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**1 OF 2**

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JPRS L/8577

20 July 1979

# USSR Report

BIOMEDICAL AND BEHAVIORAL SCIENCES

(FOUO 1/79)



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USSR REPORT  
BIOMEDICAL AND BEHAVIORAL SCIENCES

(FOUO 1/79)

This serial publication contains articles, abstracts of articles and news items from USSR scientific and technical journals on the specific subjects reflected in the table of contents.

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CONTENTS	PAGE
AGROTECHNOLOGY	
Acceleration of the Development of Winter Wheat on Treating the Seedlings With Organic Acids During Vernalization (V. I. Babenko; et al.; DOKLADY VSESOYUZHNOY ORDENA LENINA AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA, No 11, 1978) .....	1
Some Laws of Extra-Root Uptake of Sr <sup>90</sup> by Vetch and Oats as a Function of the Development Phase and Growing Conditions (N. A. Korneyev, et al.; DOKLADY VSESOYUZHNOY ORDENA LENINA AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA, No 11, 1978) .....	6
Natural Auxin and Growth Inhibitor in Cotton Seedlings of Different Ages (A. P. Ibragimov, S. A. Saidova; DOKLADY VSESOYUZHNOY ORDENA LENINA AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA, No 11, 1978) .....	12
Use of the Genetic Distance Estimate in the Early Stages of the Variety Formation Process (G. A. Stakan, V. I. Glazko; DOKLADY VSESOYUZHNOY ORDENA LENINA AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA, No 11, 1978) .....	16

- a -

[III - USSR - 21A S&T FOUO]

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CONTENTS (Continued)	Page
Ultrastructure and Antigen Nature of Spermatozooids Under the Effect of Iso- and Heteroantibodies (R. N. Qyvadis, et al.; DOKLADY VSESOYUZNOY ORDENA LENINA AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA, No 11, 1978) .....	22
Development of the Resistance of Ixodoidea to Chlorophos (O. I. Smirnova; DOKLADY VSESOYUZNOY ORDENA LENINA AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA, No 11, 1978) .....	27
<b>BIOCLIMATOLOGY</b>	
Study of Air Temperature During the Transition Process in a Climate Chamber (V. T. Oleynichenko, A. V. Alekseyev; DOKLADY VSESOYUZNOY ORDENA LENINA AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA, No 11, 1978) .....	30
<b>ECOLOGY</b>	
Biologists, Mathematicians Describe Ecosystems (P. M. Brusilovskiy, G. S. Rozenberg; EKOLOGIYA, No 2, 1979) .....	34
<b>INDUSTRIAL MICROBIOLOGY</b>	
Conference Recommends Water Protection Steps (GIDROLOZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST', No 2, 1979) .....	39
Postfermentation Residue as a Filler for Premixed Animal Feeds (M. Ye. Tamarchenko, I. P. Rotarenko; GIDROLOZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST', No 2, 1979) ...	41
Utilization of Hydrolytic Lignin in Medicine (V. I. Sharkov, et al.; GIDROLOZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST', No 2, 1979) .....	47
The Role of the Design Office in Introduction of New Equipment and Production Processes (M. F. Trintsukova; GIDROLOZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST', No 2, 1979) .....	51
New Wood Chemical Products (P. I. Zhuravlev; GIDROLOZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST', No 2, 1979) .....	56

- b -

FOR OFFICIAL USE ONLY

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CONTENTS (Continued)	Page
Yeast Association Developing in Yeast Growing Apparatus of the Kansk Biochemical Plant (L. V. Lebedeva, et al.; GIROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST', No 2, 1979) .....	60
<b>MICROBIOLOGY</b>	
Electron Microscopic Study of the Conjugative Plasmids of Serologically Typed E. Coli APl (A. P. Kalyuzhnaya, et al.; BYULLETTIN' EKSPERIMENTAL' NOY BIOLOGII I MEDITSINY, No 4, 1979) .....	69
<b>PHARMACEUTICALS</b>	
Best Producers in Pharmacochemical Industry Announced (KHIMIKO-FARMATSEVTICHESKIY ZHURNAL, No 4, 1979) ....	73
Cartridge Filter With a Mechanized Dry Residue Unloading System (Z. B. Kristall, Yu. M. Khanukovich; KHIMIKO-FARMATSEVTICHESKIY ZHURNAL, No 4, 1979) .....	75
The New Psychotropic Drugs Pirazidol and Fenazepam (G. M. Rudenko; KHIMIKO-FARMATSEVTICHESKIY ZHURNAL, No 4, 1979) .....	78
Medical Support Plants Announce 1979 Socialist Pledges (KHIMIKO-FARMATSEVTICHESKIY ZHURNAL, No 4, 1979) ....	88
<b>PSYCHIATRY</b>	
Schizophrenia Prognosis Based on Clinical and Genetic Research Data (A. N. Kornetov; et al.; TSITOLOGIYA I GENETIKA, No 2, 1979) .....	92
<b>SCIENTISTS AND SCIENTIFIC ORGANIZATIONS</b>	
First All-Union Conference on Teratology, 'The Genetics of Developmental Abnormalities' (I. R. Barilyak, et al; TSITOLOGIYA I GENETIKA, No 2, 1979) .....	98
All-Union Conference on Commercial Invertebrates in Odessa (Yu. P. Zaytsev, K. N. Nesis; BIOLOGIYA MORYA, No 1, 1979) .....	102

- c -

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FOR OFFICIAL USE ONLY

CONTENTS (Continued)	Page
Selected Translations From Symposium on Stress and Adaptation (N. N. Mironov, et al.; STRESS I ADAPTSIYA (TEZISY VSESOUZNOGO SIMPOZIUMA), 1978) .....	106
PUBLICATIONS	
Means of Individual Protection for Work With Radioactive Substances (S. M. Gorodinskiy; SREDSTVA INDIVIDUAL'NOY ZASHCHITY DLYA RABOT S RADIOAKTIVNYMI VESHCHESTVAMI, 1979) .....	109
Control Theory and Biosystems (V. N. Novosel'tsev; TEORIYA UPRAVLENIYA I BIOSISTEMY. ANALIZ SOKHRANITEL'NYKH SVOYSTV, 1978).	118
Brain Physiology Manual for College Students (V. A. Cherkes, et al.; FIZIOLOGIYA GOLOVNOGO MOZGA, 1976) .....	121

- d -

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AGROTECHNOLOGY

UDC 633.11"324":631.527.823

ACCELERATION OF THE DEVELOPMENT OF WINTER WHEAT ON TREATING THE SEEDLINGS WITH ORGANIC ACIDS DURING VERNALIZATION

Moscow DOKLADY VSESOYUZNOY ORDENA LENINA AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA in Russian No 11, 1978 pp 3-6

[Article by Doctor of Biological Sciences V. I. Babenko, Candidates of Biological Sciences S. V. Biryukov and V. P. Komarova, All-Union Order of Lenin and Order of the Red Banner of Labor Selection and Genetics Institute]  
[Text]

The derivation of valuable varieties of farm crops in short periods of time brings up the necessity for accelerating the selection process, one of the elements of which is accelerated breeding of prospective selection forms. Artificial climate stations are being built at the present time for this type of acceleration, one of the purposes of which is to create conditions which will make it possible to obtain several harvests per year. Whereas growing four to five generations of spring wheat in a phytotron presents no special difficulties (8), the achievement of a similar effect as applied to winter wheat is connected with defined difficulties. The basic factor limiting the production of several winter grain crops a year is the prolonged vernalization period preceding the transition of the winter varieties to the generative phase of development. Therefore it is necessary to develop methods which will make it possible to reduce the time the winter crops stay at low temperatures without losses to the normal course of the vernalization process.

Beginning with the concepts of the biochemical nonuniformity of the vernalization process, we (1, 2) developed a method of decreasing the winter wheat requirement for cold during vernalization. The use of this method permits us to obtain plants that head out 15 to 17 days earlier than under the ordinary vernalization method. However, the intensification of the selection process, the high requirements on its acceleration accompanied by broad introduction of the phytotron technique are forcing us to find further ways to reduce the times for deriving new varieties, in connection with which the problem of still more significant acceleration of the vernalization processes of winter wheat continues to remain an urgent one.

