the division of the nucleus itself and the cell, which in general outline resembles a polyploidisation caused by colchicine. The pair arrangement of chromosomes characteristic of postendomitotic mitosis is one of the convincing confirmations of the concept of individual continuity, succession of chromosomes. These problems were discussed in the reports "Polyploidy in plant ontogeny", by O. I. Zakhar'eva (Leningrad) and "Development of polyploidy in tissues in plant ontogeny", by L. I. Lipaeva (Moscow).

In the report "Methods of experimental obtaining of polyploids", by V. K. Shcherbakov (Moscow), special attention was paid to the problem of directed obtaining of polyploids. Of all the methods used in obtinaing polyploids, chemical action is the simplest one to apply and produces a more directed effect which, in some cases, permits obtaining polyploids after exerting action up to 100%. The method of directed obtaining of polyploids by means of stimulating further division of already differentiated polyploid cells by the action of nucleic acids, levulose sugar, some growth substances etc.

The success of obtaining polyploids depends to a considerable degree on timely detection and preservation of polyploid material. In view of this, the study of traits characterising a polyploid state in plants is of great importance. A. N. Sokolovskaia (Leningrad), in her report "Relation between the chromosome number and the size of the pollen grain in wild species of plants", demonstrated a direct relationship between the chromosome number and the size of the pollen grain (especially for autopolyploids).

The reports "Spontaneous polyploids in tuber-bearing species of potatoes", by R. L. Perlova (Moscow) and "Geographical distribution of polyploids in mountainous and Arctic regions of the USSR", by A. N. Sokolovskaia and O. S. Strelkova (Leningrad) were devoted to the problem of geographical distribution of polyploids. On the basis of a study made of the chromosome numbers in 600 plant species of the wild flora of the USSR, it was established that species with an increased chromosome number are preponderant in mountainous and Arctic regions.

The high resistance of polyploids to external factors was noted not only during the study of the geographical distribution of polyploids, but also at the reaction of polyploids to external influences under experimental conditions. On the basis of a cytological study of nuclear disturbances in diploids and autotetraploids caused by ionising radiation, V. V. Sakharov (Moscow) in his report "Polyploidy and radiation" arrived at the conclusion that the greater stability of polyploid buckwheat as compared with the diploid /type/ is not only a resultant of increased chromosome sets in a cell, but is also a result of the manifestation of properties of a unique "physiological safeguard."

Lively discussions were provoked by the report of Iu. P. Miriuta (Novosibirsk) "Polyploidy as a means of fixation and increase of heterosis". In the opinion of the speaker, the detection of a highly constant, hybrid state of pure lines in plants opens the possibility of asserting that there is a community in the hybrid state of organisms, and the transmission of /Begin p.153/ the hybrid state to the progeny is accomplished in self-pollinating asexually multiplying plants with the aid of polyploidy.

A large number of reports was devoted to the importance of the use of polyploidy in cultural plants. Achievements attained in this realm open wide possibilities for the disclosure of the law of form development and designate the means for the transformation of plants in the interest of practice.

V. L. Menabde in the report "A polyploid series in the population of the Georgian wheat Zanduri" presented the results of a study made of the origin of Georgian wheats, as a result of which there were discovered a series of phenomena valuable in the elucidation of far-reaching problems of the phylogeny of the genus of wheat, as well as of the nature and evolutionary importance of some forms of hereditary changes. A. R. Zhebrak came forth with a large survey, "Polyploidy in wheats". The author has obtained wheats with a high chromosome /number/ (2n = 56, 2n = 70) from which he isolated a series of economically valuable forms. O. N. Sorokina (Moscow), in her report "Aegilopse-wheat allopolyploids", presented the results of her work conducted in obtaining sesquidiploids that are distinguished by group immunity to leaf rust /Puccinia triticina/ and yellow stem rust /Puccinia graminis tritici/ and hold out prospects for being included in work of wheat breeding /selektsiia/.

G. K. Bondarenko (Dnepropetrovsk) presented the report "Influence of conditions of growth upon polyploidy in wheat-rye hybrids". In the process of genetic-selection work with hybrids, the author isolated promising varieties of winter wheat that now are undergoing State variety tests at the Sinel'nikov Experimental Breeding Station.

Two reports were devoted to polyploidy in millet - "Methods of obtaining large-grained forms of millet", by I. N. Zaikina (Moscow) and "Autotetraploids of millet obtained by the action of colchicine", by A. S. Afanas'eva (Moscow). The reports "Obtaining polyploid buckwheat under natural conditions", by M. I. D'iakova (Moscow) and "Appearance of tetraploid forms in interspecific grafting of buckwheat", by V. K. Sal'nikov (Moscow) were devoted to polyploidy in buckwheat. V. K. Sal'nikov's hypothesis that the appearance of tetraploids is a resultant of directed influence of the rootstock provoked serious doubt and the material presented was not recognized as conclusive.

The reports "Importance of polyploidy in the systematics of potato species", by S. M. Bukasov, "Spontaneous polyploids in tuber-bearing potato species", by R. L. Perlova, "Experimental polyploidy in the genus Solanum", by N. A. Chuksanova (Leningrad)/and/ "Polyploidy in some potato species", by N. A. Lebedeva (Leningrad) were devoted to polyploidy in potatoes. Based on the utilization of spontaneous polyploids of potatoes, excellent varieties immune to Phytophthora and wart have been created in the Soviet Union and /also/ in foreign countries. Valuable characteristics of hybrids added by wild species with a low chromosome number, are, in cases of polyploidy, not only preserved, but often even increased.

M. F. Ternovskii (Krasnodar) sent to the Conference the report /entitled/ "Polyploidy in the genus Nicotiana". He obtained a series of varieties by means of multiple crossings of an amphidiploid (Nicotiana glutinosa x N. tabacum) with tobacco and subsequent selection that were distinguished by new characteristics for cultural tobacco - immunity to tobacco mosaic and downy mildew /or blue mold - muchnistaia rosa/. Many of his varieties have been widely regionalized.

The report by A. I. Atabekova (Moscow), who had made substantial corrections in the polyploid series of lupine, was devoted to the karyological system of the genus Lupinus.

I. I. Marchenko (Kiev; "Cytological study of Jerusalem artichoke-Sunflower hybrids and of the hypothesis of the origin of the genus Helianthus") reported about prospects for economic utilization of the sunflower-Jerusalem artichoke hybrids which he obtained. The hybrids - highly productive forage plants of double usefulness (green mass and tubers) and also a valuable technical crop in the production of sugar-fructose.

A series of reports was devoted to polyploidy in essential oil crops and medicinal plants. A. N. Lutkov (Leningrad) cited in his report "Polyploidy in essential oil crops" a series of examples of successful utilization of polyploidy in the selection of these crops. The triploid variety of peppermint, Prilukskii-6, which the author introduced, has been regionalized. V. S. Andreev presented an interesting report on the experimentally obtained autotetraploid form of the Damascus nutmeg flower. N. M. Berezina (Moscow; "Methods of obtaining and economic importance of polyploid forms of pink geranium") succeeded in restoring productivity in geranium on the basis of polyploidy; as a result, the productivity, the properties and the output of essential oil increased in the new form.

Extensive work of obtaining polyploids in medicinal plants has been unfolded at the base of the Moscow Pharmaceutical Institute (report by V. V. Sakharov, "Polyploidy in medicinal plants"). Of the polyploids of pyrethrin camomile obtained by V. V. Sakharov, the triploids have special value. V. S. Andreev presented also the report "Some characteristics of experimental polyploid forms of opium poppy".

T. S. Matveeva (Leningrad) reported about rich material on polyploidy in ornamental plants in which the manifestation of polyploidy is especially effective (the title of the report is "Polyploidy in ornamental plants") /Begin p.154/. Of the polyploid forms of annual and perennial plants obtained by the speaker experimentally, Campanula persicifolia is of special interest.

Material on polyploidy in fruit plants was reported on by fellow workers of the Central Genetics Laboratory im. I. V. Michurin. I. M. Zhironkin ("Polyploid hybrids of the red currant of Kyzyrgan x the black currant Davision's Eighth /Vos'maia Devisona/") discovered for the first time the polyploid series of Ribes grossularia family (2n = 8 - haploid, 16, 24 and 32) in experiment polyploidy. A series of valuable elite forms was obtained form the second generation of triploids, three of these have been surrendered for State variety testing. E. N. Kharitonova, in her report "Concerning the problem of re-establishing productivity in the hybrids of the cherries /Prunus cerasus/ - /Cerasus avium/" indicated prospects for creating productive amphidiploids from Prunus cerasus-Cerasus avium by means of doubling the number of chromosomes artificially.

N. V. Matskevich /a woman/ (Moscow) who submitted the report "Polyploidy and its importance in forest /tree/ selection" pointed out that there is a need to begin working in this realm in our country and she mapped the course on which this type of work is to be built.

The reports heard at the Conference were discussed extensively. A series of problems were brought up and discussed during debates that had not been reflected directly in the program of the Conference, /for instance/: polyploidy in animals and in lower plants, the role of polyploidy in the problem of malignant growths. The speakers and those who took part in debates stated a series of wishes with a view to organizing work on polyploidy throughout the country; these wishes are reflected in a resolution adopted at the Conference.

In this resolution it is indicated that it is essential to inform widely the leading agencies of the achievements that have already been attained in the creation of new polyploid plant varieties, and to ask these agencies to apply measures that would strengthen the work of using polyploidy for the purpose of creating new, highly productive plant varieties.

As a means of securing measures to organize work, the Conference adopted a resolution to approach the Academy of Sciences USSR with the request that the Academy create a Committee for the purpose of working out a problem memorandum indicating the proper development of scientific-practical work on polyploidy, and that it also create within the system of the Academy of Sciences USSR, in the academies of sciences of the Union Republics, at VASKhNIL and at the Academy of Medical Sciences USSR special laboratories or groups that will conduct work on a study of all basic problems and questions having a direct bearing on polyploidy, including problems of malignant growths.

The Conference addressed biologists whose sphere of work is in the field of biochemistry, biophysics, physiology, morphology, taxonomy and ecology of plants, and it appealed to them to join the work of investigating natural and experimentally obtained polyploids and to utilize polyploidy in their work as a method of experimental biology.

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Gresin, V.

Antibiotiki v zhivotnovodstve.

/Antibiotics in animal husbandry/.

Moskva, Moskovskii Rabochii, 1958.
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(In Russian)

p.19-24

ANTIBIOTICS FOR LARGE CATTLE

Antibiotics are utilized in raising calves for the purpose of their better development, when treating certain infectious and noninfectious diseases of large cattle, as well as a means for protecting the bulls' semen from the effect of foreign microflora.

ANTIBIOTICS IN RAISING CALVES

When raising calves it is necessary, first of all, to strictly observe the established system of feeding, care and maintenance. The experience of leading farms shows that with a proper system of rearing it is possible to fully preserve the young livestock.

Rearing the young animals of milk breeds has its peculiarities. The calf is weaned from the cow during the first few days and is artificially fed through a special nipple /Begin p.20/ or from a pail. Healthy calves retain after this the suckling reflex for a certain time; they often suck the surrounding objects, which are often unclean. This can lead to a disruption of the normal activity of the gastro-intestinal tract of calves and to a subsequent sharp decline in the increase in weight.

Unsatisfactory development of the young stock can be noticed during crowded maintenance of calves, bad care, and antisanitary conditions of buildings.

On farms, where calves are placed in dry, light, clean stalls, with good ventilation, or in individual cubicles the young stock is healthy and develops normally, as a rule.

Experienced calf maids pay special attention to the feeding of newborn calves and already after the first feeding of colostrum they determine the regime of feeding for each of them. If the calf drinks greadily, the feeding is stopped several times, or the opening in the nipple is made smaller. There is a series of other means to provide a perfectly normal development of young animals.

A sure guarantee for raising healthy calves appears to be to feed them antibiotics during the first days of life.

In foreign agricultural literature the information about positive effect of antibiotics on the growth and development of calves began to appear since the year 1950. It was pointed out in these reports that calves, which received antibiotics, under other equal conditions of feeding, care and maintenance, were developing better than those which did not receive the preparations. It was mentioned also that their use is expedient only during the first 12-16 weeks after birth, that is from the moment when the rumen, reticulum and the omasum develop and begin to function.

The experiments have shown that not all the antibiotics produce a positive effect when used in raising calves, but biomycin and terramycin alone, both the pure and the unpurified. These preparations produce the best effect when they are fed to calves at a ratio of from 0.05 to 0.1 gram per head a day.

We conducted special experiments in the sovkhos "Krasnaia poima" in order to find out the effectiveness of feeding antibiotics under farm conditions. One hundred sixty nine calves of the spring calving were taken for the experiment in 1955. /Begin p.21/ Methods of use of penicillin and of biomycin were studied. One group of calves was given penicillin twice a day (in the morning and at night) since the first day after birth, at the rate of 20 milligrams per head during the course of the first 20 days of rearing. The other group was fed biomycin according to the same method. In each variant of the experiment a group of control calves was isolated. The obtained results are cited in table 4 (page 22).

Analysis of data of table 4 shows that the experimental calves, which received biomycin during the course of 20 days of rearing, gave an increase in weight for a month 3.7-18.5% higher than calves of the control group and the group receiving penicillin.

It is necessary to point out that the use of biomycin was accompanied in animals by an increase of the appetite and better absorption of milk nutrients. Gastro-intestinal diseases among calves were noted more seldom and proceeded in a lighter form, than in claves of the control group. Whereupon the appetite was fully retained in sick animals. In control calves such diseases were very frequent and proceeded in a more serious form, this being reflected in the increases of weight.

Having obtained positive results from the use of biomycin in 1955, we repeated the experiment next year, segregating 100 newborn calves, half-breeds of the first generation of Ost-Friesian /"Ostfrizy"/ and Jersey breeds. The experimental calves were divided into 4 groups. At the beginning calves of the first group were given biomycin for a prophylactic purpose, and then, starting with the third day of life and to the end of the first month, as a feed - in a dose of 0.025 grams per head in the morning and at night. Each calf of the second group received only 0.05 g. biomycin per head during the course of the first month of rearing. Calves of the third group received biomycin only for the prophylactic purpose. The fourth group served as control, and the young animals received biomycin only during gastro-intestinal diseases.

During the course of the month of rearing the conditions of maintenance, feeding and care were identical for all the calves. Both the daily expenditure of milk for each calf, as well as the increase in weight were properly accounted for every ten days /"dekada"/. Diseases of animals were carefully taken care of.

Although all the calves of the control group fell ill one after another, there were no cases of death. There were no losses /Begin p.22/

Table 4.

Results of application of penicillin and biomycin to calves

Breed	Group of calves	Antibiotics	Number of heads	Weight of one head (kg) at birth	Weight of one head (kg) on the 30th day	increase in weight (in %)	Additional increase in weight (in %)
Half-breeds	Experimental	Biomycin	10	30.6	55.7	82	18.5
Jersey	"	"	20	35	59.5	70	6.5
	Control	-	42	33.4	54.6	63.5	-
"Pol'zovatel'naia" /Profit producing?/	Experimental	Biomycin	14	38.8	57	46.7	3.7
	Control	-	3	40.3	59	43	-
Half-breeds	Experimental	Penicillin	20	41	58.4	42	-
Ost-Friesian	"	"	10	37.3	57.5	54.2	-
	Control	-	50	37.5	57.7	54	-

(5)

(text continued from page 21)

also in the first, second and third groups, although individual cases of gastro-intestinal diseases were registered among them. Among the first group, where biomycin was used, at first, for a prophylactic purpose, and then for the purpose of a better development there were only single cases of disease.

What were then the final results of this experiment?

At the end of the first month increases in weight of calves of experimental groups were 10-20% higher than of the control, which received biomycin for medicinal purpose only. The highest increase in weight was produced by the first group of calves and somewhat lower - by the two others.

Difference in increases between the experimental and the control animals varied and depended on the number of calves fallen ill in this or the other group. The more calves had diarrhea, the less increases in weight they produced and vice versa.

Interesting data were also obtained, in 1955, by the foreign scientist, Prichard when studying the effectiveness of biomycin. He conducted his experiments with four pair of twin calves. In each pair one calf received biomycin at the rate of 30 milligrams of the preparation for each 45.3 kilograms of live weight, and the other served as a control and did not receive any antibiotic. Experiments started since the first day of life and continued up to the age of eight weeks. It was established as a result, that experimental calves produced a medium daily increase in weight of 679 grams, for the whole period, and the control, under the same conditions of feeding, maintenance and care - 611 grams.

Practical application of antibiotics in rearing calves is somewhat difficult during the first 10-15 days, when each of them receives milk from its mother. During this period it is necessary to add antibiotics to milk and give the solution separately to each calf. This requires additional expenditure of labor and worker's time.

Older calves, which receive the drawn /"sbornoe"/ milk, get their antibiotics added to milk before feeding. For this purpose, the required portion of antibiotics for the group is first diluted in a small amount of milk and then is mixed with the full norm, which is intended for the given feeding.

Let us cite an exemplary calculation. The calf maid is given /Begin p.24/ in her care a group of calves in the amount of 40 heads. Issuing from the daily dose of 0.05 g per head, we obtain that 0.05 X 40 = 2 grams of the preparation are required for each day for the group and for one feeding (2:2) = 1 gram. This amount of the antibiotic is first diluted in 1-2 liters of milk, and then is carefully mixed with the full measure of milk that is required for one feeding of calves (morning or evening).

The forms of biomycin and terramycin which are not dissolvable in water are given to calves with dry supplementary feeding. In such a case the antibiotics are first mixed with a small amount of bran, and after that are gradually mixed with the feed mix, stirring it very carefully so that the introduced preparation becomes evenly distributed in the entire feed mixture.