A study was made of Odesskaya 16 winter wheat widely used in selection of a donor with high frost-resistance. This variety was also selected in connection

1

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with the fact that for completion of the vernalization processes it must be subjected to low temperature effects for a long time (up to 60 days). The acceleration of the vernalization processes in the varieties of this type now is acquiring especially important significance. The seed of the indicated variety was germinated in Petri dishes in solutions of various organic acids (0.002 M) and amylase (0.025%) at +20, +22° C under conditions of continuous illumination (400 to 4500 lux) for 5 days. The five-day shoots were subjected to the vernalizing effect of cold (+2, +3° C) with continuous illumination and wetting with the same substrates for 25 days. Later on, the shoots were transplanted to pots with soil and they were grown at +20, +22° C and with continuous illumination until they headed out, which indicated completion of the vernalization processes. Here it is necessary to keep in mind that the effect of increased temperatures (+28° C or more) directly after transplanting the vernalized shoots to the pots has a negative effect on the rates of subsequent development. The activity of the acid and base forms of ribonuclease (3) was determined in the shoots. The magnitude of the least significant difference between versions for a probability level of 0.95 (HCP<sub>0.95</sub>) was determined.

Table 1  
Number of days from the beginning of sprouting of seeds to heading out of the plants (100%) of the winter wheat in connection with treating the germination seed and vernalized shoots with organic acids and amylase

Seed Germinating Substrate	Substrate for vernalization of shoots								
	Water (control)	Acid						Acid mixture	Amylase
		Oxalacetic acid	Citric acid	α-keto-glutaric	Succinic	Malic			
Water (control)	95	75	76	70	71	72	72		
Acid:									
oxalacetic		80							
citric			82						
α-ketoglutaric				77					
succinic					75				
malic						73			
Acid mixture							79		
Amylase	97	80	80	75	75	73	78	83	

The performed studies demonstrated that (Table 1) such organic acids as oxalacetic, citric, α-ketoglutaric, succinic and malic used as the substrate for the 5-day germination of the seeds and with subsequent 25-day vernalization of the shoots, had a stimulating effect on the rates of development of the plants as a result of treating the seed and shoots with these acids, the duration of

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Table 2  
Activity of the RNA-ase of winter wheat in connection with treatment of the sprouting seed and the vernalized shoots with organic acids

Form RNA-ase	Substrate for sprouting seed and vernalization of the shoots--acids					HCP 0.95
	Oxalacetic acid	Citric acid	$\alpha$ -keto-glutaric	Succinic	Malic	
Acid	0.553	0.549	0.508	0.561	0.553	0.017
Base	0.260	0.336	0.416	0.491	0.598	0.023
Total	0.813	0.985	0.924	1.072	1.151	0.041
Percentage of alkaline RNA-ase	32.0	34.2	45.1	46.7	51.9	

the period from beginning of sprouting of the seed to heading out of the plants was reduced by 13 days or more by comparison with the control version. Significant acceleration of the development rates was noted when using malic acid. In this case the duration of the period before heading out of the plants was reduced by 22 days. Similar results were obtained when using succinic acid as the substrate for germinating the seed and vernalization of the shoots. The most perceptible effect came from citric and oxalacetic acids. The intermediate position was taken by a mixture of acids.

Positive, although less significant results were obtained also by other authors (7, 9-11) who used treatment of the winter crop seeds with organic acids during vernalization.

The use in one version of the experiment of the amylase enzyme pursued the goal of acceleration of the process of the hydrolysis of starch contained in the endosperm of the seed. At the same time it was proposed that the formation of the mobile forms of carbons capable of fast metabolism in the vernalization process be accelerated (4). Actually, treatment of the seed and the shoots with this enzyme promoted a 12-day reduction in the period before heading of the plants by comparison with the control version. Still greater acceleration was obtained if the germination of the seed was realized using amylase as the substrate, and the shoots were treated with acids during vernalization. In this case the period from sprouting of the seed to heading of the plants was in practice the same as when using the organic acids during the entire experiment. The most noticeable stimulating effect on the development of winter wheat came from malic acid, succinic acid and  $\alpha$ -ketoglutaric acid.

No positive results were noted when using the enzymes papain and trypsin which realize the hydrolysis of proteins. The treatment of the seed and the shoots

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with trypsin even promoted retardation of the rates of development of the plants by development with the control.

The most positive results were obtained in the experimental version in which the germination of the seed was carried out in a aqueous substrate , and the vernalization of the shoots, in acids. The use of oxalacetic acid and citric acid accelerated the heading of the plants by 19 to 20 days, and malic acid, succinic acid,  $\alpha$ -ketoglutaric acid and a mixture of acids, by 23-25 days.

It must be noted that the treatment of the shoots with acids led to unanimous heading of the plants. This fact seems very important from the point of view of the organization of an inefficient process for growing several generations of winter wheat and bringing about synthetic crosses under phytotron conditions. For the control plants the heading out was not unanimous, and it lasted up to 10 days.

The achieved effect can be explained by the deep, although nonspecific effect of various acids on the vernalization processes. The increase in rates of development of winter wheat was a consequence of the after-effect which the acids had on vernalization. This is indicated by the data (see Table 2) characterizing the activity of the RNA-ase in the wheat shoots subjected to the vernalizing effect in various substrates.

As is obvious, for plants of those versions of the experiment in which the acceleration of the vernalization processes were the most noticeably, the highest proportion of activity of the alkaline form of the RNA-ase was noted in the overall activity of the enzyme. The significance of these data will become understandable if we refer to the principle previously advanced by us (5, 6) but on formation of a potential readiness for reproduction in the vernalized shoots of winter wheat a regular change in activity of the various forms of the RNA-ase takes place, the proportion of the activity of the alkaline form of the enzyme increases significantly. Thus, the noted increase in activity is connected with the capacity of the shoots in defined substrates to go through the vernalization changes at accelerated rate.

It must be noted that the use of solutions of a number of organic acids as the nutritive substrate, especially malic acid, with 25-day vernalization in the light of the five-day shoots of winter wheat, will permit us to obtain headed plants 72-75 days after the beginning of sprouting of the seed. The unanimous heading out and subsequent intense development and maturing of the heads create the possibility for obtaining mature grain from the offspring of the experimental plants 105-109 days after beginning the procedure for accelerated development of winter wheat. The application of this procedure under the conditions of the artificial climate stations will promote three winter wheat harvests a year.

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AGROTECHNOLOGY

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SOME LAWS OF EXTRA-ROOT UPTAKE OF  $Sr^{90}$  BY VETCH AND OATS AS A FUNCTION OF THE DEVELOPMENT PHASE AND GROWING CONDITIONS

Moscow DOKLADY VSESOYUZHNOY ORDENA LENINA AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA in Russian No 11, 1978 pp 10-12

[Article by Academician of the VASKhNIL Institute N. A. Korneyev, Candidate of Biological Sciences N. V. Korneyeva, T. P. Popova]

[Text]

The extra-root contamination of plants is higher than the soil contamination with identical contamination density of the territory. Under the condition of extra-root uptake of radionuclides, the degree of radioactive contamination of the final harvest depends on the initial delay of the aerosols on the surface of the plants, the amounts of radionuclide losses as a result of dilution by the growing biomass, being washed out by rain, being shaken out by wind, dying and falling of old leaves (2 to 6). For pasture plants, 1 to 2 periods of field halflosses have been established which is entirely regular, for pasture plants are grazed off every 20 to 30 days (3, 4). The half-loss periods for grain crops and legumes, the harvest of which is formed over the course of 90 or more days have not been established. We studied the initial holding time of  $Sr^{90}$  on vetch and oat plants, the field half-loss rate of radioactive strontium in the plant growth process to maturity (the multiplicity of the production), and the effect of the external conditions on the halfloss rate of the radionuclide.

The vetch plants (variety L'govskaya 31/292) and oat plants (variety Orel) were grown in a mixture (30 plants each in each crop) in square pots with a capacity of 22 kg of dern-podzolized soil.

The application of  $Sr^{90}$  solution was carried out three times: first on vetch in the tillering phase and then vetch in the branching phase; second, oat plants at the beginning of milky ripeness, vetch when the lower pod has been formed (gathering for hay); third, full ripeness of the plants. Simulation of radioactive fallout was accomplished using an injector in a chamber; the area of the chamber corresponded to the area of four pots; the radioactive solution consumption was  $500 \text{ ml/m}^2$  ( $65 \text{ microcuries/m}^2$ ).

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Twenty-four hours after the application of the radioactive strontium, one part of the pots with the plants was placed in an open area under natural conditions, and a second part, in a greenhouse,

On applying  $Sr^{90}$  during the early phases of development of vetch and oats, the plants were cut after 24 hours (the control group), and then after 5, 10, 15, 25 and 42 days (the green mass), and 65, 82 days (complete ripeness). On application of radioactive solution the second time, the plants were also cut after 24 hours (control), then after 10, 20, 30 and 40 days (complete ripeness). After the application of the radioactive solution to the vetch and oat plants at full ripeness, they were cut after 24 hours.

The  $Sr^{90}$  content was analyzed on the B-2 radiometer using the T-25-BFL end counter by the relative method. The calcium concentration in the plants was determined by the method of flame photometry on the Zeiss-3 type photometer (1).

The value of the field halfloss period of  $Sr^{90}$ , that is, the time during which the radionuclide content in the plants was cut in half, was determined using the construction of the graphs.

The studies demonstrated that the amount of initial holding of the  $Sr^{90}$  depends on the type of plant and the development phase at the time of radioactive fallout on the plants (see Table 1). When applying radioactive strontium to the plants in the early phases of development, 11% of the radionuclides was held on the oat plants, and 31% on the vetch plants. In the later phases of development, 1.5-2 times more radioactive strontium was held on the vetch and oat plants than in the early phases, which is explained by an increase in the biomass of the plants per unit area.

On the vetch plants with smaller biomass, 2 to 3 times more  $Sr^{90}$  was held than on the oat plants. This depends on the shape and orientation of the leaves in space and their roughness.

The  $Sr^{90}$  concentration in the plants was reduced from the time of their contamination to the maximum buildup of the biomass, and it essentially depended on the growing conditions (see Table 2). In the case of vetch, from the branching phase to complete maturing the  $Sr^{90}$  concentration decreased by 98 times when growing in an open area and by 44 times when growing in a hothouse. On contamination of the vetch plants in the later phases of development, the  $Sr^{90}$  concentration decreased appreciably less than on contamination in the early phases.

In the oat plants from the tillering phase to complete maturing the  $Sr^{90}$  concentration in the open plot dropped by 191 times, and in the greenhouse, 44 times, and from the milky ripeness phase to complete maturing, by 6 and 2 times respectively.

The reduction in  $Sr^{90}$  concentration in the vetch and oat plants grown in a greenhouse from the time of contamination to complete maturing is a function

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Table 1  
Initial holding of Sr<sup>90</sup> by the vetch and oat biomass in the different phases of development of the plants (in percentages of the amount applied per unit area)

Phase of development at the time of contamination	Harvest (g/pot of air-dry material)	Initial holding(%)
Full tillering of oats, branching of vetch	<u>7.2</u> 5.4	<u>11</u> 31
Beginning of milky ripeness of oats, filled out lower pod in vetch	<u>102.6</u> 65.1	<u>16</u> 52
Complete ripeness	<u>179.6</u> 75.4	<u>23</u> 55

Note. Oats in the numerator and vetch in the denominator.

of the increase in biomass, and in the plants grown under natural conditions, a function of the increment of the biomass and the amount of fallout during the vegetation period.

The correlation analysis indicates the high degree of mutual dependence between the growth of the biomass and the reduction of the Sr<sup>90</sup> concentration in the plants (see Table 3).

The atmospheric precipitation has a significant influence on reducing the radioactive strontium concentration in the plants. On contamination of them during the early phases of development the final Sr<sup>90</sup> concentration in the plants grown in the open site is appreciably less than in the plants grown in the greenhouse.

When growing vetch and oats in an open area, a mutual correlation is observed to a medium degree between the Sr<sup>90</sup> concentration in the plants and the amount of fallout. The values of the correlation coefficients fluctuated as a function of the amount of fallout during the vegetation period for oats from -0.462 to -0.592, and for vetch, from -0.491 to -0.639.

The reduction of the radioactive nuclei concentration in the plant in the case of the extra-root uptake is estimated as the field half-loss period (the multiplicity of the reduction), that is, the time in which the reserve of radionuclides in the plant after one time (single) contamination is cut in half in connection with growth of the biomass, washing it off by rain and shaking in the wind.

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Table 2  
Variation of the Sr<sup>90</sup> concentration in vetch and oat plants as a function of the increase in biomass, the development phase of the plants in the case of aerosol fallout and the growing conditions

Time for sampling the plant after the application of radioactive strontium(days)	Vetch				Oats				
	Open area		Hothouse		Open area		Hothouse		
	Harvest (g/pot) Sr <sup>90</sup> (nanocuries/ /g of air-dried material)	Harvest (g/pot) Sr <sup>90</sup> (nanocuries/ /g of air-dried material)	Harvest (g/pot) Sr <sup>90</sup> (nanocuries/ /g of air-dried material)	Harvest (g/pot) Sr <sup>90</sup> (nanocuries/ /g of air-dried material)	Harvest (g/pot) Sr <sup>90</sup> (nanocuries/ /g of air-dried material)	Harvest (g/pot) Sr <sup>90</sup> (nanocuries/ /g of air-dried material)	Harvest (g/pot) Sr <sup>90</sup> (nanocuries/ /g of air-dried material)	Harvest (g/pot) Sr <sup>90</sup> (nanocuries/ /g of air-dried material)	
	Branching phase				Tillering phase				
Control	8	5.4	489	5.4	489	17.2	134	7.2	134
	10	12.0	246	12.0	246	32.0	60	13.4	60
	25	20.1	137	15.5	186	38.4	33	19.4	33
After	25	40.8	62	40.8	62	23.3	6	31.5	6
	42	89.5	10	71.0	17	128.3	3	88.5	3
	65	84.0	4	92.8	9	181.3	0.7	104.7	0.7
	82	79.1	8	99.0	11	180.5	0.7	157.3	0.7
	Filled out lower pod				Milky ripeness				
Control	10	65.1	65	65.1	65	102.5	12	102.5	12
	20	83.4	42	89.8	46	117.8	6	123.9	6
After	20	91.0	22	102.3	36	140.8	4	146.5	4
	30	97.5	13	101.6	25	145.9	2	148.7	2
	40	92.6	12	102.2	23	162.1	2	144.6	2

Table 3  
Values of the correlation coefficients between the reserve biomass and the Sr<sup>90</sup> concentration in the plants on applying radioactive strontium in the various phases of development

Phase of development	Correlation coefficient			
	Open plot		Hot house	
	1st year	2nd year	1st year	2nd year
	Oats			
Tillering	-0.701	-0.689	-0.767	-0.688
Beginning of milky ripeness	-0.981	-0.895	-0.739	-1.000
	Vetch			
Branching	-0.412	-0.631	-0.784	-0.764
Formed lower pod	-0.797	-0.963	-0.956	-0.884



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Table 4

Multiplicity of reduction of Sr<sup>90</sup>(T) for vetch and oat plants, contaminated with radionuclides in various phases of development of the plants

Phase of Development	Multiplicity of reduction													
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	T <sub>5</sub>	T <sub>6</sub>	T <sub>7</sub>	T <sub>8</sub>	T <sub>9</sub>	T <sub>10</sub>	T <sub>11</sub>	T <sub>12</sub>	T <sub>13</sub>	T <sub>14</sub>
Oats														
Tillering	$\frac{4}{5}$	$\frac{4}{6}$	$\frac{11}{12}$	$\frac{9}{9}$	$\frac{16}{19}$	$\frac{13}{17}$	$\frac{25}{30}$	$\frac{15}{23}$	$\frac{35}{40}$	$\frac{21}{41}$	$\frac{45}{50}$	$\frac{36}{57}$	$\frac{0}{0}$	$\frac{60}{60}$
Milky ripeness	$\frac{10}{16}$	$\frac{9}{16}$	$\frac{25}{0}$	$\frac{32}{29}$	-	-	-	-	-	-	-	-	-	-
Vetch														
Branching	$\frac{7}{9}$	$\frac{4}{4}$	$\frac{14}{17}$	$\frac{10}{13}$	$\frac{20}{24}$	$\frac{13}{20}$	$\frac{28}{37}$	$\frac{24}{24}$	$\frac{45}{57}$	$\frac{29}{50}$	$\frac{0}{0}$	$\frac{39}{0}$	$\frac{0}{0}$	$\frac{61}{0}$
Filled out lower pod	$\frac{18}{31}$	$\frac{6}{14}$	$\frac{29}{0}$	$\frac{19}{43}$	-	-	-	-	-	-	-	-	-	-

Note: In the numerator -- open ground, in the denominator -- in the greenhouses; first column figure -- 1st year, second column figure -- 2nd year.