Observations show that the use of antibiotics, for the purpose of better development of calves, is the most promising for groups of young animals, which are intended for fattening at an early age. This method is especially profitable on farms, which conduct milk fattening of calves.

p.32-43

ANTIBIOTICS IN ARTIFICIAL INSEMINATION

In foreign countries antibiotics are widely used as preparations which protect the bull's semen from excessive contamination with bacteria. When adding penicillin, streptomycin or other antibiotics to bull's semen, mixed with yolk-citrated, yolk-phosphatic, or milk diluent, microflora cannot develop, even if it does not die fully. /Begin p.33/

It was established by special experiments that for preserving the vitality of the bull's semen the greatest concentration of penicillin and streptomycin is approximately 500 units per 1 milliliter of the diluent. With a larger dose of preparations in the diluent the length of vitality of spermatozoa is considerably shortened. A foreign researcher, Schmidt, has established that the addition of antibiotics to the bull's semen is of purely hygienic importance. Nevertheless, other researchers (for example, Rottensten) mention the increase of the percentage of insemination. Depending on the antibiotic and on the initial quality of semen an increase of fecundity from 1 to 12.9% was noted compared to the control, where antibiotics were not used.

Other antibiotics as yet are not of importance in the practice of artificial insemination.

ANTIBIOTICS IN SWINE HUSBANDRY

Numerous reports of scientific and practical workers, in native and foreign literature, show that the addition of minute amounts of antibiotics to feeds aids in better consumption of feeds and raises the weight increases of the growing young swine stock. The raising of daily weight increases reaches 10-15%, and sometimes even more. At the same time the effectiveness of feed utilization increases by 3-5%.

The accumulated factual data show that not all the antibiotics, used for medicinal purposes, help, to a similar degree, a better development of young stock when it is given with feeds. In connection with this data of table 6, taken from the review of American scientists R. Braude and G. Vallege /"Valledzh"/, are of great interest.

These data are the result of treatment of materials which were obtained in more than 300 experiments of scientific-experimental institutions of USA. All the experiments were conducted under various conditions and for different purposes, but they all indicate quite clearly the advantage of utilization of biomycin in swine husbandry. Young pigs, which received this preparation, gave a mean daily increase of weight 35% higher than the control animals.

/Begin p.34/

Table 6.

Influence of various antibiotics on the weight of swine

Antibiotics	Relative increase in weight of swine (in %)
Aureomycin (biomycin)	135.9
Terramycin	123.7
Streptomycin	115.2
Penicillin	110.6
Bacitracin	109.0
Chloramphenicol	105.5
Polymyxin	96.0
Control	100.0

The animals which received polymyxin developed worse than the control, - the preparation not only did not help a better development of young stock, but produced an inhibiting action. Research of subsequent years has shown the inefficiency of using chloramphenicol (levomycetin) and of bacitracin for these purposes.

At the present time the use of biomycin, terramycin and penicillin is acknowledged everywhere in swine husbandry.

The feeding of antibiotics prevents gastro-intestinal diseases, raises the assimilation of feeds, lowers the number of laggards in growth and helps in the increase of the yield of piglets in litters.

For the purpose of better development of the young stock, antibiotics are utilised during raising of piglets and meat fattening of swine.

ANTIBIOTICS FOR SUCKLING PIGS

Successful raising of piglets depends on many factors: on the conditions of growth of the young stock, on what feeds are utilised on the farm; on the milk productivity of the females and the quality of their preparation for having a litter; on the correct organisation of work on the farm, and on many other things. Work experience shows that introduction of antibiotics into the practice of raising of the young stock of swine permits considerably to increase the production indices of this field of economy. /Begin p.35/

Experiments of Professor A. Kh. Sarkisov, of Candidates of Veterinary Sciences Kh. A. Dzhilovian, A. I. Moskov and O. A. Gavrilova, under conditions of kolkhoses and sovkhozes with the livestock of over 3 thousand piglets, indicate a high effectiveness of penicillin and biomycin in raising the young stock.

These experiments were conducted on the farms under different conditions of feeding, care and maintenance, and during different times of the year.

The litter of every lactating female was divided in two groups: experimental and control. In each one there were sucklings similar in weight, sex and general condition. Beginning with the first day of birth and in the course of 30-60 days, all the experimental sucklings received penicillin or biomycin twice per day. At the beginning antibiotics were administered to each piglet, individually, by mouth. When the piglets began independently to consume the feed, the portion of antibiotic assigned to them was added to the feed before giving.

Antibiotics were used in increasing doses: during the first 10 day period - 0.5 gram, during the second - 1 gram, and during the subsequent days, up to the end of the experiment - 2 grams per day for each 100 heads. The piglets were weighed before the start and every ten days during the course of the experiment. Every day both the experimental and the control animals underwent clinical observations.

Sucklings of the control group were kept together with the experimental, but did not receive any antibiotics. Since the first day of life the sucklings of both the experimental and the control groups had their markings. Usually the right teats of the mother were given to the piglets of the experimental group, and the left to the control. Strong attention was given to correct feeding of the lactating females during the experiments. The sucklings were taught to eat feeds at the proper time. The week old piglets, where it was possible, were offered pure water and dry concentrates (fried barley meal and oatmeal) in special stalls. Early supplementary feeding of piglets gives a possibility to attain good development of the young stock under females with poor milk production and to reduce in litters the number of piglets lagging in growth.

The conducted works have shown that both biomycin and penicillin produce a favorable effect on /Begin p.36/ the organism of suckling pigs. They have a better appetite, they become lively and resistant to various external lunfavorable factors. We cite in table 7, as an example, data obtained by the Scientific Co-Worker, A. I. Noskov, at the kolkhoz "Put' novoi zhizni", Kuntsev raion, Moscow oblast'. In these experiments penicillin was begun to be applied starting when 3-5 days old and continued to be fed up to the 30-40th day of age.

Table 7.

Feeding of penicillin to suckling pigs

Number of the female in succession	Number of piglets under the female (heads)	Among them		Mean daily increase in weight (in grams)	
		those, which were given penicillin	control	Those which were given penicillin	control
1	9	4	5	175	134.7
2	8	4	4	227	203
3	12	7	5	184	170
4	8	4	4	265	151.7
5	11	5	6	202	141
6	10	5	5	190	159
7	9	5	4	243	170
8	9	5	4	239	160

Experiments, conducted at the kolkhoz "Put' novoi zhizni", show that, the sucklings, which received penicillin, developed better than the control independent of the size of the litter under the female and the milk productivity of each of them. At the end of observations the weight of experimental sucklings was, on the average, 0.5-3 kilograms higher than of the control. Individual sucklings differed in weight still more. Similar results were obtained also from the use of biomycin.

Among sucklings, which received antibiotics, laggards in growth and starvelings were absent, while they were present among the control animals.

Owing to diseases during the first days of life, and because of other causes, the, so-called, sanitary groups of young stock are isolated at the swine farms. /Begin p.37/ On the farms, where there are cases of newborn sucklings falling ill with alimentary toxic dyspepsia, the number of piglets lagging in growth attains a large percentage and can reduce the production indices very considerably. Thus, in sovkhoz "Arsen'evskii" no. 1, Tula oblast', where, in March 1954, mass diarrhea was observed, from among 608 sucklings, 163 proved to be lagging in growth. At other farms the number of starvelings was a bit lower, yet here too, they reduced the indices of the farm.

Feeding antibiotics to such sucklings helps a considerable raising in their increases of weight. Appetite appears in sucklings, they begin to eat the feeds more willingly. The mean daily increases in weight of experimental animals happen to be 50-70% higher than in the groups of starvelings, which do not receive antibiotics.

Title of picture: Pig - tenders of the kolkhos "Put' novoi zhizni", Kuntsev raion, Moscow oblast', with piglets 46 days old. At the left: a piglet, which received antibiotics, had a mean daily increase in weight of 288 grams; at the right: the control piglet, whose mean daily increase in weight was 150 grams. /Begin p.38/

As a result of use of antibiotics the farms have additional profit both on account of better retaining of the young stock, as well as from the raising of increases of weight.

The Sovkhoz "Shugarovo", as a result of wide utilization of biomycin and penicillin retained, in 1955, the litter fully in the amount of 2,500 heads. The sucklings, which received antibiotics for the purpose of better development, weighed at the time of weaning 1.5-2 kilograms more than the control.

According to calculations of Czechoslovakian authors (Muller, Shkola) the use of antibiotics will permit to obtain from each million of swine, additionally, products of swine husbandry valued at 1,200 thousand crowns.

At the present time, many farms are known in Moscow oblast', which are using antibiotics in raisings piglets.

Zootechnician Ivanov, of the kolkhoz "imeni Stalina", Klinskii raion, while using antibiotics in raising sucklings from winter litters, attained full retention of the young stock and prevented the appearance of those lagging in growth. At weaning time the piglets weighed on the average 16.4 kilograms.

Moscow Oblast' Veterinary Department has at its disposal data about positive experience of utilization of antibiotics in raising piglets in many kolkhozes of Krasno-Poliansk, Chekhov, Podol'sk and other raions of the oblast'.

In table 8 are cited only some of the farms, where, owing to use of antibiotics in combination with the improvement of feeding and maintenance of swine livestock, it was succeeded to increase retention of the young animals.

Table 8.

Kolkhozes of Moscow oblast, which use antibiotics

Kolkhoz	Raion	Chief Veterinary Surgeon	Received antibiotics (heads)	Percentage of retention of piglets to the time of weaning
Imeni Ostrovskogo	Egor'evskii	Frolunin, B. V.	234	97
Imeni Parizhskoi kommuny	"	The same	157	98
"Pamiiat Il'icha"	"	" "	180	98
/Begin p.39/				
Imeni Stalina	Krasno-Polianskii	Gurkina, N. G.	427	99.9
Imeni Zhdanov	" "	The same	161	100
"Voskhod"	" "	" "	305	98.4
"Krasnaia niva"	" "	" "	471	99
Imeni Makarova	Formerly Zvenigorodskii	Volkov, K. F.	300	100
"Krasnoe znamia"	" "	The same	200	96
Imeni Kalinina	" "	" "	200	100
Imeni Kirova	" "	" "	300	97.5

Before the use of antibiotics losses of young stock in these kolkhozes were higher by 2-16%. Farms, which formerly had high indices for the retention of young stock, later on fully liquidated the losses of sucklings.

Most of the farms in Moscow oblast' follow the temporary regulations on the use of antibiotics in swine husbandry, recommended by the Chief Administration of Veterinary Science of the Ministry of Agriculture of USSR. In table 9 doses are cited for one application of the preparation for one piglet.

Table 9.

Single doses of penicillin and biomycin for piglets

Age (in days)	Penicillin		Biomycin	
	milligrams	thousand of units	milligrams	thousand of units
Up to the 10th day	2.5	3-4	2.5	2-2.25
From the 10th to 20th day	5	6-8	5	4-4.5
From the 20th to 40th day	10	13-16	10	8-9

/Begin p.40/

Since antibiotics are used twice per day, in the morning and at night, then, consequently, the daily dose of the preparation is twice larger than the single dose.

Before giving antibiotics to the sucklings, they are dissolved in drinking water at a ratio of 1 gram of the preparation to 1 liter of water. In each milliliter of such solution is contained 1 milligram of the dry substance. Thus, it is easy during further work to conduct calculations for groups of piglets.

For example, there are 200 sucklings on the farm, 3-5 days old, which will receive biomycin during the course of 30 days. Issuing from the above cited dose, during the first decade of raising the piglets for 200 animals (for each giving) it will be required 200 x 2.5 = 500 milligrams of biomycin. This amount of the antibiotic is dissolved in 0.5 liter of water and added to milk, which is utilized for the supplementary feeding at a ratio of 2.5 milliliter per head. In those cases when the sucklings were not yet trained to drink milk, the solution must be given to each piglet individually.

During each succeeding decade /10 day period/ the dose of the preparation must be doubled. Thus, during the second decade for each group of

200 heads it will comprise (200 X 5) = 1 gram. This amount of the antibiotic is diluted in a liter of pure drinking water, milk or skim milk, added to the feed, mixed carefully and fed to the piglets.

Veterinary workers on the farms prepare ahead of time the weighed portions of antibiotics for several days and pass them on to the farm. Usually penicillin flasks are utilised for this purpose. Into each of such flasks is weighed a required amount of the preparation for a single giving to each group of piglets.

The pig-tenders dissolve the antibiotics, mix them with the feed and distribute them. Of course, they must be first trained to do this work.

One should remember that after the addition of antibiotics the feeds cannot be subjected to steaming, since this may lead to inactivation of antibiotics, that is to reduction of their activity. The effectiveness of the preparations is reduced after this. Feeds with antibiotics must not be subjected to fermentation or any other treatment. They should be fed out during the course of 3-4 hours after the preparation. /Begin p.41/

ANTIBIOTICS IN MEAT FATTENING OF SWINE

Foreign experience in using antibiotics in meat fattening is quite extensive and is of definite practical interest to swine husbandmen of our country.

Utilization of biomycin, terramycin, penicillin and streptomycin, as well as of fungal (mycelial) mass helps in the raising of consumption of fodder, and at the same time raises the increases in weight. Feeding a mixture of these preparations, as well as their rotation does not have any great advantages comparing with the use of each of them separately in a pure state.

Antibiotics are added to the feeds in the following amounts: penicillin from 8 to 20, biomycin from 9 to 20, terramycin from 10 to 20 or streptomycin from 20 to 50 grams per 1 ton of concentrated feed. Raising of doses can only lead to considerable unwarranted expenditure of the preparation, while smaller doses rarely produce a positive effect.

Regardless of the noticeable effectiveness, pure antibiotics are yet rarely used in meat fattening of swine. This is explained by the high cost of purified preparations and by the fact, that the farms are provided with them in inadequate amounts.

At the present time many swine fattening farms, which are situated near factories that produce antibiotics, widely use the wastes of industrial production of biomycin - the biomycin fungal (mycelial) mass. Superficially it looks like thickly kneaded dough-like mass of dark brown color with a greenish tint. Its color and consistency can change depending on the technology of the production of the preparation.

The mycelial mass of biomycin, in its chemical composition, approximates many highly valuable concentrated feeds. As the research of A. S. Borozdin has shown, it contains: protein - from 34.1 to 42.8%; fat - from 16.9% to 25%, nitrogen free substances - from 25.7 to 41.5%; cellulose - from 1.62 to 3.69% and mineral substances - from 3.5 to 4.06% (per dry substance). The biomycin mass is also rich in vitamin B_{12}.

At the swine fattening sovkhoz "Serp i molot", Moscow /Begin p.42/ oblast' we took, together with the farm workers, 474 swine for the experiment, among which 389 received mycelial mass, and the remaining 85 were separated as control and did not receive any fungal mass. Fifty grams of fresh fungal mass per head were added daily during the course of a month to the basic ration. One half of this dose was fed out in the morning, and the other - at night. The portion of mycelium was first dissolved in a small amount of whey (about 1 kilogram in 4-5 liters), and after that added to the morning or evening giving of whey, which was utilized at the farm as supplementary feed. Such a method of feeding is more convenient, as it does not require additional expenditures of labor for uniform mixing of the preparation in the feed.

Results of the experiments have shown that the average daily increase in weight of swine, which received the mycelial mass, was by 55 grams higher than the control. During one month the farm obtained an additional increase in weight equalling 633 kilograms. But the expenditure for obtaining the fungal mass comprised only 105 rubles.

Besides that there are also other advantages in feeding mycelial mass: gastro-intestinal diseases of swine were sharply reduced, and young swine, having diarrhea, recovered much faster.

Data of the Dutch researchers, Oosterhuis and Eikelenboom /"Emkelend"?/ on this problem is of great interest. They conducted their experiment on 127 swine of a large white breed during a bacon fattening. The scientists noted that when the control swine attained 50-55 kilograms of live weight, the experimental ones, which were given biomycin, weighed 19-23% more. During further fattening this difference was somewhat reduced and comprised

12-16% regardless of the fact if the swine received biomycin or not. In the end, the animals which received antibiotics, attained the maximum weight for bacon fattening 16 days earlier than the control.

Similar data were obtained by foreign researchers, Gordon and Tayler in 1953. Their experiment on detection of effectiveness of the influence of penicillin and biomycin on swine during the period of bacon fattening they conducted with 143 piglets. The initial weight of each piglet comprised 18 kilograms, and the final - about /Begin p.43/ 95 kilograms. When antibiotics were added to the ration, which contained vegetable protein, the experimental swine gave an increase in weight 10-15% higher. Expenditures of fodder per unit of increase in weight, compared to the control swine which did not receive any preparations, were 5-8% lower. When antibiotics were added to the ration with animal proteins the average daily increase in weight increased by 12% when compared with the control. Difference in the effect of biomycin and of penicillin was insignificant.

Foreign researchers point out that utilization of antibiotics does not produce any noticeable effect on the quality of the swine carcass. The length and girth, amount and thickness of the fat layer, contents of water and fat in tissues remain normal. And after the additional feeding with biomycin the contents of vitamin B_{12}, riboflavin and nicotinic acid did not change also.

It is possible to make such recommendations on the basis of multiple observations. It is more expedient to add antibiotics to feeds that contain plant proteins. Especially effective are the antibiotics in rations, which consist of corn and plant proteins.

Antibiotics produce a positive effect on the organism of animals both during the pen and the camp maintenance. Pasturing on alfalfa gives somewhat better results than on clover.

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ANTIBIOTICS IN POULTRY HUSBANDRY

A vast and manysided research work was conducted after it was first established in 1946 that antibiotics help in a better development of chickens. At the present time, as a result of this research, it became proved in all the world that antibiotics produce a positive effect on the production indices in poultry husbandry. When antibiotics are added to rations, the meat breeds of poultry attain faster the slaughtering weight, the quality of carcasses is noticeably improved. Addition of antibiotics to the feed of laying hens is not always expedient. Some of the researchers mark the increase in egg laying, while others do not register this occurrence.

The world science and practice are interested in many questions, which relate to the effectiveness of antibiotics in poultry husbandry. The effect of various antibiotics on growth and development of the young stock during its raising is being studied: on /Begin p.48/ the accumulation of meat and fat during fattening; on egg laying of various breeds of hens during both the cage and the run maintenance of birds; on dietetic and breeding qualities of the egg, and much else.

The most expedient conditions are being detected under which it is necessary to utilize antibiotics. For this purpose experiments are conducted where antibiotics are added to rations which have proteins of animal or plant origin, rich or poor in vitamins, and so on.

Title of the figure: Inhibition of growth of bacteria around the specimens of feed with antibiotics (A) and without the preparation (B).

At the present time, special combination feeds for poultry husbandry, enriched with antibiotics, are being produced in many countries of world. Feeding of such feeds to different age groups of poultry permits to raise the profitableness of this field of farming.