On application of radioactive strontium to oat plants in the tillering phase and growing them to complete maturity under natural conditions, during the first year of the investigation a sixfold reduction was recorded, and in the second year, a sevenfold reduction, and under greenhouse conditions, these figures were fivefold and sixfold respectively. For vetch plants contaminated with Sr<sup>90</sup> in the phase of branching and growing of them to complete maturity, in the first year a fivefold reduction was established, and in the second year a seven fold reduction under natural conditions and a fivefold for the greenhouse conditions in both years of the investigation (Table 4).

Thus, the vetch plants with smaller size biomass hold 2 to 3 times more Sr<sup>90</sup> falling out in the form of aerosols on the surface of the plants than oat plants; with an increase in biomass, the dimensions of the initial holding of the radioactive strontium on the plants increase; the field halfloss time of the radionuclide is the lowest during the greatest growth period of the plant (for oats this is the tillering phase, and for vetch, branching); the halfloss rate increases for the plants not protected from rain and wind; the multiplicity of reduction of radioactivity of plants per day in the subsequent periods is higher than in the preceding periods.

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AGROTECHNOLOGY

UDC 633.511:581.14

NATURAL AUXIN AND GROWTH INHIBITOR IN COTTON SEEDLINGS OF DIFFERENT AGES

Moscow DOKLADY VSESOYUZNOY ORDENA LENINA AKADEMII SEL'SKOKHOZYAYSTVENNYKH  
NAUK IMENI V. I. LENINA in Russian No 11, 1978 pp 14-16

[Article by Doctor of Biological Sciences A. P. Ibragimov, Candidate of  
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[Text]

At the present time the physiology of the growth processes is being investi-  
gated in close connection with the function of the natural regulators: phy-  
tohormones and their antagonists -- endogenic inhibitors (1, 3).

The natural phytohormones include auxins, gibberellins and cytokinins. In  
the higher plants the auxins are predominately represented in the form of  
indolylacetic acid (IAA) and other indol derivatives.

In addition to the phytohormones, growth inhibitors are also present in the  
plants -- materials causing inhibition of the growth processes. This class  
includes certain compounds of a phenol and terpenoid nature (phenols and  
abscissic acid).

In contrast to the general type metabolites the phytohormones and natural  
inhibitors are detected in the plant tissues using biotests. A specific  
test for auxins is the drawing of segments of wheat coleoptiles. Other  
hormones -- gibberellins and cytokinins -- are not sensitive to this test.

Natural inhibitors do not have a specific biotest. They are detected by  
using hormonal tests by the inhibiting reaction which they have on the growth  
processes. For this purpose predominately the auxin test is used.

The study of the phytohormone activity and the activity of the natural in-  
hibitors in the plants is important for the understanding and study of the  
mechanism of their effect. A great deal of research has been done on the  
function and regulatory activity of the phytohormones and natural inhibitors  
on a number of crops.

The problem of the participation of the phytohormones and inhibitors in the  
growth regulation and development of cotton has been little studied.

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Considering the high physiological activity of the natural growth regulators, we have decided to investigate the presence of endogenic auxins and inhibitors in cotton shoots and trace their alteration as a function of the age of the shoots.

As experimental objects, we used two-day-old shoots of fine-fiber cotton, variety 5904-I. The cotton seed were wet in water for 46 hours, then they were put on the bottom of enameled couvettes coated with several layers of wet filter paper; they were tightly covered with glass and placed in a thermostat at 37° C for 48 hours. Then the two-day shoots were incubated in water and were used for analysis during various times of their growth.

The content of the natural auxins and inhibitors was determined in the cotton shoots 3, 4, 7 and 20 days old by the Kefeli method, et al. (2). The chromatographic analysis of the plant material extracted by ethyl ether previously purified to remove peroxides was carried out in the system made up of the solvents isopropanol-ammonia-water (10:1:1). The chromatograms were examined in the daylight, in ultraviolet light and ultraviolet light in ammonia vapor.

The content of natural stimulators and inhibitors was determined by the biological activity of the detected materials after chromatographic separation of them. The biological activity of these materials was tested using a biotest -- variation of the growth of segments of the coleoptiles of grains of Saratovskaya heat. The data were expressed in percentages of the growth of the segments of the control coleoptiles. The experimental error was  $\pm 10\%$ .

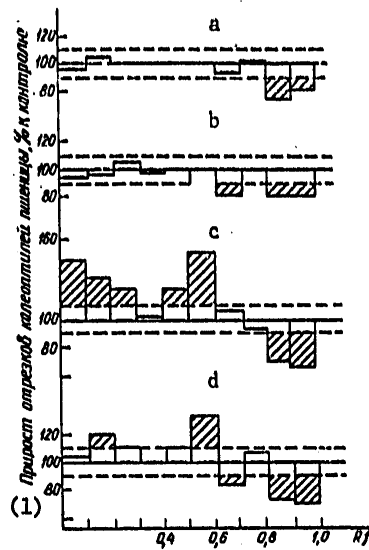
The results of the study demonstrated that in the three and four day old cotton shoots only the growth inhibitors were detected (Figure a,b). The natural growth inhibitor with a value of 0.6-0.8 and 0.8-1.0, according to the published data (2), coincides with the abscissic acid marker. This offers the possibility of talking about the fact that the detected inhibitor is abscissic acid.

The abscissic acid level and the three and four-day old cotton shoots was insignificant. The growth suppression of the coleoptile segments in the eluate from the inhibitor zone expressed in percentages of the control is 76-80.

When enlisting the biological activity of the growth materials in the seven-day old cotton shoots, the presence of auxins and auxin-like materials was detected (Figure c). The appearance on the chromatograph of a stimulator with a value of 0.29-0.4 corresponded to the indolylacetic acid tag (IAA). For seven-day-old cotton shoots, a significant increase in the IAA activity is characteristic.

As is obvious from the figure (c), the growth increments of the segments of the wheat coleoptiles in the eluate from the auxin zone expressed in percentages of a control is 153. As for the growth inhibitors, they were also discovered. Their biological activity with the respect to the inhibiting reaction is little higher than in the younger cotton shoots (3 and 4 days old).

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Auxin and inhibitor content in cotton shoots of different age: a -- three-day old, b -- four-day old, c -- seven-day old, d -- twenty day old.

Key: 1. Increase in the segments of the coleoptiles of wheat, % of the control

Thus, the abscissic acids detected in the chromatogram suppresses the growth of the wheat coleoptile segments by 64-70%. Thus, the growth of the seven-day-old cotton shoots is characterized by the presence of natural auxins and inhibitors (abscissic acid).

In the 20-day-old cotton shoots, both the auxins and auxin-like materials and natural inhibitors were detected. The results are presented in the figure (d), from which it is obvious that the level of biological activity of the auxins is lower than for the seven-day-old cotton shoots, whereas the growth inhibitors remain in the same ratio. The growth of the coleoptile segments is 138% stimulated by the aluates from the auxin zone.

Thus, the results of our studies have demonstrated that for normal realization of the growth processes in the plants, in particular, for cotton, it is necessary to have natural auxins and growth inhibitors present. The absence of one of the components in the plant tissue leads to disturbance of the growth process.

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AGROTECHNOLOGY

UDC 636.32/.38:636.082.1

USE OF THE GENETIC DISTANCE ESTIMATE IN THE EARLY STAGES OF THE VARIETY  
FORMATION PROCESS

Moscow DOKLADY VSEJOYUZHNOY ORDENA LENINA AKADEMII SEL'SKOKHOZYAYSTVENNYKH  
NAUK IMENI V. I. LENINA in Russian No 11, 1978 pp 25-28

[Article by Doctor of Biological Sciences G. A. Stakan, V. I. Glazko, Insti-  
tute Cytology and Genetics of the Siberian Department of the USSR Academy of  
Sciences]  
[Text]

When creating varieties, especially by the method of complex cross breeding,  
it is interesting to trace not only the formation of new productive attri-  
butes in the hybrids on the phenotypic level, but also the variation of the  
genetic structure, the effect of the inherited peculiarities of the initial  
parent varieties on the gene stock of the newly created group of animals.

It is known that the performance of an analysis of the variation of the gene-  
tic structure with respect to quantitative, complexly inherited economically  
useful attributes subject to a high degree to the effects of the environment  
does not appear possible. One of the means of solving this problem is to  
study and use genetically determined proteins and enzymes with simple codomi-  
nant inheritance.

In the given paper a discussion is presented of the results obtained for the  
first time from the application of biochemical markers in the early stages  
of the creation of meat and wool sheep with crossbred type wool. This work  
will be done by the laboratory of genetic principles of the selection of the  
animals of the Institute of Cytology and Genetics of the Siberian department  
of the USSR Academy of Sciences in 1963. The initial parent varieties were  
as follows: Altay fine-wool (A), the sheep of which are distinguished by  
good wool-meat qualities and adaptability to the severe conditions of Siberia,  
and two fast-maturing meat-wool semifine wool varieties -- Lincoln (L) and  
Romni-Marsh (RM).

The analysis of the formation and development of productive characteristics  
in sheep of different versions of crossing demonstrated the selective advan-  
tages of the animals obtained from the three-variety crossing. Accordingly,

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Table 1  
Productive characteristics ( $\bar{X} \pm M_x$ ) of pure breeds and various cross combinations one year old (reckoned for 365 days of development of the attributes)

Variety and type of cross	Live weight (kg)	Shearing of pure wool (kg)	Length of wool (cm)	Fiber diameter (micr)	Ratio of secondary follicles, primary mm <sup>2</sup> of skin	Thickness of follicles
Altay	45.8 ± 0.4	2.8 ± 0.1	8.6 ± 0.1	19.2 ± 0.4	15.5 ± 0.3	84.3 ± 4.7
Romni-Marsh	50.0 ± 0.5	3.1 ± 0.1	11.9 ± 0.2	20.1 ± 0.9	8.6 ± 0.2	37.3 ± 2.7
Lincoln	42.3 ± 0.7	3.7 ± 0.1	31.1 ± 0.2	29.8 ± 0.2	5.1 ± 0.2	31.6 ± 2.1
L × A	47.4 ± 0.6	3.0 ± 0.1	15.2 ± 0.2	27.0 ± 0.4	9.0 ± 0.4	51.6 ± 3.9
RM × A	51.9 ± 0.8	3.4 ± 0.1	12.0 ± 0.2	26.7 ± 0.3	10.2 ± 0.3	50.3 ± 3.2
L × (RM × A)	50.1 ± 0.6	3.3 ± 0.1	16.8 ± 0.2	27.7 ± 0.4	8.1 ± 0.1	39.5 ± 0.9
(L × RM × A) × (L × RM × A)	53.3 ± 0.7	3.5 ± 0.1	15.3 ± 0.1	26.0 ± 0.4	7.8 ± 0.1	41.4 ± 0.5
(L × RM × A) × (RM × L × A)	49.8 ± 1.2	1.2 ± 0.1	17.6 ± 0.2	27.2 ± 0.4	8.2 ± 0.1	40.1 ± 0.6
(L × RM × A) × (RM × L × A)	54.0 ± 1.4	4.0 ± 0.1	17.3 ± 0.2	26.2 ± 0.3	8.0 ± 0.1	41.0 ± 0.7
Trivariety from inbreeding in 3rd generation	55.0 ± 1.2	4.76 ± 0.1	17.9 ± 0.2	26.6 ± 0.3	8.1 ± 0.1	42.1 ± 0.9

Key: L = Lincoln, A = Altay, RM = Romni-Marsh

provision was made for crossing the Altay ewes with productive varieties of Lincoln and Romni-Marsh with subsequent inbreeding of the three-variety hybrids of the desired type, that is, L × (RM × A) and RM × (L × A) or RM × (L × A) × L × (RM × A) (5, 6).

Comparative data are presented in Table 1 on the development of the basic productivity attributes in the ewe lambs of the initial current varieties, hybrids of different cross versions and the ewe lambs obtained from inbreeding of the third generation (F<sub>3</sub>).

The sheep obtained from inbreeding (F<sub>3</sub>) corresponded with respect to the development, body weight and characteristics of the wool (thickness and length of fiber), to the new meat-wool type with crossbreed wool. The following proteins were investigated in pure-bred, hybrid and group F<sub>3</sub> animals by starch-gel electrophoresis -- lactate-dehydrogenase (LDH), diaphorase (DI), hemoglobin (HB), superoxidizedismutase (SOD), carboanhydrase (CA), 6-phosphogluconatedehydrogenase (PGD), malatedehydrogenase (MOR); in the blood plasma, arylesterase (ES-1), carboxylesterase (ES-2), transferrin (Tf). The isolation of the proteins was carried out with respect to the standard histochemical formulas (7). The above-enumerated proteins are controlled by 14 autosomal loci. In the investigated sheep polymorphism with respect to the following loci was found: Ldr-1 (4), Di-1 (1, 8), Hb (1), ES-1 (2, 9, 10), CA (9) and Tf (the transferrins are typed in accordance with the international standards made available to us by Professor A. Stratyl from Czechoslovakia). In the investigated groups of sheep the remaining loci were monomorphic.



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In the analysis it was demonstrated that each initial variety and the animals from inbreeding the third generation had their own characteristic distribution of the gene frequencies and were reliably distinguished among each other with respect to certain gene concentrations. The total distribution of the gene frequencies for the new type of meat and wool sheep ( $F_3$ ) is closer to the Lincoln and Romni-Marsh varieties than to the Altay fine-wool variety (Figure 1).

In order to generalize the characteristics of the gene stock of the investigated populations with respect to biochemical markers in recent times a number of estimates have been proposed (11-13) indicating when analyzing the microevolutionary processes the degree of genetic divergence of the investigated populations. The most widespread in recent times is the Nei estimate (13) which is calculated by the following formula:

$$D_N = -\ln I,$$

where

$$I = \frac{\sum_{j=1}^n \sum_{i=1}^{K_j} X_{ji} Y_{ji}}{\sqrt{\left( \sum_{j=1}^n \sum_{i=1}^{K_j} X_{ji}^2 \right) \left( \sum_{j=1}^n \sum_{i=1}^{K_j} Y_{ji}^2 \right)}}$$

where  $X_{ji}$  and  $Y_{ji}$  are the frequencies of the  $i$ -allele, the  $j$ -locus in two compared  $X$  and  $Y$  coefficients, respectively;  $n$  is the number of investigated loci;  $K_j$  is the number of alleles in the  $j$ -locus.

By the Nei formula, using polymorphic loci, a comparative estimate was made of the differentiation of the animals obtained from inbreeding ( $F_3$ ) with initial parent varieties and with intermediate versions for crossing. It was established that with respect to genetic distance the sheep in group  $F_3$  are closer to the semifine-wool varieties and they are farther from the Altay fine-wool (see Figure 2). When comparing the genetic closeness to the three-variety animals it was discovered that the sheep in group  $F_3$  are appreciably closer to the animals of the  $L \times (RM \times A)$  type than to the  $RM \times (L \times A)$  type. It was also discovered that the animals of the new meat and wool type are essentially closer to the cross type  $L \times (RM \times A) \times L \times (RM \times A)$  than to the type  $RM \times (L \times A) \times L \times (RM \times A)$ .