The effectiveness of antibiotics in a series of infectious diseases of poultry is quite indisputable.

Data, relating to the use of antibiotics in poultry husbandry are extremely voluminous, and it is impossible to describe them in /Begin p.49/ their full volume in the present booklet. Therefore we will discuss only certain problems, which have a direct relation to the practical utilisation of antibiotics.

ANTIBIOTICS IN RAISING CHICKENS

Special experiments, conducted by A. Kh. Sarkisov, N. S. Akulova and V. F. Grezin, in 1953, at the Kuntsev Poultry Factory, have shown that the addition of 40 milligrams of penicillin and 20 milligrams of biomycin per 1 kilogram of concentrated feed helped in raising the production indices.

In table 10 data are cited according to various groups of chickens, which were under experiments.

Table 10.

Utilization of penicillin and biomycin in raising chickens

Number of the group	Antibiotic	Number of heads	Losses (in %)	Those lagging in growth (in %)	Average weight of one head at the end of the experiment (in grams)
1	Penicillin	428	1.4	1.9	297
	Biomycin	913	1.2	1.3	303.1
	Control	1,000	2.3	6.0	274
2	Penicillin	732	3.3	4.9	322
	Control	1,354	6.6	8.3	269
3	Biomycin	736	3.6	4.9	226.2
	Control	1,585	19.1	16.6	223.5

It is possible to ascertain a positive action of antibiotics, comparing the indices for each group separately. Among chickens of experimental groups the losses were twice lower, and the number of those lagging in growth were more than 3 times less than in the control. At the end of the experiment the average weight of chickens, which received antibiotics, was 8-20% higher than of the control. The following experiments with many groups of chickens at this farm have shown, that the use of penicillin or biomycin /Begin p.50/ helps a better development of chickens, reduces by 2-6 times the number of those lagging in growth and decreases losses by 2-4 times.

Observations of more than 200 thousand chickens in many zones of the Union during different times of the year, at farms with dissimilar production-economic indices, have confirmed the original data about the positive effect of feeds which contain antibiotics.

Under the leadership of Professor Z. V. Ermol'eva, the co-workers of the Chair of Microbiology of the Central Institute of Improvement of Doctors, together with workers of the Bratsev poultry factory, conducted experiments with over 20 thousand heads of poultry. In these experiments chickens, from the day-old to the 30-day of age, received antibiotics daily. Computing for 1 kilogram of feed, they received one of the preparations in the following dose: penicillin (sodium or novocaine salt) - 5 to 10 millig grams, ekmonovocillin - 2 milligrams, streptomycin - 15 milligrams, ecmolin - 1 milligram, biomycin - 5 milligram. As a result of use of antibiotics in the cited doses at the end of the experiment data were obtained, which are shown in table 11.

Table 11.

Effect of penicillin, biomycin and streptomycin on chickens from the first to the 30th day of age

Antibiotic	Weight of chickens (in grams)	Index of growth	Died (in %)
Penicillin	268	129	2.1
Biomycin	228	109	2.4
Streptomycin	206	104	2.9
Control	208	100	3.8

The table's data indicate, that the greatest effect was attained from the use of penicillin. In chickens, which received it at the end of the first month,the increase of weight was 29% greater than in the control group, that was under the same conditions, but which did not receive antibiotics. /Begin p.51/. At the same time the loss percentage among experimental chickens was almost twice lower than among the control.

For detecting the best doses of penicillin under conditions of a specialized poultry husbandry farm, that has high indices on chicken raising, experiments were conducted with one group of chickens of a summer hatching. Results of the experiments are cited in table 12.

Table 12.

Effect of penicillin doses in raising chickens

Dose of penicillin per 1 kilogram of feeds (in milligrams)	Number of heads	Losses (in %)	Weight of one head at the end of the experiment (in grams)
40	732	3.3	322
20	721	2.6	334
10	690	2.7	325
Control	1,365	6.6	269

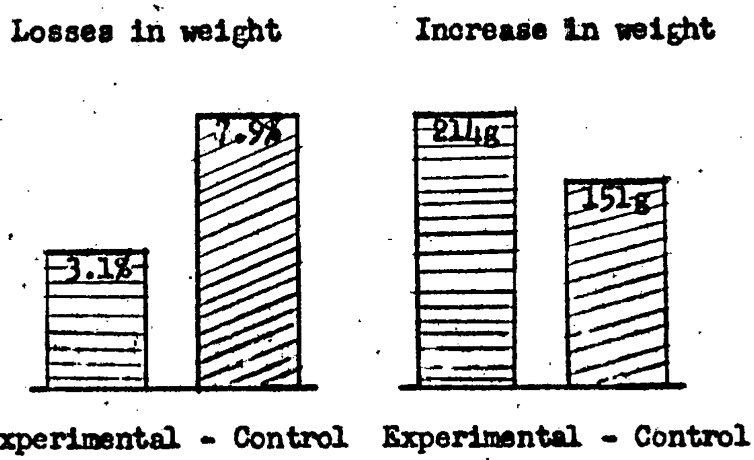
The cited figures show that utilization of smaller doses, compared with large and medium, also gives good results. When giving penicillin in a dose of 10 milligrams per 1 kilogram of concentrated feed the additional increase in weight and the percent of loss are essentially similar to those which were obtained at the dose of 40 milligrams per 1 kilogram of feed.

Utilization of biomycin, according to the same method, gave similar results.

Thus, reduction of the dose of antibiotics on farms with good conditions of maintainance, care and feeding of poultry is fully justified economically. It is more effective when antibiotics are given to the young stock of early spring hatching, when the health of chickens is much stronger.

Results of another character were obtained on a farm, where violations of conditions of feeding, care and maintenance were permitted. Here utilization of antibiotics in smaller doses produced a positive effect, but it somewhat gave way in effectiveness to the use of penicillin /Begin p.52/ in a dose of 40 milligrams and of biomycin in a dose of 20 milligrams per 1 kilogram of concentrated feeds.

In kolkhozes, where experiments were conducted with a separation of control groups, data were also obtained, which point to the positive effect of antibiotics. Results of observations at the kolkhoz chicken farms are cited in the diagram.



Title of the diagram. Diagram of the effect of antibiotics in raising 4,500 chickens at kolkhozes.

Among chickens which received antibiotics, losses were more than twice lower, than in the control. At the same time, during the period of observation the increase in weight of experimental chickens proved to be 31.5% higher than of the control birds that did not receive antibiotics. This ascertains the favorable effect of feeds, containing antibiotics, on chickens, as all other conditions, which influence the productive indices, were similar for both groups.

The raising of increases of weight occur at the expense of better consumption and assimilation of feeds. Expenses for each kilogram of the increase in weight are reduced, and their compensation increases by 10% and even more sometimes. This is especially noticed on weak chickens, lagging in growth, which were culled in daily sortings during the process of raising. Feeding of antibiotics helps their normal development, and in most of them productivity is restored (increase in weight).

The following observations are of interest. At one /Begin p.53/ of the farms when sorting 10 day old chickens, a group of 147 head was separated, which were thought to be unfit for further raising and had to be disposed of. The weight of these chickens was 30% less than the required norms (48.7 grams instead of 62 grams). It was decided to keep the chickens. They were given 40 milligrams of penicillin per 1 kilogram of feed twice per day with their feed. The appetite appeared in chickens, their general condition was greatly improved, the increases of weight were raised very quickly. At 30 days of age the average weight of chickens was equal to 234.6 grams, the loss during the 24 days consisted of only 17 head.

The economic side of the problem is very important. Computation of expenses for buying antibiotics have shown, that their cost was not higher than 15-20 kopeks (1/100 of a ruble) per month, which comprised on the average about 1/2 kopek per head per day. This is fully compensated by the price of the additionally retained poultry and its raised increases in weight.

At the sovkhoz "Gorki - II" as a result of use of antibiotics in 1955 it was succeeded to reduce the loss of young stock by 44% (against the corresponding period in 1954) and to attain the retention of 98.9% of chickens. The farm has additionally raised over 6.5 thousand head of young poultry stock, the value of which to a considerable degree covers the expenses for buying antibiotics.

The experience of work shows, that for a successful introduction of antibiotics into the practice of kolkhoz poultry husbandry, it is necessary to conduct a series of organizational measures, which will provide a planned provision of kolkhozes with the required preparations.

The network of incubator-poultry husbandry stations (IPS) /hatcheries/ can, in our opinion, play an important role in this matter. The oblast' offices of IPS, through planned orders, can obtain from "zoovetsnab" /Zoological and Veterinary Supply Office/ and supply the inter-raion offices with the required amount of antibiotics. The hatcheries, while transferring the chickens to the kolkhoz for raising, could then release the antibiotics for the whole livestock. Thus the cost of the preparation would be paid by the farm together with the price of the acquired livestock of day-old chickens. Such an order of supplying the farms with required antibiotics would free the poultry-maids and the farm specialists from spending profitable time for acquiring the preparations. /Begin p.54/.

The utilization of antibiotics in raising young poultry is a new work and, naturally, it will require from the veterinary and zootechnical workers of the raion, IPS, of poultry husbandry farms and kolkhozes to teach the poultry-maids the new technical practice.

At the present time antibiotics are already utilized with success in raising chickens on many farms. Therefore a wide exchange in experience could play an important role in the raising of production indices.

Workers of Zaraisk raion, Moscow oblast', together with scientific-co-workers (Kh A. Dzhilovian and others), in 1955, have conducted a wide experiment in utilizing antibiotics in raising chickens at 25 kolkhozes of the raion and at IPS.

In spite of unfavorable conditions of the summer, all the kolkhozes of the raion retained over 97% of chickens at the end of the first month of raising and over 84% at the moment of replacement of the flock (October 1st). Such high indices were attained by the kolkhozes for the first time during the last several years. And individual farms attained still better results. Thus, kolkhozes "Bor'ba" and "Svetlyi put'" retained all the chickens, which they obtained from the hatchery during the first month of raising, and on October 1st - 99% of the young stock. Kolkhozes "Kommunist", "Slava geroiam", "Primernyi trud", "Zaria svobody", "Kul'tura", "Krasnyi maiak", "imeni Meretskova", and certain others, retained at the time of flock replacement 90 and over percent of the young stock, which was obtained for raising. Of course, while using antibiotics, the poultry-maids of these kolkhozes did not forget to fulfil also the other necessary zootechnical measures.

The wide exchange of experience in utilizing antibiotics in raising chickens in Moscow oblast', organized, in 1956, by the Oblast' Veterinary Department and the Department of Poultry Husbandry, has shown that many kolkhozes, utilizing antibiotics, attained a high retention of chickens.

Data, collected for the year 1956 from some of the kolkhozes of several raions in Moscow oblast', where the effectiveness of utilization of antibiotics in raising chickens was taken into consideration, indicates the necessity of introduction of this measure. Thus, the kolkhozes of Mikhnevskii raion, /Begin p.55/ "1 Maia", "Pobeda", "Pamiat' Lenina", "Put' Il'icha", "imeni Frunze" and others have retained by July 1st from 92 to 97% of the stock. Similar results were obtained at kolkhozes "Vernyi put'", "Krasnyi Oktiabr'", "Vpered", "Druzhba", "Krasnaia zvezda", and others in Chekhov raion.

There are reports about the positive experience in utilization of antibiotics in raising of chickens at individual kolkhozes of Podol'skii, former Zvenigorodskii, Ukhtomskii, Leninskii, Ramenskii and other raions of Moscow oblast.

Single specialists of raions mentioned low effectiveness of antibiotics on those farms where conditions of feeding, care and maintenance of chickens were entirely disrupted.

Overcrowding, improper feeding, disturbing the temperature regime during the first and the following days of raising led to the loss of 16-20% of chickens, and even a greater percentage on some individual farms.

Use of antibiotics in a complex with other measures will provide a high percentage of retention of valuable young poultry livestock.

A more profitable regime of feeding antibiotics in poultry husbandry has been established on the basis of practical observations and special research. (Text is continued after Table 13)

Table 13.

Single doses of antibiotics for chickens one to 30 days old

Age (in days)	Penicillin for the preparation of medicinal forms		Penicillin for injections (in thousand units)		Biomycin hydrochloride	
	per 1 head (in milligrams)	per 1,000 heads (in grams)	per 1 head	per 1,000 heads	per 1 head (in milligrams)	per 1,000 heads (in grams)
1-10	0.2	0.2	0.3	300	0.1	0.1
11-20	0.4	0.4	0.6	600	0.2	0.2
21-30	0.6	0.6	0.9	900	0.3	0.3

In the instructions on the use of antibiotics in poultry husbandry, recommended by the Chief Veterinary Administration, the positive experience has been generalized and practical recommendations given /Begin p.56/ on the utilization of antibiotics in raising chickens, fattening of the young stock and feeding of the laying hens.

Single doses of antibiotics for chickens one to 30 days old are cited in table 13.

At kolkhozes and sovkhozes, provided with good poultry houses and which can feed the young stock a plentiful ration, the expenditure of antibiotics can be cut in two compared to the doses cited in the table.

On such farms the use of antibiotics is for the purpose of promoting the assimilation of feeds, and raising of weight increases of the young stock since the retention of poultry is high on these farms.

How to feed antibiotics to chickens? Before mixing the required amount of penicillin or biomycin with the concentrated feeds, it must be dissolved in pure drinking water. When preparing dry grain mixture the amount of water is taken which will be sufficient for moistening the grains. When preparing moist mash, the preparation is first dissolved in a small amount of water, and then added to the liquid which is used to moisten the grains.

Solutions of antibiotics are carefully mixed with the feeds; a compulsory condition is that it must be uniformly distributed in the feeds. An uneven concentration of the preparation can lead to the condition, that part of chickens will receive feeds with a low content of antibiotics and this will considerably reduce the results of its utilization.

The prepared water solutions of antibiotics must be used during the next 3-4 hours. It is not permitted to prepare antibiotic solutions for a longer time since the activity of solutions is reduced sharply.

The results of addition of antibiotics to the ration of chickens are apparent already during the first 5-10 days of use. The chickens show an increased appetite, they eat their feed well and are very lively. In a group of young stock, which receive antibiotics, the number of chickens, which lag in growth, is very small, and on the whole the party develops evenly.

On the day of admission of chickens to the farm the full daily /Begin p.57/ dose of antibiotics is fed with the first feeding, beginning with the second day it is divided in two even parts: the first is given with the feed in the morning, and the second - at night.

Let us cite an exemplary computation of the requirement of penicillin for 1,000 chickens. For one chicken one to ten days old 300 units of the preparation are required for one giving, and for the entire livestock 300 X 1,000 = 300,000 units (one flask - 300,000 units). Daily requirement of penicillin will comprise: 300,000 X 2 = 600,000 units (two flasks of 300,000 units). During the second decade (10 day period) the amount of penicillin is doubled and will comprise (in the morning and at night) two flasks, each containing 300,000 units. During the third decade (10 day period) one chicken requires 900 units for each giving, and for 1,000 heads (900 X 1,000) = 900,000 units, or three flasks in the morning and as much at night.

The farm can easily use penicillin in tablet form. If each tablet contains 100,000 units of penicillin, then, according to the above cited computation, 3 tablets will be required during the first decade (10 day period), during the second - 6 tablets each time and during the third - 9 tablets of penicillin for each giving.

Tablets should be first dissolved in one glass of drinking water, and then the obtained solution should be diluted in a volume of liquid that will be required for moistening the feed (mash or grain mixture).

It is more complicated to use penicillin or biomycin on small farms when they are not packaged, in powder form, which must be weighed for each giving. In such a case the preparation of proper weighed portions and preparation of water solutions of antibiotics must be entrusted to persons who have an experience in the work of precise weighing.

On large poultry husbandry farms, on the contrary, the use of unpackaged preparations is handier. It is more expedient here to calculate antibiotic requirements for 1 kilogram of concentrated feed, which is required according to ration for chickens of a corresponding age. It is recommended to add penicillin for the preparation of medicinal forms (technical) in a ratio of 40 grams per 1 ton of feed (40 milligrams per 1 kilogram), and biomycin - 20 grams per ton (20 milligrams /Begin p.58/ per 1 kilogram). It is recommended to farms with good conditions of poultry maintenance, where the retention of chickens comprises 96% and over, to use penicillin in the amount of 10 grams per 1 ton of feed, and 5 grams of biomycin per 1 ton of feed.

Calculating per head the doses are increased according to age, but calculating per 1 kilogram of feed they remain constant during the course of a month, inasmuch the norms of feeding are increased with the growing of the young stock.

ANTIBIOTICS IN MACHINE FATTENING OF POULTRY

Yearly millions of head of poultry are fattened on poultry husbandry farms and at specialized poultry fattening points. Unfortunately, kolkhozes up to the present time did not pay any proper attention to the problem of fattening of the young stock. Experience of the leading kolkhozes of the

Krasnodar krai shows that it is possible to conduct machine fattening of cokerels directly on the farm.

The advantage of such a fattening is that during 23-26 days poultry shows a very sharp rise in the increase of weight - up to 100% and more over the initial weight before fattening. At the same time the quality of carcasses changes also; the number of higher and first grades increases.

Accomplishment of poultry fattening at kolkhozes already during the next few years can play an important role in the increase of meat resources of our country and to raise the profits of kolkhozes from poultry husbandry.

The composition of the ration and the preparation of feeds for consumption are of great importance when fattening cockerels. Addition of antibiotics to feeds helps in the increase of the assimilation of these (by 5-10%), and, consequently, the feeds are better reimbursed.

Up to the present time there as yet is no unanimous opinion as to which of the antibiotics has the advantage in poultry fattening. Nevertheless, it is considered to be established that penicillin, biomycin, and terramycin produce a stimulating effect. Utilization of these preparations in a dose of from 10 to 40 grams per 1 ton of feed produces a positive effect. /Begin p.59/

Workers of poultry husbandry farms, situated near factories, which produce biomycin, utilize widely the wastes of this production - mycelial (fungal) mass.

Pure antibiotics, as well as the mycelial mass are added to the feed before consumption. Crystallised preparations are dissolved at the rate of 1 gram per liter, and the fungal mass at a rate of 1 kilogram for 1-5 liters of drinking water. Solutions of the preparations should not be kept longer than 3-4 hours, as in such a form they become quickly inactivated and lose their positive qualities.