In addition, the genetic distance between the varieties (the intervariety differentiation) was calculated by the Nei method using all of the investigated loci (including monomorphic). The data presented in Table 2 indicate that with respect to the genetic distance the sheep of the Altay variety are more removed from the Romni-Marsh, Lincoln and new meat and wool group ( $F_3$ ). This should also be expected, for the Altay belongs to the fine-wool varieties. The semifine wool Romni-Marsh Lincoln varieties are the closest in genetic respect, which reflects the commonness of the origin (3). With respect to genetic distance, the animals belonging to group  $F_3$  are closer

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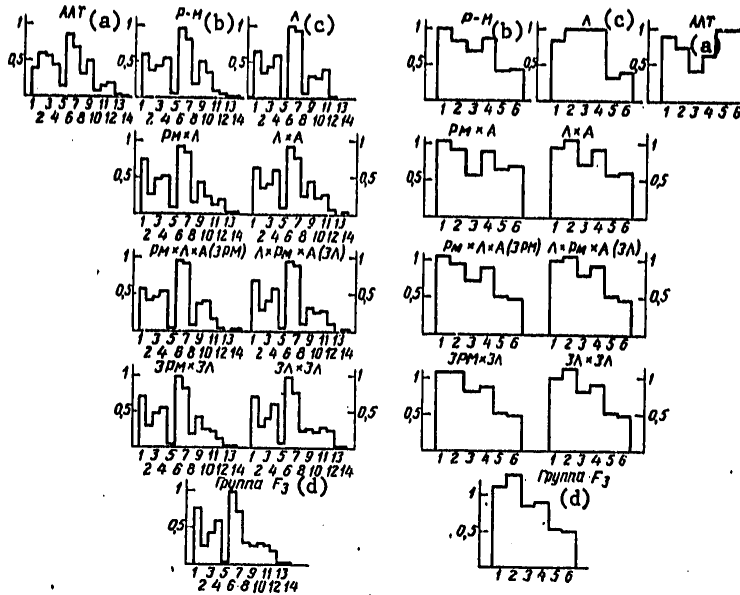


Figure 1. Productive characteristics (in fractions) and gene concentrations of the biochemical markers in the pure-bred animals and the sheep with different cross combinations. Left side of the figure:

1 - Dia-1P, 2 - Dia-1S, 3 - Ldr-1A, 4 - Ldr-1B, 5 - HbA, 6 - HbB, 7 - Est-1a, 8 - Est-1b, 9 - Tf A, 10 - Tf B, 11 - Tf C, 12 - Tf D, 13 - Tf E, 14 - Tf P.

Right side of the figure:

1 -- live weight, 2 -- shearing of wool, 3 -- length of wool, 4 -- fiber diameter, 5 -- V/P ratio, 6 -- density of follicles per mm<sup>2</sup> of skin.

Key: a. ALT = Altay c. L = Lincoln  
b. R-M = Romni-Marsh d. group F<sub>3</sub>

to Lincoln and Romni-Marsh than to Altay. This also is provided for when selecting the most optimal system for obtaining the animals of the new variety group. Consequently, with respect to level of development of the productivity attributes, the characteristics of the wool, the indexes of the markers were used and also estimation of the genetic distance, the sheep obtained from inbreeding the third generation can be considered animals of the meat and wool area.

Thus, using the experimental material, it was established for the first time that the indexes of genetic distance calculated on the basis of using the

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Table 2  
Estimate of the intervariety differentiation ( $D_N$  with respect to all of the investigated loci)

Variety	A	RM	L	$F_3$
A	--			
RM	0.011	--		
L	0.021	0.008	--	
$F_3$	0.019	0.005	0.005	--

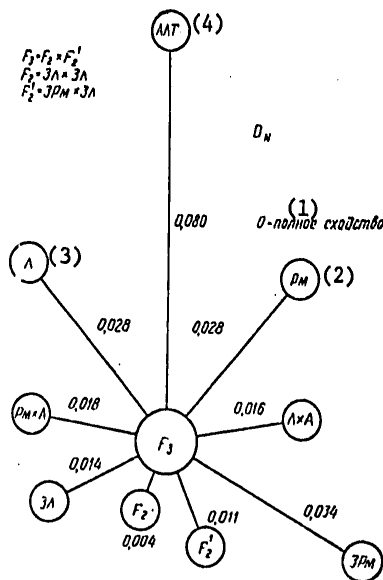


Figure 2. Genetic distances between animals obtained from inbreeding ( $F_3$  -- desired type) with pure-bred sheep and sheep of different cross varieties

Key: 1. complete similarity      3. Lincoln  
2. Romni-Marsh                  4. Altay

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genetically determined versions of the proteins and enzymes reflect the changes occurring during the variety forming process. These data can serve as valuable information for estimating the variation in the genetic structure of each generation, establishment of the genetic closeness to the initial parent varieties and substantiation of the future optimal scheme for inbreeding animals.

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AGROTECHNOLOGY

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ULTRASTRUCTURE AND ANTIGEN NATURE OF SPERMATOZOIDS UNDER THE EFFECT OF ISO-  
AND HETEROANTIBODIES

Moscow DOKLADY VSESOYUZNOY ORDENA IENINA AKADEMII SEL'SKOKHOZYAYSTVENNYKH  
NAUK IMENI V. I. LENINA in Russian No 11, 1978 pp 31-34

[Article by Candidate of Biological Sciences R. N. Oyvdais, R. I. Gorbunova,  
Candidate of Agricultural Sciences A. V. Bronskaya, Candidate of Biological  
Sciences V. I. Gorbunov, V. S. Osadchuk]  
[Text]

The immune reactions participating in reproduction are caused most frequently  
by the interrelations between the spermatozooids and the organism of the  
animal (male or female).

It has been established that the spermatozooids and the hyaluronidase con-  
tained in their acrosome have high antigen activity capable of causing an  
immune response of the organism to itself with the generation of iso and  
heteroantibodies (1-3, 6-8). Simultaneously with the immobilizing effect of  
the isoantibodies on the spermatozoid, damage takes place to their acrosomes  
(10).

We have investigated the effect of iso and heteroantibodies to extract and  
hyaluronidase of the spermatozooids on the ultrastructure and antigen activ-  
ity of freshly taken and thawed spermatozooids from bull and ram sperm frozen  
in grenules. The antibody to the extracts of ejaculated spermatozooids and  
their hyaluronidase was prepared, by immunizing rabbits by the Zubzhitskiy  
method in the eyelid. Blood was taken 7 days after completion of the injec-  
tions. The normal blood serum of the rabbit was used as the control. The  
hyaluronidase was prepared from washed ejaculated spermatozooids of a bull  
and ram by the I. I. Sokolovskaya procedure (4). The effectiveness of the  
immunization was tested by the method of precipitation in agar according to  
Oukhterlone. The activity of the hyaluronidase was established by the skin  
test method (5).

The smears of the thrice-washed spermatozooids were treated with antibody  
to the spermatozoid extracts and to hyaluronidase with subsequent treatment  
with serum tagged with FITTs. The fluorescence was observed on the ML-2  
microscope with the FS-1 exciting filter and the ZhS-18 blocking filter.

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Table 1  
Distribution of spermatozooids with ultrastructure after treatment with iso and heteroantibodies (200 spermatozooids in each group)

Antibody	Percentage of bull spermatozooids		Percentage of ram spermatozooids	
	with undamaged acrosome			
	In the total number	In No of undamaged in the control	In the total number	In No of undamaged in the control
Freshly taken ejaculate				
To bull ES	46.7 ± 3.5	60 ± 3.9	52.5 ± 3.6	92 ± 2.5
To ram ES	70.0 ± 3.2	90 ± 2.4	30.7 ± 3.1	87 ± 4.6
To bull HS	38.8 ± 3.4	50 ± 4.0	48.4 ± 3.5	81 ± 3.7
To ram HS	64.0 ± 3.4	82 ± 3.7	36.5 ± 3.4	64 ± 4.6
Normal rabbit serum (control)	77.4 ± 2.9	100	57.0 ± 3.4	100
Thawed spermatozooids				
To bull ES	24.8 ± 3.1	63 ± 5.4	16.1 ± 2.6	64 ± 5.9
To ram ES	42.2 ± 3.6	100	14.0 ± 2.4	74 ± 7.1
To bull HS	20.4 ± 2.8	51 ± 5.6	13.6 ± 2.4	71 ± 7.3
To ram HS	40.0 ± 3.4	100	11.7 ± 2.2	60 ± 6.0
Normal rabbit serum (control)	39.6 ± 3.4	100	18.9 ± 2.7	100

Note. ES -- extract of spermatozooids, GS -- hyaluronidase spermatozooids.