After adding either the antibiotic or the fungal mass to the feeds, these must be mixed very carefully, because an uneven distribution of the preparation in feeds leads to the condition that part of the poultry do not receive any antibiotic, and this lowers its effectiveness.

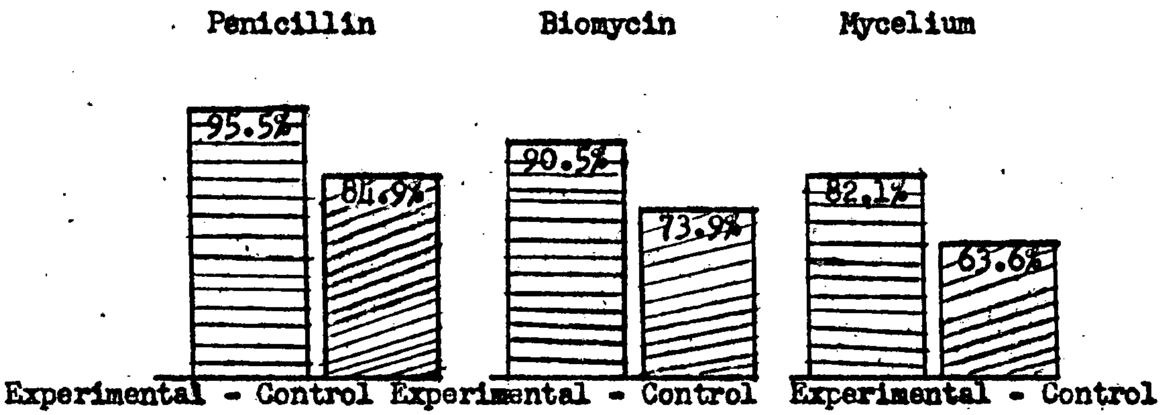
We repeat: the feeds, to which antibiotics have been added cannot be subjected to steaming, fermentation or any other treatment. Steaming can destroy the acting basis of the preparation.

The workers of Kuntsev poultry factory, A. A. Kostenko and A. I. Borisova, in 1954, used for the machine fattening of poultry mycelium of penicillin (4-5 grams per day per head) and of biomycin (6-8 grams per day per head). According to their observations the birds ate the feed better, and as a result of this - the increases in weight were raised and the quality of carcasses was improved when compared with cockerels of the control group.

The workers of sovkhoz "Gorki - II" together with Doctor of Biological Science, A. Kh. Sarkisov, and Candidate of Veterinary Science, N. S. Akulova, conducted a series of production experiments on detecting the effectiveness of pure antibiotics and of the mycelial mass. On this farm, in machine fattening of cockerels, in 1955, were utilized: penicillin, at the rate of 4 milligrams (600 units) per head, biomycin hydrochloride - 2 milligrams and mycelial mass of the producer of biomycin at the rate of 3-5 grams per head.

Factors, which could influence the results of the experiment were excluded to the greatest degree. For this purpose a group of poultry of one feeder was separated into two equal /Begin p.60/ groups. One of them received feeds with antibiotics, the other - without them.

After 25-26 days all the birds were killed during the course of one day, and the specialists on determining the quality of carcasses evaluated each one of the experimental and the control group. (see diagram).



Title of diagram. Diagram of the yield of carcasses of the first and higher qualities in machine fattening of cockerels with the use of antibiotics.

The yield of carcasses of the higher and first qualities was 10-16% higher in cockerels which received antibiotics as compared with the control, which did not receive any preparations. At the same time, the average weight of the carcasses of cockerels of experimental groups was also somewhat higher than of the control.

Similar data were obtained also on other farms, where corresponding experiments were conducted. Addition of antibiotics helped a better assimilation of feeds and an improvement of production indices.

Farm specialists think, that, in fattening, it is more expedient to feed the mycelial mass of the biomycin producer. Expense for its acquisition is very small, but the results attained are just as good as the indices obtained in the utilisation of pure antibiotics.

ANTIBIOTICS FOR LAYING HENS

It is known that a laying hen, which lays 180-200 eggs, that is 12-13 kilograms of egg mass per year, has to digest a considerable amount of feeds. Computations /Begin p.61/ show that weight of these feeds must by 25 times exceed the live weight of the hen. Therefore poultry husbandmen take a series of measures which will provide a good consumption of feeds: they prepare various mixes, change their blends, introduce mineral feeds, and so on.

Expediency in utilisation of antibiotics for this group of birds remains unclear. Complexity in conducting rigid experiments does not permit to finally solve this problem. This is explained by the fact that it is practically impossible to choose equivalent groups in egg laying since the productivity of hens depends on many individual qualities of the layers, on the time of the beginning of laying, the breed of hens, and so on. Therefore, the assertion about positive influence of feeds on the increase of egg-laying of hens we express only on the basis of observations of the practical workers.

At the sovkhoz "Gorki - II", at the Kuntsevo and Brattsevsk poultry factories, as well as at poultry farms of individual kolkhozes of Moscow oblast, they add to the feed of laying hens the mycelial mass of the biomycin producer at a ratio of 5-8 grams per head per day. Such an addition helps in the improvement of the appetite and a full consumption of the feed, what in its turn points to a good assimilation of nutrient substances and leads to the increase in the productivity of the poultry.

Comparing the egg-laying of the birds before and after the addition of antibiotics to the feed, the bird-breeders record an increase in egg-laying after the use of preparations. On individual farms these data are obvious and do not arouse any doubts. Thus, for a high-laying group of hens at sovkhos "Gorki-II", for the first five months of 1955, egg-laying increased on the average by 7 eggs from each hen when compared with a similar period in 1954, when the mycelial mass was not utilised.

Proceeding from observations of practical workers, specialists, the Chief Veterinary Administration of the Ministry of Agriculture of USSR recommends to feed to laying hens the mycelial mass in the morning and at night per 2.5-4 grams per head at each giving.

Before introducing it into the feed, the mass is preliminarily diluted in pure water until pasty. /Begin p.62/ In such a condition it is carefully mixed with mash or grain-mix and is fed the same day.

It is recommended after a two-week use of mycelial mass to interrupt it for 10-14 days, and then again to resume giving it with the feed. Such a rotation helps a good consumption of feed by poultry.

Feeding antibiotics, as well as the mycelial mass, to the hens does not produce any negative effect on the flavor qualities of dietetic eggs. Hatching of chickens from breeding eggs is not reduced also. More than that, individual researchers point to an increased percentage in the hatching of chickens from eggs, obtained from such hens.

According to data of foreign researchers, "Tezingi" and Bright, addition of biomycin to feeds during the course of six months did not produce any effect on the quality of eggs. The quality of egg white, the thickness of the shell, weight and size of eggs in experimental hens did not differ from those in the control.

Literary data and practical observations do not give sufficient grounds for assertion about a positive effect from feeding antibiotics to hens on the growth of chickens. According to data of certain researchers, the feeding of antibiotics to hens stimulated the development of chickens. Others, in similar experiments, did not notice such advantages: chickens of the experimental and of the control groups developed similarly.

Farms, which utilized the mycelial mass for laying hens, point out to the positive action and the economic expediency of this measure.

ANTIBIOTICS FOR TURKEY-POULTS

Antibiotics produce a positive effect in feeding them to turkey-poults during the first month of raising. This property is possessed by penicillin, biomycin and terramycin when introducing them to feeds in a ratio of 10-20 milligrams per 1 kilogram of dry concentrated feed.

Turkey-poults, which received antibiotics produced an increase in weight 15-20% higher than those in the control, which did not receive any preparations. At that, the effect of antibiotics is expressed much stronger when they are added to feeds which contain proteins of animal origin.

/Begin p.63/

There are reports, in foreign literature, about positive action of biomycin and penicillin in raising turkey-poults. During the experiment of Almquist and Morritt (1953) 4 thousand turkey-poults were broken up into 5 groups. From each of these groups 10% were separated for weighing every 10 days. Observations were conducted during the course of 110 days, beginning with the first day of life of the poults. As a result of these observations it was noted that the addition of antibiotics always produced a positive effect on the growth of males up to the age of 110 days, and on the growth of females only to the age of 70 days. Remuneration for feed of poults which received antibiotics was higher when compared with the control, which did not receive these preparations.

ANTIBIOTICS FOR WATERFOWLS

The experience in the use of antibiotics for waterfowls is limited. Penicillin, biomycin, terramycin and streptomycin were tested in raising ducklings and goslings. Each of these preparations was introduced to the food mix at the rate of 25 milligrams per 1 kilogram of dry concentrated feed.

The effect of unpurified biomycin (Aurofac), prepared especially for utilization in animal husbandry, was studied besides that. Aurofac was introduced to the feed mix reckoning on conversion to pure biomycin.

Limitedness of experiments and diversity of conditions under which they proceeded are the basic causes why this field of poultry husbandry does not use antibiotics until the present time.

According to data of some researchers and practical workers, feeding antibiotics to ducklings helps their intensive development. Data of others do not confirm this.

Practical observations of duck raisers show that penicillin and biomycin can be successfully used during the first days of raising ducklings. Thus, according to reports of the Veterinary Surgeon, N. A. Odabosh'ian, the poultry-maid of the kolkhoz "imeni Stalina", Kanevsk raion, Krasnodar krai, in 1957, utilized the antibiotics widely in raising 101 thousand ducklings. At the kolkhoz 96.2% of the young stock were retained, and the best section of V. I. Krutilova, /Begin p.64/ raised 99% of ducklings from the 7 thousand heads, that were obtained for raising.

Antibiotics were given together with feeds to all ducklings only the first 6-8 days of raising, and after that they were given only to the feeble and those which lagged in growth; to these were fed the best concentrated feeds - cottage cheese, cooked eggs, finely chopped greens, oil cakes, and others. The feeds were given in the form of moist crumbly mash, to which were added 20-40 milligrams of penicillin or 10-20 milligrams of biomycin for 1 kilogram of dry concentrated feed. Special attention was paid to careful mixing of antibiotics with the feeds. Use of antibiotics helped in the improvement of the appetite in the raising of feed consumption, in reduction of sickness among young stock and its better development. The greatest part of feeble ducklings under such conditions recovered already during the first 3-5 days and became active and lively.

On farms, which grow a small number of ducklings, computation of requirements of antibiotics can be made proceeding from their dose for one duckling. The young stock from one to 10 days old should be given 1-2 milligrams (1,500-3,000 units) of penicillin or 1 milligram of biomycin per head per day.

The daily dose of antibiotics is fed in two stages - in the morning and at night. If the farm has received penicillin for raising 1,000 ducklings and decided to use it, the computation is made as follows: the general requirement for all the livestock will consist of 1-2 grams (1,500,000-3,000,000 units), or for each feeding 0.5-1 gram (two or three flasks of 300,000-500,000 each). The requirement for biomycin is calculated according to a similar scheme.

Effectiveness of the above cited antibiotics for goslings was noticed only in the case when they did not receive and green grass. Penicillin and biomycin helped the improvement of growth and the raising of effectiveness of utilization of feed by goslings in brooder raising during the course of 4 weeks. Positive effect of antibiotics was noted also in their further utilization.

When studying the effect of penicillin and of the green grass on the growth of goslings, it was ascertained that the grass influences in the same way, and in some cases even better than penicillin. Goslings, /Begin p.65/ which received penicillin, but did not utilize the pasture or received any green grass, developed worse than those which were pastured regularly.

Data, cited above, indicates that the possibility of use of antibiotics for waterfowl requires studying and practical testing.

p.69-70

ANTIBIOTICS FOR LAMBS

The experience of use of antibiotics as measures for improving the growth and development of lambs is very limited, and the obtained data are very contradictory.

Foreign researchers, R. Elliot and S. "Ellsuft", in 1953, mentioned a positive result when adding biomycin to the lamb's feed in a ratio of 10-20 milligrams per 1 kilogram of feed. /Begin p.70/ Three forms of rations were utilized in the experiment. In the first ration there were 80% of coarse fodder and 20% of grains, in the second - 40% of coarse fodder and 60% of grains, and in the third - 60% of coarse fodder and 40% of grains. There were five lambs in each experimental group. All lambs, which received biomycin, at the end of ten weeks of the experiment had an increase of weight approximately 15% greater than the control, which did not receive the preparation.

Another experiment is interesting which showed the positive effect of biomycin in the fattening of lambs. Two hundred fifty lambs were divided into 5 groups. The first group received the feeds without antibiotics, and all the rest received biomycin also besides the similar feeds, in a dose of 5, 10, 15 or 20 milligrams per 1 English pound of feed (425 grams). The experiment continued for 63 days. Its results are cited in table 14.

Table 14

Effect of biomycin in lamb fattening

Indices	Biomycin (in milligrams per 1 English pound of feed				
	0	5	10	15	20
"Postanovochnyi" /at the beginning of the experiment?/ weight of 1 head (in pounds)	77.9	76.7	76.5	75.8	25.2
Final weight of 1 head (in pounds)	92.2	98.7	100.6	97.9	97.6
Daily increase in weight of 1 head (in pounds)	0.22	0.33	0.38	0.35	0.34
Expenditure of feeds per 1 pound of increase in weight (in pounds)	16.0	11.5	10.3	11.3	11.2
Quality of meat (in %):					
Highest grade	59.4	72.2	78.5	72.0	78.9
good quality	38.5	27.3	21.5	28.0	21.2
low quality	2.1	0.5	0	0	0

It is seen from the table that the lambs, which received biomycin, increased in weight better, and after slaughtering their carcasses were evaluated higher. The best indices were marked after the use of biomycin in a dose of 10 milligrams per 1 pound (approximately 20 milligrams per 1 kilogram) of feed.

CHOICE OF ANTIBIOTICS ACCORDING TO THEIR EFFECTIVENESS

b) in raising young animals

	Degree of effectiveness					
	Penicillin	Streptomycin	Biomycin	Terramycin	Syntomycin	Levomycetin
Calves		3	1	2		
Piglets	2	4	1	3		
Chickens	1	3	1	2		
Turkey-poults	1		1			
Ducklings	1		1			
Fattening of young stock	1					

Note: numbers 1, 2, 3, 4 indicate approximate degree of effectiveness.

(In part)
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Gresin, V.

Antibiotiki v zhivotnovodstve.

/Antibiotics in animal husbandry/.

Moskva, Moskovskii Rabochii, 1958.
81p. 41 G869.

(In Russian)

p.19-24

ANTIBIOTICS FOR LARGE CATTLE

Antibiotics are utilized in raising calves for the purpose of their better development, when treating certain infectious and noninfectious diseases of large cattle, as well as a means for protecting the bulls' semen from the effect of foreign microflora.

ANTIBIOTICS IN RAISING CALVES

When raising calves it is necessary, first of all, to strictly observe the established system of feeding, care and maintenance. The experience of leading farms shows that with a proper system of rearing it is possible to fully preserve the young livestock.

Rearing the young animals of milk breeds has its peculiarities. The calf is weaned from the cow during the first few days and is artificially fed through a special nipple /Begin p.20/ or from a pail. Healthy calves retain after this the suckling reflex for a certain time; they often suck the surrounding objects, which are often unclean. This can lead to a disruption of the normal activity of the gastro-intestinal tract of calves and to a subsequent sharp decline in the increase in weight.

Unsatisfactory development of the young stock can be noticed during crowded maintenance of calves, bad care, and antisanitary conditions of buildings.

On farms, where calves are placed in dry, light, clean stalls, with good ventilation, or in individual cubicles the young stock is healthy and develops normally, as a rule.

Experienced calf maids pay special attention to the feeding of newborn calves and already after the first feeding of colostrum they determine the regime of feeding for each of them. If the calf drinks greadily, the feeding is stopped several times, or the opening in the nipple is made smaller. There is a series of other means to provide a perfectly normal development of young animals.

A sure guarantee for raising healthy calves appears to be to feed them antibiotics during the first days of life.

In foreign agricultural literature the information about positive effect of antibiotics on the growth and development of calves began to appear since the year 1950. It was pointed out in these reports that calves, which received antibiotics, under other equal conditions of feeding, care and maintenance, were developing better than those which did not receive the preparations. It was mentioned also that their use is expedient only during the first 12-16 weeks after birth, that is from the moment when the rumen, reticulum and the omasum develop and begin to function.

The experiments have shown that not all the antibiotics produce a positive effect when used in raising calves, but biomycin and terramycin alone, both the pure and the unpurified. These preparations produce the best effect when they are fed to calves at a ratio of from 0.05 to 0.1 gram per head a day.

We conducted special experiments in the sovkhos "Krasnaia poima" in order to find out the effectiveness of feeding antibiotics under farm conditions. One hundred sixty nine calves of the spring calving were taken for the experiment in 1955. /Begin p.21/ Methods of use of penicillin and of biomycin were studied. One group of calves was given penicillin twice a day (in the morning and at night) since the first day after birth, at the rate of 20 milligrams per head during the course of the first 20 days of rearing. The other group was fed biomycin according to the same method. In each variant of the experiment a group of control calves was isolated. The obtained results are cited in table 4 (page 22).

Analysis of data of table 4 shows that the experimental calves, which received biomycin during the course of 20 days of rearing, gave an increase in weight for a month 3.7-18.5% higher than calves of the control group and the group receiving penicillin.

It is necessary to point out that the use of biomycin was accompanied in animals by an increase of the appetite and better absorption of milk nutrients. Gastro-intestinal diseases among calves were noted more seldom and proceeded in a lighter form, than in claves of the control group. Whereupon the appetite was fully retained in sick animals. In control calves such diseases were very frequent and proceeded in a more serious form, this being reflected in the increases of weight.

Having obtained positive results from the use of biomycin in 1955, we repeated the experiment next year, segregating 100 newborn calves, half-breeds of the first generation of Ost-Friesian /"Ostfrizy"/ and Jersey breeds. The experimental calves were divided into 4 groups. At the beginning calves of the first group were given biomycin for a prophylactic purpose, and then, starting with the third day of life and to the end of the first month, as a feed - in a dose of 0.025 grams per head in the morning and at night. Each calf of the second group received only 0.05 g. biomycin per head during the course of the first month of rearing. Calves of the third group received biomycin only for the prophylactic purpose. The fourth group served as control, and the young animals received biomycin only during gastro-intestinal diseases.

During the course of the month of rearing the conditions of maintenance, feeding and care were identical for all the calves. Both the daily expenditure of milk for each calf, as well as the increase in weight were properly accounted for every ten days /"dekada"/. Diseases of animals were carefully taken care of.

Although all the calves of the control group fell ill one after another, there were no cases of death. There were no losses /Begin p.22/

Table 4.

Results of application of penicillin and biomycin to calves

Breed	Group of calves	Antibiotics	Number of heads	Weight of one head (kg) at birth	Weight of one head (kg) on the 30th day	increase in weight (in %)	Additional increase in weight (in %)
Half-breeds Jersey	Experimental	Biomycin	10	30.6	55.7	82	18.5
	"	"	20	35	59.5	70	6.5
	Control	-	42	33.4	54.6	63.5	-
"Pol'zovatel'naia" /Profit producing?/	Experimental	Biomycin	14	38.8	57	46.7	3.7
	Control	-	3	40.3	59	43	-
Half-breeds Ost-Friesian	Experimental	Penicillin	20	41	58.4	42	-
	"	"	10	37.3	57.5	54.2	-
	Control	-	50	37.5	57.7	54	-

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(text continued from page 21)
also in the first, second and third groups, although individual cases of gastro-intestinal diseases were registered among them. Among the first group, where biomycin was used, at first, for a prophylactic purpose, and then for the purpose of a better development there were only single cases of disease.

What were then the final results of this experiment?

At the end of the first month increases in weight of calves of experimental groups were 10-20% higher than of the control, which received biomycin for medicinal purpose only. The highest increase in weight was produced by the first group of calves and somewhat lower - by the two others.

Difference in increases between the experimental and the control animals varied and depended on the number of calves fallen ill in this or the other group. The more calves had diarrhea, the less increases in weight they produced and vice versa.

Interesting data were also obtained, in 1955, by the foreign scientist, Prichard when studying the effectiveness of biomycin. He conducted his experiments with four pair of twin calves. In each pair one calf received biomycin at the rate of 30 milligrams of the preparation for each 45.3 kilograms of live weight, and the other served as a control and did not receive any antibiotic. Experiments started since the first day of life and continued up to the age of eight weeks. It was established as a result, that experimental calves produced a medium daily increase in weight of 679 grams, for the whole period, and the control, under the same conditions of feeding, maintenance and care - 611 grams.

Practical application of antibiotics in rearing calves is somewhat difficult during the first 10-15 days, when each of them receives milk from its mother. During this period it is necessary to add antibiotics to milk and give the solution separately to each calf. This requires additional expenditure of labor and worker's time.

Older calves, which receive the drawn /"sbornoe"/ milk, get their antibiotics added to milk before feeding. For this purpose, the required portion of antibiotics for the group is first diluted in a small amount of milk and then is mixed with the full norm, which is intended for the given feeding.

Let us cite an exemplary calculation. The calf maid is given /Begin p.24/ in her care a group of calves in the amount of 40 heads. Issuing from the daily dose of 0.05 g per head, we obtain that 0.05 X 40 = 2 grams of the preparation are required for each day for the group and for one feeding (2:2) = 1 gram. This amount of the antibiotic is first diluted in 1-2 liters of milk, and then is carefully mixed with the full measure of milk that is required for one feeding of calves (morning or evening).

The forms of biomycin and terramycin which are not dissolvable in water are given to calves with dry supplementary feeding. In such a case the antibiotics are first mixed with a small amount of bran, and after that are gradually mixed with the feed mix, stirring it very carefully so that the introduced preparation becomes evenly distributed in the entire feed mixture.

Observations show that the use of antibiotics, for the purpose of better development of calves, is the most promising for groups of young animals, which are intended for fattening at an early age. This method is especially profitable on farms, which conduct milk fattening of calves.

p.32-43

ANTIBIOTICS IN ARTIFICIAL INSEMINATION

In foreign countries antibiotics are widely used as preparations which protect the bull's semen from excessive contamination with bacteria. When adding penicillin, streptomycin or other antibiotics to bull's semen, mixed with yolk-citrated, yolk-phosphatic, or milk diluent, microflora cannot develop, even if it does not die fully. /Begin p.33/

It was established by special experiments that for preserving the vitality of the bull's semen the greatest concentration of penicillin and streptomycin is approximately 500 units per 1 milliliter of the diluent. With a larger dose of preparations in the diluent the length of vitality of spermatozoa is considerably shortened. A foreign researcher, Schmidt, has established that the addition of antibiotics to the bull's semen is of purely hygienic importance. Nevertheless, other researchers (for example, Rottensten) mention the increase of the percentage of insemination. Depending on the antibiotic and on the initial quality of semen an increase of fecundity from 1 to 12.9% was noted compared to the control, where antibiotics were not used.

Other antibiotics as yet are not of importance in the practice of artificial insemination.

ANTIBIOTICS IN SWINE HUSBANDRY

Numerous reports of scientific and practical workers, in native and foreign literature, show that the addition of minute amounts of antibiotics to feeds aids in better consumption of feeds and raises the weight increases of the growing young swine stock. The raising of daily weight increases reaches 10-15%, and sometimes even more. At the same time the effectiveness of feed utilization increases by 3-5%.

The accumulated factual data show that not all the antibiotics, used for medicinal purposes, help, to a similar degree, a better development of young stock when it is given with feeds. In connection with this data of table 6, taken from the review of American scientists R. Braude and G. Vallege /"Valledzh"/, are of great interest.

These data are the result of treatment of materials which were obtained in more than 300 experiments of scientific-experimental institutions of USA. All the experiments were conducted under various conditions and for different purposes, but they all indicate quite clearly the advantage of utilization of biomycin in swine husbandry. Young pigs, which received this preparation, gave a mean daily increase of weight 35% higher than the control animals.

/Begin p.34/

Table 6.

Influence of various antibiotics on the weight of swine

Antibiotics	Relative increase in weight of swine (in %)
Aureomycin (biomycin)	135.9
Terramycin	123.7
Streptomycin	115.2
Penicillin	110.6
Bacitracin	109.0
Chloramphenicol	105.5
Polymyxin	96.0
Control	100.0

The animals which received polymyxin developed worse than the control, - the preparation not only did not help a better development of young stock, but produced an inhibiting action. Research of subsequent years has shown the inefficiency of using chloramphenicol (levomycetin) and of bacitracin for these purposes.

At the present time the use of biomycin, terramycin and penicillin is acknowledged everywhere in swine husbandry.

The feeding of antibiotics prevents gastro-intestinal diseases, raises the assimilation of feeds, lowers the number of laggards in growth and helps in the increase of the yield of piglets in litters.

For the purpose of better development of the young stock, antibiotics are utilised during raising of piglets and meat fattening of swine.

ANTIBIOTICS FOR SUCKLING PIGS

Successful raising of piglets depends on many factors: on the conditions of growth of the young stock, on what feeds are utilised on the farm; on the milk productivity of the females and the quality of their preparation for having a litter; on the correct organisation of work on the farm, and on many other things. Work experience shows that introduction of antibiotics into the practice of raising of the young stock of swine permits considerably to increase the production indices of this field of economy. /Begin p.35/

Experiments of Professor A. Kh. Sarkisov, of Candidates of Veterinary Sciences Kh. A. Dzhilovian, A. I. Noskov and O. A. Gavrilova, under conditions of kolkhozes and sovkhozes with the livestock of over 3 thousand piglets, indicate a high effectiveness of penicillin and biomycin in raising the young stock.

These experiments were conducted on the farms under different conditions of feeding, care and maintenance, and during different times of the year.

The litter of every lactating female was divided in two groups: experimental and control. In each one there were sucklings similar in weight, sex and general condition. Beginning with the first day of birth and in the course of 30-60 days, all the experimental sucklings received penicillin or biomycin twice per day. At the beginning antibiotics were administered to each piglet, individually, by mouth. When the piglets began independently to consume the feed, the portion of antibiotic assigned to them was added to the feed before giving.

Antibiotics were used in increasing doses: during the first 10 day period - 0.5 gram, during the second - 1 gram, and during the subsequent days, up to the end of the experiment - 2 grams per day for each 100 heads. The piglets were weighed before the start and every ten days during the course of the experiment. Every day both the experimental and the control animals underwent clinical observations.

Sucklings of the control group were kept together with the experimental, but did not receive any antibiotics. Since the first day of life the sucklings of both the experimental and the control groups had their markings. Usually the right teats of the mother were given to the piglets of the experimental group, and the left to the control. Strong attention was given to correct feeding of the lactating females during the experiments. The sucklings were taught to eat feeds at the proper time. The week old piglets, where it was possible, were offered pure water and dry concentrates (fried barley meal and oatmeal) in special stalls. Early supplementary feeding of piglets gives a possibility to attain good development of the young stock under females with poor milk production and to reduce in litters the number of piglets lagging in growth.

The conducted works have shown that both biomycin and penicillin produce a favorable effect on /Begin p.36/ the organism of suckling pigs. They have a better appetite, they become lively and resistant to various external lunfavorable factors. We cite in table 7, as an example, data obtained by the Scientific Co-Worker, A. I. Noskov, at the kolkhoz "Put' novoi zhizni", Kuntsev raion, Moscow oblast'. In these experiments penicillin was begun to be applied starting when 3-5 days old and continued to be fed up to the 30-40th day of age.

Table 7.

Feeding of penicillin to suckling pigs

Number of the female in succession	Number of piglets under the female (heads)	Among them		Mean daily increase in weight (in grams)	
		those, which were given penicillin	control	Those which were given penicillin	control
1	9	4	5	175	134.7
2	8	4	4	227	203
3	12	7	5	184	170
4	8	4	4	265	151.7
5	11	5	6	202	141
6	10	5	5	190	159
7	9	5	4	243	170
8	9	5	4	239	160

Experiments, conducted at the kolkhoz "Put' novoi zhizni", show that, the sucklings, which received penicillin, developed better than the control independent of the size of the litter under the female and the milk productivity of each of them. At the end of observations the weight of experimental sucklings was, on the average, 0.5-3 kilograms higher than of the control. Individual sucklings differed in weight still more. Similar results were obtained also from the use of biomycin.

Among sucklings, which received antibiotics, laggards in growth and starvelings were absent, while they were present among the control animals.

Owing to diseases during the first days of life, and because of other causes, the, so-called, sanitary groups of young stock are isolated at the swine farms. /Begin p.37/ On the farms, where there are cases of newborn sucklings falling ill with alimentary toxic dyspepsia, the number of piglets lagging in growth attains a large percentage and can reduce the production indices very considerably. Thus, in sovkhoz "Arsen'evskii" no. 1, Tula oblast', where, in March 1954, mass diarrhea was observed, from among 608 sucklings, 163 proved to be lagging in growth. At other farms the number of starvelings was a bit lower, yet here too, they reduced the indices of the farm.

Feeding antibiotics to such sucklings helps a considerable raising in their increases of weight. Appetite appears in sucklings, they begin to eat the feeds more willingly. The mean daily increases in weight of experimental animals happen to be 50-70% higher than in the groups of starvelings, which do not receive antibiotics.

Title of picture: Pig - tenders of the kolkhoz "Put' novoi zhizni", Kuntsev raion, Moscow oblast', with piglets 46 days old. At the left: a piglet, which received antibiotics, had a mean daily increase in weight of 288 grams; at the right: the control piglet, whose mean daily increase in weight was 150 grams. /Begin p.38/

As a result of use of antibiotics the farms have additional profit both on account of better retaining of the young stock, as well as from the raising of increases of weight.

The Sovkhoz "Shugarovo", as a result of wide utilization of biomycin and penicillin retained, in 1955, the litter fully in the amount of 2,500 heads. The sucklings, which received antibiotics for the purpose of better development, weighed at the time of weaning 1.5-2 kilograms more than the control.

According to calculations of Czechoslovakian authors (Muller, Shkola) the use of antibiotics will permit to obtain from each million of swine, additionally, products of swine husbandry valued at 1,200 thousand crowns.

At the present time, many farms are known in Moscow oblast', which are using antibiotics in raisings piglets.

Zootechnician Ivanov, of the kolkhoz "imeni Stalina", Klinskii raion, while using antibiotics in raising sucklings from winter litters, attained full retention of the young stock and prevented the appearance of those lagging in growth. At weaning time the piglets weighed on the average 16.4 kilograms.

Moscow Oblast' Veterinary Department has at its disposal data about positive experience of utilization of antibiotics in raising piglets in many kolkhozes of Krasno-Poliansk, Chekhov, Podol'sk and other raions of the oblast'.

In table 8 are cited only some of the farms, where, owing to use of antibiotics in combination with the improvement of feeding and maintenance of swine livestock, it was succeeded to increase retention of the young animals.

Table 8.

Kolkhozes of Moscow oblast, which use antibiotics

Kolkhoz	Raion	Chief Veterinary Surgeon	Received antibiotics (heads)	Percentage of retention of piglets to the time of weaning
Imeni Ostrovskogo	Egor'evskii	Frolunin, B. V.	234	97
Imeni Parizhskoi kommuny	"	The same	157	98
"Pamiiat Il'icha"	"	" "	180	98
/Begin p.39/				
Imeni Stalina	Krasno-Polianskii	Gurkina, N. G.	427	99.9
Imeni Zhdanov	" "	The same	161	100
"Voskhod"	" "	" "	305	98.4
"Krasnaia niva"	" "	" "	471	99
Imeni Makarova	Formerly Zvenigorodskii	Volkov, K. F.	300	100
"Krasnoe znamia"	" "	The same	200	96
Imeni Kalinina	" "	" "	200	100
Imeni Kirova	" "	" "	300	97.5

Before the use of antibiotics losses of young stock in these kolkhozes were higher by 2-16%. Farms, which formerly had high indices for the retention of young stock, later on fully liquidated the losses of sucklings.

Most of the farms in Moscow oblast' follow the temporary regulations on the use of antibiotics in swine husbandry, recommended by the Chief Administration of Veterinary Science of the Ministry of Agriculture of USSR. In table 9 doses are cited for one application of the preparation for one piglet.

Table 9.

Single doses of penicillin and biomycin for piglets

Age (in days)	Penicillin		Biomycin	
	milligrams	thousand of units	milligrams	thousand of units
Up to the 10th day	2.5	3-4	2.5	2-2.25
From the 10th to 20th day	5	6-8	5	4-4.5
From the 20th to 40th day	10	13-16	10	8-9

/Begin p.40/

Since antibiotics are used twice per day, in the morning and at night, then, consequently, the daily dose of the preparation is twice larger than the single dose.

Before giving antibiotics to the sucklings, they are dissolved in drinking water at a ratio of 1 gram of the preparation to 1 liter of water. In each milliliter of such solution is contained 1 milligram of the dry substance. Thus, it is easy during further work to conduct calculations for groups of piglets.

For example, there are 200 sucklings on the farm, 3-5 days old, which will receive biomycin during the course of 30 days. Issuing from the above cited dose, during the first decade of raising the piglets for 200 animals (for each giving) it will be required 200 X 2.5 = 500 milligrams of biomycin. This amount of the antibiotic is dissolved in 0.5 liter of water and added to milk, which is utilized for the supplementary feeding at a ratio of 2.5 milliliter per head. In those cases when the sucklings were not yet trained to drink milk, the solution must be given to each piglet individually.

During each succeeding decade /10 day period/ the dose of the preparation must be doubled. Thus, during the second decade for each group of

200 heads it will comprise (200 X 5) = 1 gram. This amount of the antibiotic is diluted in a liter of pure drinking water, milk or skim milk, added to the feed, mixed carefully and fed to the piglets.

Veterinary workers on the farms prepare ahead of time the weighed portions of antibiotics for several days and pass them on to the farm. Usually penicillin flasks are utilised for this purpose. Into each of such flasks is weighed a required amount of the preparation for a single giving to each group of piglets.

The pig-tenders dissolve the antibiotics, mix them with the feed and distribute them. Of course, they must be first trained to do this work.

One should remember that after the addition of antibiotics the feeds cannot be subjected to steaming, since this may lead to inactivation of antibiotics, that is to reduction of their activity. The effectiveness of the preparations is reduced after this. Feeds with antibiotics must not be subjected to fermentation or any other treatment. They should be fed out during the course of 3-4 hours after the preparation. /Begin p.41/

ANTIBIOTICS IN MEAT FATTENING OF SWINE

Foreign experience in using antibiotics in meat fattening is quite extensive and is of definite practical interest to swine husbandmen of our country.

Utilization of biomycin, terramycin, penicillin and streptomycin, as well as of fungal (mycelial) mass helps in the raising of consumption of fodder, and at the same time raises the increases in weight. Feeding a mixture of these preparations, as well as their rotation does not have any great advantages comparing with the use of each of them separately in a pure state.

Antibiotics are added to the feeds in the following amounts: penicillin from 8 to 20, biomycin from 9 to 20, terramycin from 10 to 20 or streptomycin from 20 to 50 grams per 1 ton of concentrated feed. Raising of doses can only lead to considerable unwarranted expenditure of the preparation, while smaller doses rarely produce a positive effect.

Regardless of the noticeable effectiveness, pure antibiotics are yet rarely used in meat fattening of swine. This is explained by the high cost of purified preparations and by the fact, that the farms are provided with them in inadequate amounts.

At the present time many swine fattening farms, which are situated near factories that produce antibiotics, widely use the wastes of industrial production of biomycin - the biomycin fungal (mycelial) mass. Superficially it looks like thickly kneaded dough-like mass of dark brown color with a greenish tint. Its color and consistency can change depending on the technology of the production of the preparation.

The mycelial mass of biomycin, in its chemical composition, approximates many highly valuable concentrated feeds. As the research of A. S. Borozdin has shown, it contains: protein - from 34.1 to 42.8%; fat - from 16.9% to 25%, nitrogen free substances - from 25.7 to 41.5%; cellulose - from 1.62 to 3.69% and mineral substances - from 3.5 to 4.06% (per dry substance). The biomycin mass is also rich in vitamin B_{12}.