Table 2  
Distribution of freshly taken ram spermatozooids (%) with altered ultrastructure in connection with the antigen activity under the effect of iso and heteroantibodies (with respect to 100-145 spermatozooids for fluorescence and 200 for ultrastructure)

Spermatozooids	Antibodies			
	To spermatozoid extract		To hyaluridase	
	Bull	Ram	Bull	Ram
With undamaged acrosome	52.5 ± 3.6	30.7 ± 3.1	46.4 ± 3.5	36.5 ± 3.4
With clarified, swollen disintegrated acrosome	36.3 ± 3.4	49.6 ± 3.5	36.0 ± 3.4	41.7 ± 3.5
Total with acrosome fluorescence of acrosome	88.8	80.3	82.4	78.2
	87.0 ± 3.3	72.0 ± 4.3	82.0 ± 3.2	80.0 ± 3.3

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For electron microscopy of spermatozooids, they were twice washed with phosphate buffer at pH of 7.4 to remove the plasma and medium, they were incubated with antibodies to the extractor to the hyaluronidase of the spermatozooids for 30 minutes at 37° C, after which they were washed twice to remove the serum. Then they were resuspended in the phosphate buffer and applied to the microscope slide.

After drying in the air the preparations were contrasted on an electrovacuum unit by depositing carbon with platinum on them. The spermatozooids were investigated and photographed in the Tesla electron microscope.

The data on the effect of the iso and heteroantibodies to the extract of spermatozooids and to hyaluronidase on the acrosome of the bull or ram spermatozooids are presented in Table 1.

From Table 1 the relation of the integralness of the ultrastructures of the spermatozooids to the reaction to treating them with iso and heteroantibodies is obvious.

The specific nature of the effect of the antibodies on the ultrastructure expressed in different percentage of the spermatozooids remaining unharmed in the cross reactions was discovered: namely, more undamaged spermatozooids remained after treatment of them with heterologic antibody by comparison with isologic antibody independently of the used type of antibody (to the spermatozoid extract or to the hyaluronidase isolated from them). This law is observed both for the freshly taken bull and ram sperm and for the frozen bull sperm with statically reliable differences.

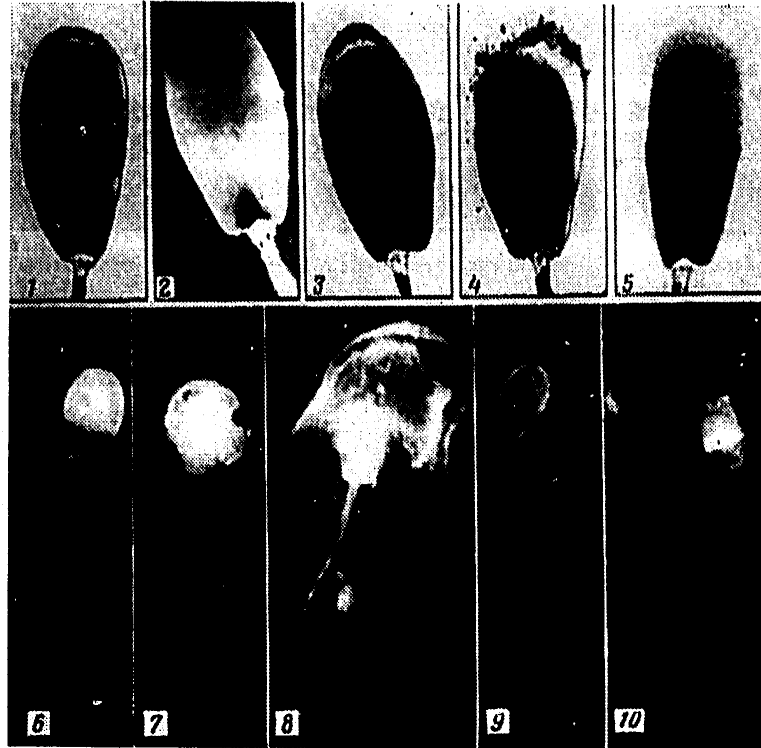
It is of interest that the ram spermatozooids are twice as sensitive to freezing as the bull spermatozooids, which is obvious by the number of undamaged ones in the control (18.9 and 39.6% respectively).

This can be explained by the characteristic features of the given process in which the spermatozooids were not protected against necrobiosis in the process of preparation for freezing. In addition, in the thawed ram spermatozooids, the specific nature of the reactions to the treatment with isologic and heterologic antibody was lowered, and the tendency toward intensification of the damaging effect of the heterologic antibody by comparison with isologic in contrast to the spermatozooids from the freshly taken sperm was observed. From Table 1 it is also obvious that inside the species in practice there is no difference between the effect on the spermatozooids of the antibody to the extract of whole gametes and to the hyaluronidase isolated from them.

Obviously, in the extracts of the spermatozooids the antigen activity of the surface and acrosome hyaluronidase predominates over the other antigens.

Table 2 shows the distribution of the spermatozooids with altered ultrastructure in connection with the antigen activity under the effect of iso antibodies and heteroantibodies.

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Ultrastructure of spermatozoids and localization of their antigens under the effect of iso antibodies and heteroantibodies (1-5×6000, 6-10×1800).

From Table 2 it is obvious that immunofluorescence reveals antigens of the acrosomes not only of the undamaged but also the partially disintegrated ones which explains the absence of comparison between the number of fluorescent and undamaged spermatozoids. This means that the partial structural damage of the acrosome does not relieve it of its antigen properties.

The figure shows the effect of iso and heteroantibodies to the extract and hyaluronidase of the spermatozoids on their ultrastructure and the localization of the antigens discovered by the method of immunofluorescence. After treatment of the spermatozoids with heteroantibody and normal serum, the majority of them retained the acrosome undamaged (see Figure 1, 2). Under the effect of the isoantibodies significant damage occurred to the acrosomes expressed in its clarification, swelling, disintegration and loss (Figures 3-5).

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The treatment of the spermatozooids with isoantibody to hyaluronidase made it possible to discover the localization of the different antigens in the ram spermatozooids. It turned out that in the majority of cases all of them are located in the front part of the head (see Figure, 6). However, during swelling and destruction of the acrosome, certain antigens remained in the front part of the head, others were discovered in the swelling or destroyed outer shell of the acrosome (Figure, 7, 8). In some spermatozooids it was also possible to see localization of the antigens in the rear nuclear cap (see Figure, 8). In the case of complete destruction of the acrosome, the antigen properties of the hyaluronidase were not detected (see Figure, 9), but in 33% of such spermatozooids antigens were discovered in the equatorial segment (see Figure, 10). A comparison of these data with other investigations makes it possible to assume that these antigens are capable of causing autoimmune response of the organism of the male in the case of damaged testicles.

Thus, the antibodies to the extract of spermatozooids and their hyaluronidase have to almost equal degree specific nature of destructive effect of the ultrastructure of the freshly taken spermatozooids of the bull and ram.

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AGROTECHNOLOGY

UDC 595.42:632.951

DEVELOPMENT OF THE RESISTANCE OF IXODOIDEA TO CHLOROPHOS

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NAUK IMENI V. I. LENINA in Russian No 11, 1978 pp 34-35

[Article by Candidate of Biological Sciences O. I. Smirnova, All-Union  
Scientific Research Institute of Veterinary Sanitation]

[Text] The resistance of ticks and other forms of insects to pesticides is one of the main obstacles in the control of the majority of human and animal diseases caused or carried by arthropods. The broad application of chlorophos over many years in veterinary and medical practice and also in plant husbandry has led to the development of resistance to this compound in many species of insects, including Ixodoidea [1, 2, 5, 6].

The purpose of our research was to reproduce the resistance of Ixodoidea to chlorophos under laboratory conditions and study the possible mechanisms of the development of this process.