At the swine fattening sovkhoz "Serp i molot", Moscow /Begin p.42/ oblast' we took, together with the farm workers, 474 swine for the experiment, among which 389 received mycelial mass, and the remaining 85 were separated as control and did not receive any fungal mass. Fifty grams of fresh fungal mass per head were added daily during the course of a month to the basic ration. One half of this dose was fed out in the morning, and the other - at night. The portion of mycelium was first dissolved in a small amount of whey (about 1 kilogram in 4-5 liters), and after that added to the morning or evening giving of whey, which was utilized at the farm as supplementary feed. Such a method of feeding is more convenient, as it does not require additional expenditures of labor for uniform mixing of the preparation in the feed.

Results of the experiments have shown that the average daily increase in weight of swine, which received the mycelial mass, was by 55 grams higher than the control. During one month the farm obtained an additional increase in weight equalling 633 kilograms. But the expenditure for obtaining the fungal mass comprised only 105 rubles.

Besides that there are also other advantages in feeding mycelial mass: gastro-intestinal diseases of swine were sharply reduced, and young swine, having diarrhea, recovered much faster.

Data of the Dutch researchers, Oosterhuis and Eikelenboom /"Emkelend"?/ on this problem is of great interest. They conducted their experiment on 127 swine of a large white breed during a bacon fattening. The scientists noted that when the control swine attained 50-55 kilograms of live weight, the experimental ones, which were given biomycin, weighed 19-23% more. During further fattening this difference was somewhat reduced and comprised

12-16% regardless of the fact if the swine received biomycin or not. In the end, the animals which received antibiotics, attained the maximum weight for bacon fattening 16 days earlier than the control.

Similar data were obtained by foreign researchers, Gordon and Taylor in 1953. Their experiment on detection of effectiveness of the influence of penicillin and biomycin on swine during the period of bacon fattening they conducted with 143 piglets. The initial weight of each piglet comprised 18 kilograms, and the final - about /Begin p.43/ 95 kilograms. When antibiotics were added to the ration, which contained vegetable protein, the experimental swine gave an increase in weight 10-15% higher. Expenditures of fodder per unit of increase in weight, compared to the control swine which did not receive any preparations, were 5-8% lower. When antibiotics were added to the ration with animal proteins the average daily increase in weight increased by 12% when compared with the control. Difference in the effect of biomycin and of penicillin was insignificant.

Foreign researchers point out that utilization of antibiotics does not produce any noticeable effect on the quality of the swine carcass. The length and girth, amount and thickness of the fat layer, contents of water and fat in tissues remain normal. And after the additional feeding with biomycin the contents of vitamin B_{12}, riboflavin and nicotinic acid did not change also.

It is possible to make such recommendations on the basis of multiple observations. It is more expedient to add antibiotics to feeds that contain plant proteins. Especially effective are the antibiotics in rations, which consist of corn and plant proteins.

Antibiotics produce a positive effect on the organism of animals both during the pen and the camp maintenance. Pasturing on alfalfa gives somewhat better results than on clover.

p.47-65

ANTIBIOTICS IN POULTRY HUSBANDRY

A vast and manysided research work was conducted after it was first established in 1946 that antibiotics help in a better development of chickens. At the present time, as a result of this research, it became proved in all the world that antibiotics produce a positive effect on the production indices in poultry husbandry. When antibiotics are added to rations, the meat breeds of poultry attain faster the slaughtering weight, the quality of carcasses is noticeably improved. Addition of antibiotics to the feed of laying hens is not always expedient. Some of the researchers mark the increase in egg laying, while others do not register this occurrence.

The world science and practice are interested in many questions, which relate to the effectiveness of antibiotics in poultry husbandry. The effect of various antibiotics on growth and development of the young stock during its raising is being studied: on /Begin p.48/ the accumulation of meat and fat during fattening; on egg laying of various breeds of hens during both the cage and the run maintenance of birds; on dietetic and breeding qualities of the egg, and much else.

The most expedient conditions are being detected under which it is necessary to utilize antibiotics. For this purpose experiments are conducted where antibiotics are added to rations which have proteins of animal or plant origin, rich or poor in vitamins, and so on.

Title of the figure: Inhibition of growth of bacteria around the specimens of feed with antibiotics (A) and without the preparation (B).

At the present time, special combination feeds for poultry husbandry, enriched with antibiotics, are being produced in many countries of world. Feeding of such feeds to different age groups of poultry permits to raise the profitableness of this field of farming.

The effectiveness of antibiotics in a series of infectious diseases of poultry is quite indisputable.

Data, relating to the use of antibiotics in poultry husbandry are extremely voluminous, and it is impossible to describe them in /Begin p.49/ their full volume in the present booklet. Therefore we will discuss only certain problems, which have a direct relation to the practical utilisation of antibiotics.

ANTIBIOTICS IN RAISING CHICKENS

Special experiments, conducted by A. Kh. Sarkisov, N. S. Akulova and V. F. Grezin, in 1953, at the Kuntsev Poultry Factory, have shown that the addition of 40 milligrams of penicillin and 20 milligrams of biomycin per 1 kilogram of concentrated feed helped in raising the production indices.

In table 10 data are cited according to various groups of chickens, which were under experiments.

Table 10.

Utilisation of penicillin and biomycin in raising chickens

Number of the group	Antibiotic	Number of heads	Losses (in %)	Those lagging in growth (in %)	Average weight of one head at the end of the experiment (in grams)
1	Penicillin	428	1.4	1.9	297
	Biomycin	913	1.2	1.3	303.1
	Control	1,000	2.3	6.0	274
2	Penicillin	732	3.3	4.9	322
	Control	1,354	6.6	8.3	269
3	Biomycin	736	3.6	4.9	226.2
	Control	1,585	19.1	16.6	223.5

It is possible to ascertain a positive action of antibiotics, comparing the indices for each group separately. Among chickens of experimental groups the losses were twice lower, and the number of those lagging in growth were more than 3 times less than in the control. At the end of the experiment the average weight of chickens, which received antibiotics, was 8-20% higher than of the control. The following experiments with many groups of chickens at this farm have shown, that the use of penicillin or biomycin /Begin p.50/ helps a better development of chickens, reduces by 2-6 times the number of those lagging in growth and decreases losses by 2-4 times.

Observations of more than 200 thousand chickens in many zones of the Union during different times of the year, at farms with dissimilar production-economic indices, have confirmed the original data about the positive effect of feeds which contain antibiotics.

Under the leadership of Professor Z. V. Ermol'eva, the co-workers of the Chair of Microbiology of the Central Institute of Improvement of Doctors, together with workers of the Bratsev poultry factory, conducted experiments with over 20 thousand heads of poultry. In these experiments chickens, from the day-old to the 30-day of age, received antibiotics daily. Computing for 1 kilogram of feed, they received one of the preparations in the following dose: penicillin (sodium or novocaine salt) - 5 to 10 millip grams, ekmonovocillin - 2 milligrams, streptomycin - 15 milligrams, ecmolin - 1 milligram, biomycin - 5 milligram. As a result of use of antibiotics in the cited doses at the end of the experiment data were obtained, which are shown in table 11.

Table 11.

Effect of penicillin, biomycin and streptomycin on chickens from the first to the 30th day of age

Antibiotic	Weight of chickens (in grams)	Index of growth	Died (in %)
Penicillin	268	129	2.1
Biomycin	228	109	2.4
Streptomycin	206	104	2.9
Control	208	100	3.8

The table's data indicate, that the greatest effect was attained from the use of penicillin. In chickens, which received it at the end of the first month, the increase of weight was 29% greater than in the control group, that was under the same conditions, but which did not receive antibiotics. /Begin p.51/. At the same time the loss percentage among experimental chickens was almost twice lower than among the control.

For detecting the best doses of penicillin under conditions of a specialized poultry husbandry farm, that has high indices on chicken raising, experiments were conducted with one group of chickens of a summer hatching. Results of the experiments are cited in table 12.

Table 12.

Effect of penicillin doses in raising chickens

Dose of penicillin per 1 kilogram of feeds (in milligrams)	Number of heads	Losses (in %)	Weight of one head at the end of the experiment (in grams)
40	732	3.3	322
20	721	2.6	334
10	690	2.7	325
Control	1,365	6.6	269

The cited figures show that utilization of smaller doses, compared with large and medium, also gives good results. When giving penicillin in a dose of 10 milligrams per 1 kilogram of concentrated feed the additional increase in weight and the percent of loss are essentially similar to those which were obtained at the dose of 40 milligrams per 1 kilogram of feed.

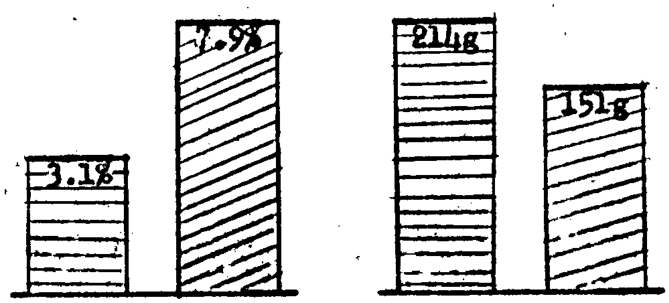
Utilization of biomycin, according to the same method, gave similar results.

Thus, reduction of the dose of antibiotics on farms with good conditions of maintainance, care and feeding of poultry is fully justified economically. It is more effective when antibiotics are given to the young stock of early spring hatching, when the health of chickens is much stronger.

Results of another character were obtained on a farm, where violations of conditions of feeding, care and maintenance were permitted. Here utilisation of antibiotics in smaller doses produced a positive effect, but it somewhat gave way in effectiveness to the use of penicillin /Begin p.52/ in a dose of 40 milligrams and of biomycin in a dose of 20 milligrams per 1 kilogram of concentrated feeds.

In kolkhozes, where experiments were conducted with a separation of control groups, data were also obtained, which point to the positive effect of antibiotics. Results of observations at the kolkhoz chicken farms are cited in the diagram.

Losses in weight Increase in weight



Experimental - Control Experimental - Control

Title of the diagram. Diagram of the effect of antibiotics in raising 4,500 chickens at kolkhozes.

Among chickens which received antibiotics, losses were more than twice lower, than in the control. At the same time, during the period of observation the increase in weight of experimental chickens proved to be 31.5% higher than of the control birds that did not receive antibiotics. This ascertains the favorable effect of feeds, containing antibiotics, on chickens, as all other conditions, which influence the productive indices, were similar for both groups.

The raising of increases of weight occur at the expense of better consumption and assimilation of feeds. Expenses for each kilogram of the increase in weight are reduced, and their compensation increases by 10% and even more sometimes. This is especially noticed on weak chickens, lagging in growth, which were culled in daily sortings during the process of raising. Feeding of antibiotics helps their normal development, and in most of them productivity is restored (increase in weight).

The following observations are of interest. At one /Begin p.53/ of the farms when sorting 10 day old chickens, a group of 147 head was separated, which were thought to be unfit for further raising and had to be disposed of. The weight of these chickens was 30% less than the required norms (48.7 grams instead of 62 grams). It was decided to keep the chickens. They were given 40 milligrams of penicillin per 1 kilogram of feed twice per day with their feed. The appetite appeared in chickens, their general condition was greatly improved, the increases of weight were raised very quickly. At 30 days of age the average weight of chickens was equal to 234.6 grams, the loss during the 24 days consisted of only 17 head.

The economic side of the problem is very important. Computation of expenses for buying antibiotics have shown, that their cost was not higher than 15-20 kopeks (1/100 of a ruble) per month, which comprised on the average about 1/2 kopek per head per day. This is fully compensated by the price of the additionally retained poultry and its raised increases in weight.

At the sovkhoz "Gorki - II" as a result of use of antibiotics in 1955 it was succeeded to reduce the loss of young stock by 44% (against the corresponding period in 1954) and to attain the retention of 98.9% of chickens. The farm has additionally raised over 6.5 thousand head of young poultry stock, the value of which to a considerable degree covers the expenses for buying antibiotics.

The experience of work shows, that for a successful introduction of antibiotics into the practice of kolkhos poultry husbandry, it is necessary to conduct a series of organisational measures, which will provide a planned provision of kolkhozes with the required preparations.

The network of incubator-poultry husbandry stations (IPS) /hatcheries/ can, in our opinion, play an important role in this matter. The oblast' offices of IPS, through planned orders, can obtain from "zoovetsnab" /Zoological and Veterinary Supply Office/ and supply the inter-raion offices with the required amount of antibiotics. The hatcheries, while transferring the chickens to the kolkhez for raising, could then release the antibiotics for the whole livestock. Thus the cost of the preparation would be paid by the farm together with the price of the acquired livestock of day-old chickens. Such an order of supplying the farms with required antibiotics would free the poultry-maids and the farm specialists from spending profitable time for acquiring the preparations. /Begin p.54/.

The utilisation of antibiotics in raising young poultry is a new work and, naturally, it will require from the veterinary and zootechnical workers of the raion, IPS, of poultry husbandry farms and kolkhozes to teach the poultry-maids the new technical practice.

At the present time antibiotics are already utilized with success in raising chickens on many farms. Therefore a wide exchange in experience could play an important role in the raising of production indices.

Workers of Zaraisk raion, Moscow oblast', together with scientific-co-workers (Kh A. Dzhilovian and others), in 1955, have conducted a wide experiment in utilizing antibiotics in raising chickens at 25 kolkhozes of the raion and at IPS.

In spite of unfavorable conditions of the summer, all the kolkhozes of the raion retained over 97% of chickens at the end of the first month of raising and over 84% at the moment of replacement of the flock (October 1st). Such high indices were attained by the kolkhozes for the first time during the last several years. And individual farms attained still better results. Thus, kolkhozes "Bor'ba" and "Svetlyi put'" retained all the chickens, which they obtained from the hatchery during the first month of raising, and on October 1st - 99% of the young stock. Kolkhozes "Kommunist", "Slava geroiam", "Primernyi trud", "Zaria svobody", "Kul'tura", "Krasnyi maiak", "imeni Meretskova", and certain others, retained at the time of flock replacement 90 and over percent of the young stock, which was obtained for raising. Of course, while using antibiotics, the poultry-maids of these kolkhozes did not forget to fulfil also the other necessary zootechnical measures.

The wide exchange of experience in utilizing antibiotics in raising chickens in Moscow oblast', organized, in 1956, by the Oblast' Veterinary Department and the Department of Poultry Husbandry, has shown that many kolkhozes, utilizing antibiotics, attained a high retention of chickens.

Data, collected for the year 1956 from some of the kolkhozes of several raions in Moscow oblast', where the effectiveness of utilization of antibiotics in raising chickens was taken into consideration, indicates the necessity of introduction of this measure. Thus, the kolkhozes of Mikhnevskii raion, /Begin p.55/ "1 Maia", "Pobeda", "Pamiat' Lenina", "Put' Il'icha", "imeni Frunze" and others have retained by July 1st from 92 to 97% of the stock. Similar results were obtained at kolkhozes "Vernyi put'", "Krasnyi Oktiabr'", "Vpered", "Druzhba", "Krasnaia zvezda", and others in Chekhov raion.

There are reports about the positive experience in utilization of antibiotics in raising of chickens at individual kolkhozes of Podol'skii, former Zvenigorodskii, Ukhtomskii, Leninskii, Ramenskii and other raions of Moscow oblast.

Single specialists of raions mentioned low effectiveness of antibiotics on those farms where conditions of feeding, care and maintenance of chickens were entirely disrupted.

Overcrowding, improper feeding, disturbing the temperature regime during the first and the following days of raising led to the loss of 16-20% of chickens, and even a greater percentage on some individual farms.

Use of antibiotics in a complex with other measures will provide a high percentage of retention of valuable young poultry livestock.

A more profitable regime of feeding antibiotics in poultry husbandry has been established on the basis of practical observations and special research. (Text is continued after Table 13)

Table 13.

Single doses of antibiotics for chickens one to 30 days old

Age (in days)	Penicillin for the preparation of medicinal forms		Penicillin for injections (in thousand units)		Biomycin hydrochloride	
	per 1 head (in milligrams)	per 1,000 heads (in grams)	per 1 head	per 1,000 heads	per 1 head (in milligrams)	per 1,000 heads (in grams)
1-10	0.2	0.2	0.3	300	0.1	0.1
11-20	0.4	0.4	0.6	600	0.2	0.2
21-30	0.6	0.6	0.9	900	0.3	0.3

In the instructions on the use of antibiotics in poultry husbandry, recommended by the Chief Veterinary Administration, the positive experience has been generalized and practical recommendations given /Begin p.56/ on the utilization of antibiotics in raising chickens, fattening of the young stock and feeding of the laying hens.

Single doses of antibiotics for chickens one to 30 days old are cited in table 13.

At kolkhozes and sovkhozes, provided with good poultry houses and which can feed the young stock a plentiful ration, the expenditure of antibiotics can be cut in two compared to the doses cited in the table.

On such farms the use of antibiotics is for the purpose of promoting the assimilation of feeds, and raising of weight increases of the young stock since the retention of poultry is high on these farms.

How to feed antibiotics to chickens? Before mixing the required amount of penicillin or biomycin with the concentrated feeds, it must be dissolved in pure drinking water. When preparing dry grain mixture the amount of water is taken which will be sufficient for moistening the grains. When preparing moist mash, the preparation is first dissolved in a small amount of water, and then added to the liquid which is used to moisten the grains.

Solutions of antibiotics are carefully mixed with the feeds; a compulsory condition is that it must be uniformly distributed in the feeds. An uneven concentration of the preparation can lead to the condition, that part of chickens will receive feeds with a low content of antibiotics and this will considerably reduce the results of its utilisation.

The prepared water solutions of antibiotics must be used during the next 3-4 hours. It is not permitted to prepare antibiotic solutions for a longer time since the activity of solutions is reduced sharply.

The results of addition of antibiotics to the ration of chickens are apparent already during the first 5-10 days of use. The chickens show an increased appetite, they eat their feed well and are very lively. In a group of young stock, which receive antibiotics, the number of chickens, which lag in growth, is very small, and on the whole the party develops evenly.

On the day of admission of chickens to the farm the full daily /Begin p.57/ dose of antibiotics is fed with the first feeding, beginning with the second day it is divided in two even parts: the first is given with the feed in the morning, and the second - at night.

Let us cite an exemplary computation of the requirement of penicillin for 1,000 chickens. For one chicken one to ten days old 300 units of the preparation are required for one giving, and for the entire livestock 300 X 1,000 = 300,000 units (one flask - 300,000 units). Daily requirement of penicillin will comprise: 300,000 X 2 = 600,000 units (two flasks of 300,000 units). During the second decade (10 day period) the amount of penicillin is doubled and will comprise (in the morning and at night) two flasks, each containing 300,000 units. During the third decade (10 day period) one chicken requires 900 units for each giving, and for 1,000 heads (900 X 1,000) = 900,000 units, or three flasks in the morning and as much at night.

The farm can easily use penicillin in tablet form. If each tablet contains 100,000 units of penicillin, then, according to the above cited computation, 3 tablets will be required during the first decade (10 day period), during the second - 6 tablets each time and during the third - 9 tablets of penicillin for each giving.

Tablets should be first dissolved in one glass of drinking water, and then the obtained solution should be diluted in a volume of liquid that will be required for moistening the feed (mash or grain mixture).

It is more complicated to use penicillin or biomycin on small farms when they are not packaged, in powder form, which must be weighed for each giving. In such a case the preparation of proper weighed portions and preparation of water solutions of antibiotics must be entrusted to persons who have an experience in the work of precise weighing.

On large poultry husbandry farms, on the contrary, the use of unpackaged preparations is handier. It is more expedient here to calculate antibiotic requirements for 1 kilogram of concentrated feed, which is required according to ration for chickens of a corresponding age. It is recommended to add penicillin for the preparation of medicinal forms (technical) in a ratio of 40 grams per 1 ton of feed (40 milligrams per 1 kilogram), and biomycin - 20 grams per ton (20 milligrams /Begin p.58/ per 1 kilogram). It is recommended to farms with good conditions of poultry maintenance, where the retention of chickens comprises 96% and over, to use penicillin in the amount of 10 grams per 1 ton of feed, and 5 grams of biomycin per 1 ton of feed.

Calculating per head the doses are increased according to age, but calculating per 1 kilogram of feed they remain constant during the course of a month, inasmuch the norms of feeding are increased with the growing of the young stock.

ANTIBIOTICS IN MACHINE FATTENING OF POULTRY

Yearly millions of head of poultry are fattened on poultry husbandry farms and at specialized poultry fattening points. Unfortunately, kolkhozes up to the present time did not pay any proper attention to the problem of fattening of the young stock. Experience of the leading kolkhozes of the

Krasnodar krai shows that it is possible to conduct machine fattening of cokerels directly on the farm.

The advantage of such a fattening is that during 23-26 days poultry shows a very sharp rise in the increase of weight - up to 100% and more over the initial weight before fattening. At the same time the quality of carcasses changes also; the number of higher and first grades increases.

Accomplishment of poultry fattening at kolkhozes already during the next few years can play an important role in the increase of meat resources of our country and to raise the profits of kolkhozes from poultry husbandry.

The composition of the ration and the preparation of feeds for consumption are of great importance when fattening cockerels. Addition of antibiotics to feeds helps in the increase of the assimilation of these (by 5-10%), and, consequently, the feeds are better reimbursed.

Up to the present time there as yet is no unanimous opinion as to which of the antibiotics has the advantage in poultry fattening. Nevertheless, it is considered to be established that penicillin, biomycin, and terramycin produce a stimulating effect. Utilization of these preparations in a dose of from 10 to 40 grams per 1 ton of feed produces a positive effect. /Begin p.59/

Workers of poultry husbandry farms, situated near factories, which produce biomycin, utilize widely the wastes of this production - mycelial (fungal) mass.

Pure antibiotics, as well as the mycelial mass are added to the feed before consumption. Crystallized preparations are dissolved at the rate of 1 gram per liter, and the fungal mass at a rate of 1 kilogram for 1-5 liters of drinking water. Solutions of the preparations should not be kept longer than 3-4 hours, as in such a form they become quickly inactivated and lose their positive qualities.

After adding either the antibiotic or the fungal mass to the feeds, these must be mixed very carefully, because an uneven distribution of the preparation in feeds leads to the condition that part of the poultry do not receive any antibiotic, and this lowers its effectiveness.

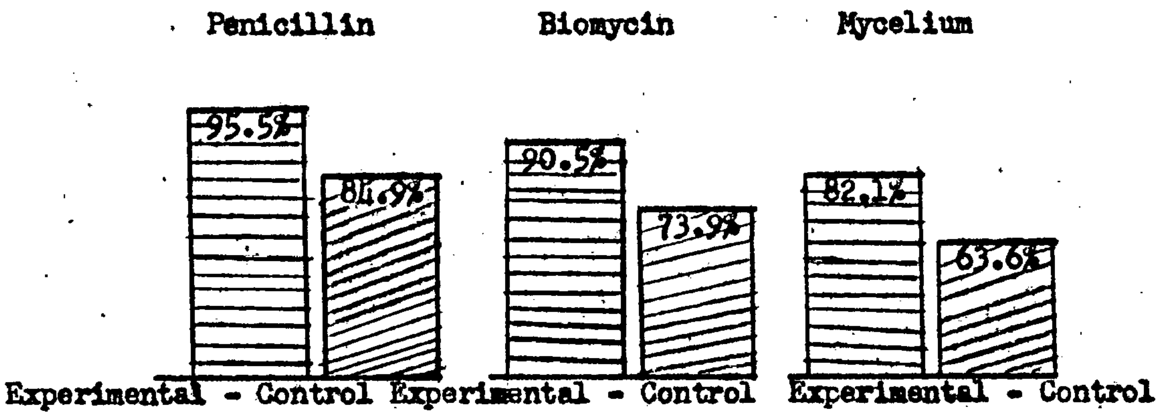
We repeat: the feeds, to which antibiotics have been added cannot be subjected to steaming, fermentation or any other treatment. Steaming can destroy the acting basis of the preparation.

The workers of Kuntsev poultry factory, A. A. Kostenko and A. I. Borisova, in 1954, used for the machine fattening of poultry mycelium of penicillin (4-5 grams per day per head) and of biomycin (6-8 grams per day per head). According to their observations the birds ate the feed better, and as a result of this - the increases in weight were raised and the quality of carcasses was improved when compared with cockerels of the control group.

The workers of sovkhoz "Gorki - II" together with Doctor of Biological Science, A. Kh. Sarkisov, and Candidate of Veterinary Science, N. S. Akulova, conducted a series of production experiments on detecting the effectiveness of pure antibiotics and of the mycelial mass. On this farm, in machine fattening of cockerels, in 1955, were utilized: penicillin, at the rate of 4 milligrams (600 units) per head, biomycin hydrochloride - 2 milligrams and mycelial mass of the producer of biomycin at the rate of 3-5 grams per head.

Factors, which could influence the results of the experiment were excluded to the greatest degree. For this purpose a group of poultry of one feeder was separated into two equal /Begin p.60/ groups. One of them received feeds with antibiotics, the other - without them.

After 25-26 days all the birds were killed during the course of one day, and the specialists on determining the quality of carcasses evaluated each one of the experimental and the control group. (see diagram).



Title of diagram. Diagram of the yield of carcasses of the first and higher qualities in machine fattening of cockerels with the use of antibiotics.

The yield of carcasses of the higher and first qualities was 10-16% higher in cockerels which received antibiotics as compared with the control, which did not receive any preparations. At the same time, the average weight of the carcasses of cockerels of experimental groups was also somewhat higher than of the control.

Similar data were obtained also on other farms, where corresponding experiments were conducted. Addition of antibiotics helped a better assimilation of feeds and an improvement of production indices.

Farm specialists think, that, in fattening, it is more expedient to feed the mycelial mass of the biomycin producer. Expense for its acquisition is very small, but the results attained are just as good as the indices obtained in the utilization of pure antibiotics.

ANTIBIOTICS FOR LAYING HENS

It is known that a laying hen, which lays 180-200 eggs, that is 12-13 kilograms of egg mass per year, has to digest a considerable amount of feeds. Computations /Begin p.61/ show that weight of these feeds must by 25 times exceed the live weight of the hen. Therefore poultry husbandmen take a series of measures which will provide a good consumption of feeds: they prepare various mixes, change their blends, introduce mineral feeds, and so on.

Expediency in utilization of antibiotics for this group of birds remains unclear. Complexity in conducting rigid experiments does not permit to finally solve this problem. This is explained by the fact that it is practically impossible to choose equivalent groups in egg laying since the productivity of hens depends on many individual qualities of the layers, on the time of the beginning of laying, the breed of hens, and so on. Therefore, the assertion about positive influence of feeds on the increase of egg-laying of hens we express only on the basis of observations of the practical workers.

At the sovkhoz "Gorki - II", at the Kuntsevo and Brattsevsk poultry factories, as well as at poultry farms of individual kolkhozes of Moscow oblast, they add to the feed of laying hens the mycelial mass of the biomycin producer at a ratio of 5-8 grams per head per day. Such an addition helps in the improvement of the appetite and a full consumption of the feed, what in its turn points to a good assimilation of nutrient substances and leads to the increase in the productivity of the poultry.

Comparing the egg-laying of the birds before and after the addition of antibiotics to the feed, the bird-breeders record an increase in egg-laying after the use of preparations. On individual farms these data are obvious and do not arouse any doubts. Thus, for a high-laying group of hens at sovkhos "Gorki-II", for the first five months of 1955, egg-laying increased on the average by 7 eggs from each hen when compared with a similar period in 1954, when the mycelial mass was not utilised.

Proceeding from observations of practical workers, specialists, the Chief Veterinary Administration of the Ministry of Agriculture of USSR recommends to feed to laying hens the mycelial mass in the morning and at night per 2.5-4 grams per head at each giving.

Before introducing it into the feed, the mass is preliminarily diluted in pure water until pasty. /Begin p.62/ In such a condition it is carefully mixed with mash or grain-mix and is fed the same day.

It is recommended after a two-week use of mycelial mass to interrupt it for 10-14 days, and then again to resume giving it with the feed. Such a rotation helps a good consumption of feed by poultry.

Feeding antibiotics, as well as the mycelial mass, to the hens does not produce any negative effect on the flavor qualities of dietetic eggs. Hatching of chickens from breeding eggs is not reduced also. More than that, individual researchers point to an increased percentage in the hatching of chickens from eggs, obtained from such hens.

According to data of foreign researchers, "Tszingi" and Bright, addition of biomycin to feeds during the course of six months did not produce any effect on the quality of eggs. The quality of egg white, the thickness of the shell, weight and size of eggs in experimental hens did not differ from those in the control.

Literary data and practical observations do not give sufficient grounds for assertion about a positive effect from feeding antibiotics to hens on the growth of chickens. According to data of certain researchers, the feeding of antibiotics to hens stimulated the development of chickens. Others, in similar experiments, did not notice such advantages: chickens of the experimental and of the control groups developed similarly.

Farms, which utilized the mycelial mass for laying hens, point out to the positive action and the economic expediency of this measure.

ANTIBIOTICS FOR TURKEY-POULTS

Antibiotics produce a positive effect in feeding them to turkey-poults during the first month of raising. This property is possessed by penicillin, biomycin and terramycin when introducing them to feeds in a ratio of 10-20 milligrams per 1 kilogram of dry concentrated feed.

Turkey-poults, which received antibiotics produced an increase in weight 15-20% higher than those in the control, which did not receive any preparations. At that, the effect of antibiotics is expressed much stronger when they are added to feeds which contain proteins of animal origin.

/Begin p.63/

There are reports, in foreign literature, about positive action of biomycin and penicillin in raising turkey-poults. During the experiment of Almquist and Morritt (1953) 4 thousand turkey-poults were broken up into 5 groups. From each of these groups 10% were separated for weighing every 10 days. Observations were conducted during the course of 110 days, beginning with the first day of life of the poults. As a result of these observations it was noted that the addition of antibiotics always produced a positive effect on the growth of males up to the age of 110 days, and on the growth of females only to the age of 70 days. Remuneration for feed of poults which received antibiotics was higher when compared with the control, which did not receive these preparations.

ANTIBIOTICS FOR WATERFOWLS

The experience in the use of antibiotics for waterfowls is limited. Penicillin, biomycin, terramycin and streptomycin were tested in raising ducklings and goslings. Each of these preparations was introduced to the food mix at the rate of 25 milligrams per 1 kilogram of dry concentrated feed.

The effect of unpurified biomycin (Aurofac), prepared especially for utilization in animal husbandry, was studied besides that. Aurofac was introduced to the feed mix reckoning on conversion to pure biomycin.

Limitedness of experiments and diversity of conditions under which they proceeded are the basic causes why this field of poultry husbandry does not use antibiotics until the present time.

According to data of some researchers and practical workers, feeding antibiotics to ducklings helps their intensive development. Data of others do not confirm this.

Practical observations of duck raisers show that penicillin and biomycin can be successfully used during the first days of raising ducklings. Thus, according to reports of the Veterinary Surgeon, N. A. Odabosh'ian, the poultry-maid of the kolkhoz "imeni Stalina", Kanevsk raion, Krasnodar krai, in 1957, utilized the antibiotics widely in raising 101 thousand ducklings. At the kolkhoz 96.2% of the young stock were retained, and the best section of V. I. Krutilova, /Begin p.64/ raised 99% of ducklings from the 7 thousand heads, that were obtained for raising.

Antibiotics were given together with feeds to all ducklings only the first 6-8 days of raising, and after that they were given only to the feeble and those which lagged in growth; to these were fed the best concentrated feeds - cottage cheese, cooked eggs, finely chopped greens, oil cakes, and others. The feeds were given in the form of moist crumbly mash, to which were added 20-40 milligrams of penicillin or 10-20 milligrams of biomycin for 1 kilogram of dry concentrated feed. Special attention was paid to careful mixing of antibiotics with the feeds. Use of antibiotics helped in the improvement of the appetite in the raising of feed consumption, in reduction of sickness among young stock and its better development. The greatest part of feeble ducklings under such conditions recovered already during the first 3-5 days and became active and lively.

On farms, which grow a small number of ducklings, computation of requirements of antibiotics can be made proceeding from their dose for one duckling. The young stock from one to 10 days old should be given 1-2 milligrams (1,500-3,000 units) of penicillin or 1 milligram of biomycin per head per day.

The daily dose of antibiotics is fed in two stages - in the morning and at night. If the farm has received penicillin for raising 1,000 ducklings and decided to use it, the computation is made as follows: the general requirement for all the livestock will consist of 1-2 grams (1,500,000-3,000,000 units), or for each feeding 0.5-1 gram (two or three flasks of 300,000-500,000 each). The requirement for biomycin is calculated according to a similar scheme.

Effectiveness of the above cited antibiotics for goslings was noticed only in the case when they did not receive and green grass. Penicillin and biomycin helped the improvement of growth and the raising of effectiveness of utilization of feed by goslings in brooder raising during the course of 4 weeks. Positive effect of antibiotics was noted also in their further utilization.

When studying the effect of penicillin and of the green grass on the growth of goslings, it was ascertained that the grass influences in the same way, and in some cases even better than penicillin. Goslings, /Begin p.65/ which received penicillin, but did not utilize the pasture or received any green grass, developed worse than those which were pastured regularly.

Data, cited above, indicates that the possibility of use of antibiotics for waterfowl requires studying and practical testing.

p.69-70

ANTIBIOTICS FOR LAMBS

The experience of use of antibiotics as measures for improving the growth and development of lambs is very limited, and the obtained data are very contradictory.

Foreign researchers, R. Elliot and S. "Ellsuft", in 1953, mentioned a positive result when adding biomycin to the lamb's feed in a ratio of 10-20 milligrams per 1 kilogram of feed. /Begin p.70/ Three forms of rations were utilized in the experiment. In the first ration there were 80% of coarse fodder and 20% of grains, in the second - 40% of coarse fodder and 60% of grains, and in the third - 60% of coarse fodder and 40% of grains. There were five lambs in each experimental group. All lambs, which received biomycin, at the end of ten weeks of the experiment had an increase of weight approximately 15% greater than the control, which did not receive the preparation.

Another experiment is interesting which showed the positive effect of biomycin in the fattening of lambs. Two hundred fifty lambs were divided into 5 groups. The first group received the feeds without antibiotics, and all the rest received biomycin also besides the similar feeds, in a dose of 5, 10, 15 or 20 milligrams per 1 English pound of feed (425 grams). The experiment continued for 63 days. Its results are cited in table 14.

Table 14

Effect of biomycin in lamb fattening

Indices	Biomycin (in milligrams per 1 English pound of feed				
	0	5	10	15	20
"Postanovochnyi" /at the beginning of the experiment?/ weight of 1 head (in pounds)	77.9	76.7	76.5	75.8	25.2
Final weight of 1 head (in pounds)	92.2	98.7	100.6	97.9	97.6
Daily increase in weight of 1 head (in pounds)	0.22	0.33	0.38	0.35	0.34
Expenditure of feeds per 1 pound of increase in weight (in pounds)	16.0	11.5	10.3	11.3	11.2
Quality of meat (in %):					
Highest grade	59.4	72.2	78.5	72.0	78.9
good quality	38.5	27.3	21.5	28.0	21.2
low quality	2.1	0.5	0	0	0

It is seen from the table that the lambs, which received biomycin, increased in weight better, and after slaughtering their carcasses were evaluated higher. The best indices were marked after the use of biomycin in a dose of 10 milligrams per 1 pound (approximately 20 milligrams per 1 kilogram) of feed.

CHOICE OF ANTIBIOTICS ACCORDING TO THEIR EFFECTIVENESS

b) in raising young animals

	Degree of effectiveness					
	Penicillin	Strepto-mycin	Biomycin	Terramy-cin	Synto-mycin	Levomy-cetin
Calves		3	1	2		
Piglets	2	4	1	3		
Chickens	1	3	1	2		
Turkey-poults	1		1			
Ducklings	1		1			
Fattening of young stock	1					

Note: numbers 1, 2, 3, 4 indicate approximate degree of effectiveness.

KPSS /Communist Party of the Soviet Union/ concerning the matter of increasing the productivity of our forests. He noted that the principal purpose of the Conference was to bring up to-date the results obtained in the realm of forest selection in our country and abroad, and also to determine further means to be used in the development of scientific work for the selection of forest tree species.

L. F. Pravdin (Institute of Forestry, Academy of Sciences, USSR) presented a report on the importance of and the problems involved in the work of forest selection aimed toward raising the productivity of forests. The speaker shed light on the significance of selection as one of the links in learning about evolution regulated by man. As a scientific discipline, selection is characterized by a high degree of complexity. Based on fundamental disciplines, it develops its own methods and establishes regularities to which the process of form development is subordinate. One of the leading methods used in forest selection is the study of form variety of tree species because it helps to disclose the potential possibilities of plant genera and species with respect to selection.

The further diverse and thorough study of the variety of forms of our tree species should, in connection with the growing demands of the forestry industry, become one of the most important tasks of forest selection. /Begin p.629/.

The method of hybridization of tree species has, for the last 25-30 years, become widely distributed. Hybridization has been conducted between numerous species of woody plants that are of national economic importance: larch, pine, oak, birch, poplar, willow, nuts, elms /Ulmus/, elms /Ulmus effusa Willd./ and others.

In unfolding the work of hybridization it is essential to use more widely the method of grafting that permits obtaining early blossoming of the scion if the cuttings have been taken from fruit bearing specimens, and facilitates the procedure of pollination, because the hereditary characteristics of the maternal plant are invariably retained in the scion.

Embryonic and physiological investigations must also be extended. Along with the artificially obtained hybrids, interest is aroused also by hybrids that have formed under natural conditions.

A very important section of selection is the study of resistance to fungus diseases and insect injuries in forms selected in nature and obtained artificially.

Work should also be unfolded on obtaining polyploid forms artificially among woody species by methods of radiation selection known earlier and improved in recent years. L. F. Pravdin dwelt on systematizing work for the approval of new forms and hybrids in the USSR. In evaluating a variety, the geographical regions of its cultivation must definitely be defined.

In his second report dealing with breeding /o selektsii/ by the method of individual selection and its importance in creating seed plantings, L. F. Pravdin noted that without establishing scientific seed production that would permit obtaining seed with adequate hereditary properties, the problem of increasing the productivity of forests cannot be settled fully. One of the most effective and promising methods to be used in this field would have to be individual selection of highly productive, so-called "plus" trees with their subsequent propagation by means of grafting for the creation of seed plantings.

The problem of improving natural and regenerated forests has been brought up in all its severity in every country of the world. Using Swedish foresters as an example, L. F. Pravdin dwelt in detail on the theoretical substantiation of individual selection of "plus" trees in natural plantings and told about the working methods used. Vegetative propagation of selected "plus" trees realized by grafting their shoots onto 3-4 year old stocks of the same species permits creating seed plantings that reach the full fruit-bearing phase rapidly. A staggered /shakhmatnyi/ arrangement of grafts from various trees insures a cross-wise interclonal pollination that offers a possibility of obtaining high-grade seed from low-stemmed seed trees.

The head of the Administration of Forest Crops and Forest Improvement of the Ministry of Agriculture USSR, M. G. Pinchuk, made a report on measures carried out by a forest farm practicing selection and acclimatization of tree species. In the current decade the productivity of forest areas must be increased by no less than 10-15%. One of the most effective methods of increasing the productivity of forest areas is definitely the cultivation of fast-growing tree species. More and more poplar, cork tree /barkhat/ of Amur /Phellodendron amurense/, red oak, nut, larch and other species have been adapted from year to year to plantings of State forest resources and to shelterbelts.

M. M. Veresin (Voronezh Technical Forestry Institute) made a report on the technical and practical importance of the use of typological forest /lesotipologicheskikh/ forms of tree and shrub plants in forest selection. The heterogeneity of soil-topographical and other environmental conditions within the limits of individual natural and historical regions leads to the formation of ecological forms of tree species that are known also as "typological forest" species. Typological forest variation of forest tree species manifests itself in a series of characteristics in the first generation of the seed progeny and is of great selection and forest cultural importance. In the data cited on the growth of seedlings and cultural strains of pine and oak from seed of a different forest typological origin, it was demonstrated that in oak, as well as in pine, strains with the best properties are obtained from seed taken from highly productive forest types, and the worst - from those of low productivity.

V. M. [illegible] (Briansk Institute of the Forestry Industry) made a report on the topic of "Theoretical and practical importance of the use of geographical forms of forest tree and shrub plants in forest selection".

It was noted in the report that forest plantings of each species have the greatest productivity within the limits of a so-called physico-geographical growth optimum. Beyond the limits of this optimum the productivity of plantings gradually decreased when growth conditions deteriorated. When forest tree plants were removed from certain kinds of physico-geographical conditions into /areas/ in different directions and with different conditions, they retained within them the /acquired/ geographical changes that manifested themselves to various degrees in relation to the influence exerted by the new environmental conditions and the age of the plantings. The geographical changes in forest tree species can be utilized extensively in forest selection with a view to selecting valuable forms, as well as obtaining new forms by means of hybridization, and they can be taken into account in forest seed production.

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N. V. Dylis (Institute of Forestry, Academy of Sciences USSR), in his report concerning genetic selection and botanico-geographical importance of the contact between the areas of the Siberian and Daur larches /*Larix dahurica*/, noted that the question of contact between areas of two related species is of varied /Begin p.630/ practical and, especially, theoretical interest. The edge of the areas between the Siberian and Daur larches bears the character of a shallow contact, their areas do not lean against each other, but /merely/ touch upon each other. In the places of contact the Siberian larch appears to be a species that requires more heat as compared with the Daur type which is more sensitive to aeration and warmth of the soil and to the duration of the vegetative period. Here, often are encountered typical interspecific mixtures (Chekanovskii's larch). Hybrids with dominant characteristics of the Siberian larch adapt themselves to drier and warmer habitats, those with the dominant characteristics of the Daur larch fill the habitat characteristic of it. N. V. Dylis arrived at the conclusion that in hybridizing species that come from oblasts with a severe climate with species from a milder climate, the characteristics of the first will be dominant in the hybrid progeny of plants that grow in more severe habitats, and the characteristics of the second /group/ of plants growing in a more favorable atmosphere.

A. S. Iablokov (VNIILM) /All-Union Scientific-Research Institute of Forest Materials (or Forestry Mechanization)/, in the report entitled "Distant hybridization - the leading method used in acclimatizing forest species and in creating new forms", noted that the /following/ problems were tackled with the aid of distant hybridization: 1) acclimatization of nuts of the *Juglans* and *Corylus* genera /and/ Lombardy poplars; 2) introduction of faster-growing and more productive tree forms; 3) increasing immunity to the heart rot disease (in aspen) and to rust (in birch). The use of distant hybridization has permitted reducing the period of directed rearing of acclimatized species, of accelerating the process of plant adaptation to the environment of a new habitat. Production of huge quantities of hybrid seed of the first generation may have special promise for forestry. Their future use will permit increasing greatly the productivity, the span of life and the stability of forest plantings. A. S. Iablokov dwelt on the results of experiments conducted in distant hybridization of forest trees and shrubs. Hybrids have been obtained from different species of nuts: the Manchurian, the butternut, the black walnut /Juglans nigra/, the walnut /Juglans regia/, the Japanese nut and the pithy /serdtsevinnyi/ nut (many were obtained for the first time in history); mother /matochnye/ seed-orchards have been established in which over two thousand of the hybrids distinguished by winter hardiness, fast growth and increased productivity are growing. Frost resistant, northern nut varieties /funduki/ have been developed by means of interspecific hybridization for the Moscow area. Valuable new varieties of winter hardy and fast-growing Lombardy poplars and fast-growing poplars for cultivation on podzolic northern soils have been obtained. I. A. Kazartsev has obtained for the first time hybrids of the poplars Populus-Populus pruinosa /"turanga" of Turkestan/ for the saline soils of the South East. Crossing of the Lowland whitefir /ispolinsk- Abies grandis/ triploid forms of the Oboyan and the Shar'in aspen has been realized and the hybrids obtained are now being cultivated (S. P. Ivannikov). Quite positive results were produced by experiments conducted in distant intraspecific and interspecific crossing of birch (A. Ia. Liubavskaia), maple (I. M. Zaikina), lilac (O. K.

Nikolaeva), larch (N. F. Kudasheva), pine (N. V. Kotelova), firs (Z. I. Zabolotnova), and sequoia (V. I. Ermakov). By the use of distant hybridization of deciduous and coniferous species it is possible to solve the problem of acclimatization of valuable species, to create new forms and species of trees and shrubs, and also to change radically the situation by organizing technically improved forest seed production.

In conclusion, A. S. Iablokov noted that the current situation of scientific work in the fields of seed growing, selection and acclimatization of forest species cannot be recognized as satisfactory.

The report by A. V. Al'benskii (VNIALMI) /All-Union Scientific-Research Institute of Agricultural and Forest Melioration/ on distant hybrids of the trees of the All-Union Scientific-Research Institute of Agro-Forest Melioration /VNIALMI/ was read at the Conference. Hybridization work with larches and poplars was begun within the system of VNIALMI in the year 1933 for the purpose of developing stable forms under conditions of the southern forest zone of the European part of the USSR. The larches used for hybridization included the Siberian, the European, the Japanese and the Daur /Larix dahurica/. The advantage of the hybrids over pure species is expressed in their superiority in height, diameter and volume of stems. To obtain winter hardy poplar forms possessing heterosis, crossings were carried out with the following poplars: the white, the Berlin, the balsamiferous, the suaveolens, Bolleau's Canadian, Lombardy, black, Cathay, aspen and others. Hybridization was carried out on small cut off branches.

At present, work is being conducted also on hybridizing of pine, nuts, maple, ash, acacia and birch. Experience has demonstrated that even though hybrids, in individual cases, adapt themselves well to external conditions, work on the selection of tree species must be carried out separately in each large natural-historical region.

P. L. Bogdanov(Technical Forestry Academy) reported on the results of selection work with poplars in Leningrad. Hybridization work was conducted from 1932 through 1941. Tests were made of a large variety of poplar species and forms, and 160 combination crossings were accomplished. Elite specimens were obtained of hybrid poplars that were distinguished by rapid growth, cold resistance and ornamental value. They are propagated vegetatively and are tested under various conditions by the method of geographical planting. Two vegetative hybrids were obtained by the method of grafting Populus suaveolens onto Populus nigra and Populus suaveolens onto Populus canadensis. A combination of rapid growth and ready rooting of grafts, adequate cold resistance, resistance of leaves to rust and to aphids and a strong morphological variation in the blade of the leaf the form of which resembled one of the graft components were observed in the hybrids.

Consideration of the report of N. V. Matskevich (Institute of Forestry, Academy of Sciences USSR), /Begin p.631/, "Polyploidy and its importance in forest selection" and of the report of N. A. Delone (Institute of Biophysics, Academy of Sciences USSR), "Use of ionizing radiation in the selection of plants" assumed the character of a discussion. N. V. Matskevich clarified the importance of polyploids as an evolutionary factor and noted also the prospect of using polyploids as a method of selection. A further study of the phenomena of natural and experimental polyploids, applicable to woody objects of a forest, will be not only of theoretical but of practical interest as well. N. V. Matskevich told about the first results of work conducted at the Institute of Forestry, Academy of Sciences USSR for the purpose of obtaining polyploid forms of forest tree species.

A. M. Ozol (Institute of Biology, Academy of Sciences, Latvian SSR) reported on the results obtained in the introduction and acclimatization of tree species in the Latvian SSR. Of coniferous /trees/ the best results were displayed by Larix europea, Larix sukaczewi /Sukachev's/, Pinus stribus /Weymutov's/, Abies alba and posevdotsyga /or poseudotsuga; of deciduous /listvennykh/ species - Quercus rubra, Populus setigerum /Hairy poplar/, Fagus /buk obyknovennyi/, Juglans cinerea and Juglans sieboldiana, Phellodendron amurense and others. Best results of acclimatization of tree species of foreign origin are obtained when seeds of local trees that are the progeny of the second, third and subsequent generations are used.

V. A. Panin (Institute of Forestry, Academy of Science USSR) reported on biological forest-production characteristics of forms of firs of the central taiga in the European part of the USSR. E. T. Orlenko (Belorussian NIILKh) /Belorussian Forestry Scientific-Research Institute/ - on selection of aspen in the Belorussian SSR; D. Ia. Girgidov (TsNIILKH /Central Forestry Scientific-Research Institute/) on the introduction of new rapidly growing and economically valuable tree species in the north western oblasts of the European part of the USSR for the purpose of increasing forest productivity; A. M. Golikov (Moldavian Forestry Experimental Station) - about results of the introduction of eucommia in Moldavia; S. P. Ivannikov (VNIILM /All-Union

Scientific-Research Institute of Forest Materials (or Forestry Mechanization)/) - about selection, development and propagation of economically valuable forms of aspen under conditions of the central forest steppe; E. I. Ka'kova (Voronezh Technical Forestry Institute) - about the importance of phenological forms of the pedunculate /summer/ oak in forest culture.

A. V. Kudzin'sh (Institute of Problems of the Forest Industry, Academy of Sciences, Latvian SSR) dwelt on the results of work accomplished in the discovery in the Latvian SSR of valuable plantings and forms of aspen, Scotch pine /Pinus sylvestris/, black cotton-wood poplar /Populus trichocarpa/ and alder of hybrid origin /Alnus hybrida/; I. V. Kalinina (Kamyshin Base of VNIALMI /All-Union Scientific-Research Institute of Agricultural and Forest Melioration/) - about transpiration intensity in vegetative ash hybrids in the Lower Volga area; A. F. Kushinskii (BelNIILKh /Belorussian Forestry Scientific-Research Institute/) - about the experimental increase of frost resistance in corktree seedlings with the aid of microelements introduced in the soil - boron, manganese, zinc, copper and lime.

The problem of the biology of fruit-bearing of woody plants was assigned an important place at the Conference.

E. G. Minina (Institute of Forestry, Academy of Sciences USSR) presented a report on the topic "Method of study of the biology of flowering and fruit-bearing of tree species for selection purposes"; L. Ia. Polozova (Institute of Forestry, Academy of Sciences USSR) - "Reciprocal relations between the processes of growth and fruit-bearing in oak shoots"; A. I. Akhremeiko and the scientific workers N. M. Pankratova and Z. A. Deriugina (VNIILM) reported on the use of the method of tagged atoms in a study of fruit-bearing in tree species; M. N. Prozina (MGU /Moscow State University/) - on the biology of flowering of some maple species; O. V. Val'tsova (MGU) - on the study of the biology of flowering in the European ash /*Fraxinus excelsior*/.

A number of speeches were devoted to scientific principles used in organising of forest seed farms.

The Conference adopted a resolution in which the work done at the Conference is cited and concrete means for the further expansion and deepening of selection work with forest tree species are noted. The need to strengthen the study of form variety of tree species especially in Siberian and Far Eastern regions is noted in particular in the resolution. Work on individual selection of specially productive trees, so-called "plus-trees" must be carried out concurrently with the taking of inventory of forests for the purpose of isolating highly productive plantings; propagation of/plus-trees/ should be provided by means of grafting and seeding, thus creating forest seed plantations.

The method of distant hybridisation should be developed and strengthened for selection purposes through acclimatization and obtaining of new forms. To render adaptation of the methods of forest selection to production more successful, the Conference has suggested a number of implementation measures for the improvement of propagation of selected forms, establishment of seed plantations, seed crops /matochnikov/ and other experimental-production work.

A decision was adopted to organize similar conferences regularly (once every three years) with the presentation of reports on surveys of achievements within the realm of forest selection here, in our country, as well as abroad. A decision was made to publish the material of the Conference.

Addendum 1.

VASKhNIL - Vsesoiuznaia Akademiia Sel'skokhoziaistvennykh Nauk im. V. I. Lenina - /All-Union Academy of Agricultural Sciences im. V. I. Lenin/.

MSKh - Ministerstvo Sel'skogo Khoziaistva - /Ministry of Agriculture/.

RSFSR - Rossiiskaia Sotsialisticheskaia Federativnaia Sovetskaia Respublika - /Russian Socialist Federative Soviet Republic/.

BSSR - Belorusskaia SSR /White Russian SSR or Belorussian SSR/.

KPSS - Kommunisticheskaia Partiia Sovetskogo Soiuza - /Communist Party of the Soviet Union/.

VNIILM - Vsesoiuznyi Nauchno-Issledovatel'skii Institut Lesomaterialov (or Lesomekhanizatsii) - /All-Union Scientific-Research Institute of Forest Materials (or Forestry Mechanization)/.

VNIALMI - Vsesoiuznyi Nauchno-Issledovatel'skii Institut Agrolesomelioratsii - /All-Union Scientific-Research Institute of Agricultural and Forest Melioration/.

BelNIILKh - Belorusskii Nauchno-Issledovatel'skii Institut Lesnogo Khoziaistva - /Belorussian Forestry Scientific-Research Institute/.

MGU - Moskovskii Gosudarstvennyi Universitet - /Moscow State University/.

TsNIILKh - Tsentral'nyi Nauchno-Issledovatel'skii Institut Lesnogo Khoziaistva - /Central Forestry Scientific-Research Institute/.

Addendum 2.

INSTITUTIONS:

Institut Lesa Akademii Nauk /AN/ SSSR - /Institute of Forestry, Academy of Sciences USSR.

Upravlenie Lesnykh Kul'tur i Lesomelioratsii Ministerstva Sel'skogo Khoziaistva /MSKh/ SSSR - /Administration of Forest Crops and Forest Improvement of the Ministry of Agriculture USSR/.

Voronezhskii Lesotekhnicheskii Institut - /Voronezh Technical Forestry Institute/.

Brianskii Lesokhoziaistvennyi Institut - /Briansk Institute of the Forestry Industry/.

Lesotekhnicheskaia Akademiia - /Technical Forestry Academy/.

Institut Biofiziki Akademii Nauk SSSR - /Institute of Biophysics, Academy of Sciences USSR/.

Institut Biologii AN /Akademii Nauk/ Latviiskoi SSR - /Institute of Biology, Academy of Sciences, Latvian SSR/.

Moldavskaia Lesnaia Opytnaia Stantsiia - /Moldavian Forestry Experimental Station/.

Institut Lesokhoziaistvennykh Problem AN Latviiskoi SSR - /Institute of Problems of the Forest Industry, Academy of Sciences, Latvian SSR/.

Kamyshinskii Opornyi Punkt VNIALMI - / Kamyshin Base of VNIALMI - All-Union Scientific- Research Institute of Agricultural and Forest Melioration/.