In the experiments we used resistant Ixodoidea Rhipicephalus bursa Hyalomma anatolicum with 50-fold and 20-fold resistance respectively to chlorophos, and as the control we used sensitive ticks of the same species. The study of the possible mechanisms of the resistance to chlorophos were performed by the methods of histochemistry, biochemistry and thin-layer chromatography. The activity of the cholinesterase enzyme was determined by the histochemical method according to Kelly and Friedewald in the V. V. Portugalov version [3] and the biochemical method according to Khesterin in the S. A. Roslavtseva version. The chlorophos content in the organs and tissues of the Ixodoidea were determined by the method of thin-layer chromatography, lipids in the cuticle of the Ixodoidea--the histochemical method according to Lizon [4]. When comparing the activity of the cholinesterase enzyme in the organs and tissues of resistant and sensitive ticks in the normal condition, we discovered that in the tissues of the resistant species the level of its activity is reduced by 40 to 60 percent by comparison with sensitive ticks.

In order to discover the difference in inhibition of the enzyme in the sensitive and resistant Ixodoidea, they were treated with 0.2 percent chlorophos solution, which is lethal for sensitive Ixodoidea and harmless to the resistant ones. In the sensitive ticks an hour after treatment, 10 to 20 percent suppression of the cholinesterase was observed in the pre-esophageal

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division of the nerve ganglion. After 3, 6 and 12 hours the suppression progressed and spread to the post-esophageal division of the ganglion. In the resistant ticks the enzyme activity remained on the former level. Lethal concentrations of acaricide (1.0-1.5 percent) in resistant individuals caused partial suppression of the preesophageal division of the nerve ganglion. By using the Chestrin biochemical method, we established that the cholinesterase activity of the Ixodoidea population resistant to chlorophos is 3.7 times lower than the cholinesterase of the sensitive Ixodoidea. The differences in activity of the aliphatic esterase (methylbutyrate esterase, phenyl acetate esterase and tributyrate esterase) in the sensitive and resistant Ixodoidea are insignificant. The experimental data that we obtained with respect to the lowered level of activity of the cholinesterase in resistant Ixodoidea by the biochemical method correlate with the data obtained by the histochemical method. These studies performed by two different methods indicate the reported difference in cholinesterase activity of the susceptible and resistant strains.

The cuticle also plays a defined role in the development of the resistance of ticks to chlorophos. The acaricide applied to the ticks passes through the cuticle which lowers the toxic dosage of the acaricide reaching the vitally important centers.

Our experiments have established that ticks resistant to chlorophos has 4 to 6 times more wax on the cuticle than the sensitive ones. It is characteristic that with an increase in resistance the amount of wax also increases. Thus, in the sixth generation of Rh. bursa, one individual had 23 micrograms of wax at the same time as in the tenth generation an individual had 50 micrograms. For the sensitive Ixodoidea of the same species the amount of wax is 10 micrograms/individual.

The partial removal of the wax from the Ixodoidea integuments using a mixture of acetone with water (1:1) significantly increased their sensitivity to the given acaricide. Consequently, the wax layer on the cuticle of the Ixodoidea resistant to chlorophos, accumulating in the wax, delayed entry of the acaricide into the organism of the ticks.

In our experiments on sensitive Ixodoidea the wax-lipoid layer does not differ morphologically from that of the resistant ticks, but the intensity of color in the resistant imago is intensified by approximately 50 to 60 percent. This indicates high lipid content in the cuticle of the resistant Ixodoidea. In addition, a study was made of the lipid content in the cuticle of the Ixodoidea as a function of their age. It was established that the lipid content in the cuticle of the resistant ticks of the tenth generation three months old decreases by 70 to 80 percent by comparison with the same ticks at one month old. The  $SK_{50}$  of chlorophos for resistant Rh. bursa of the tenth generation three months old was 0.01 percent at the same time as for the same ticks at a month old it was 0.54 percent, that is, with age the resistance to chlorophos dropped by 54 times. Consequently, a correlation is observed between the lowering of the lipid content and the loss of resistance of the Ixodoidea to chlorophos.

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For sensitive ticks of the same species, an insignificant reduction of the lipid content (10-15 percent) and relative constancy of CK<sub>50</sub> with an increase in age are characteristic.

In order to determine the chlorophos content in the organism of the resistant and sensitive Ixodoidea, they were treated with 0.3 percent solution of chlorophos causing a lethal effect of the sensitive Ixodoidea after 24 hours and 100 percent survival of the resistant Ixodoidea. Three hours after treatment the washings from the cuticle of the resistant ticks contain three times more chlorophos than the washings from the sensitive ticks at the same time as for the sensitive ticks the basic mass of compound was concentrated in the internal organs.

Probably, a consequence of organic titration of the chlorophos into the internal organs is faster removal of the acaricide from the organism of the resistant Ixodoidea, for protective mechanisms become active which neutralize the toxic agent.

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BIOCLIMATOLOGY

UDC 551.524:542.2

## STUDY OF AIR TEMPERATURE DURING THE TRANSITION PROCESS IN A CLIMATE CHAMBER

Moscow DOKLADY VSESOYUZNOY ORDENA LENINA AKADEMII SEL'SKOKHOZYAYSTVENNYKH  
NAUK IMENI V. I. LENINA in Russian No 11, 1978 pp 41-42

[Article by Candidate of Technical Sciences V. T. Oleynichenko, A. V. Alekseyev,  
Odessa Branch of the Agropribor Farmtool Scientific Production Association]  
[Text]

The analysis of the existing methods of surveying and investigating various biological organisms under laboratory conditions [2, 6-8] confirms the necessity for studying the effect of the changes in light and temperature-moisture conditions in the climate chambers.

We have performed studies of the law of variation of air temperature under changing conditions (the transition from day to night) in a climate chamber with an operating volume of 0.5 m<sup>3</sup>.

The air was cooled by the I-114 standard evaporator connected to the VS-0.45-~3 freon cooling unit. The temperature was measured using thermocouples and resistance thermometers [3]. The schematic for the placement of the temperature gages in the chamber is shown in Figure 1.

When daytime conditions are replaced by night, there is a significant decrease in the temperature of the cold carrier in the evaporator which leads to a change in temperature of the air environment within the chamber. In general form the air cooling process can be represented by a differential equation [1, 4] of the type:

$$f\left(\frac{d^2T}{d\tau^2}; \frac{dT}{d\tau}; T\right) = \sum Q_i, \quad (1)$$

where T is the current value of the temperature (°C);  $\tau$  is the time (sec);  $Q_i$  is the heat flux (watts).

In the investigated case  $\sum Q_i$  can be written in the form

$$\sum Q_i = Q_1 + Q_2 + Q_3 + Q_4 - Q_5, \quad (2)$$

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where  $Q_1$  is the heat flux released by the biological organisms (watts);  $Q_2$  is the heat flux from filtration (watts);  $Q_3$  is the heat flux through the enclosures (watts);  $Q_4$  is the heat flux from the illumination (watts);  $Q_5$  the heat flux removed by the evaporator (watts).

During the course of performing the experiments in the climate chamber with a thermal load on the evaporator of 450-465 watts and at a boiling point of the Khladon-12 [cold carrier-12] with the limits from  $-20$  to  $-22^\circ\text{C}$  we obtained the air cooling curves (see Figure 2).

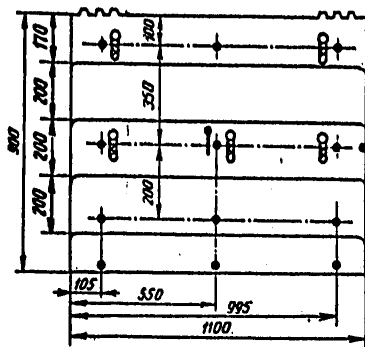


Figure 1. Schematic of the arrangement of the thermocouples, resistance thermometers in the chamber.

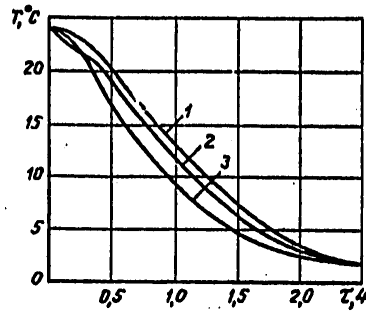


Figure 2. Graphs of the air temperature measurements in the chamber: 1 -- at the geometric center, 2 -- on the left side, 3 -- on the right side.

The studies of the experimental curves of the temperature variation of the air environment in the transition mode demonstrated that they are described by second-order differential equations.

The solution to equation (1) can be obtained in the form [4]:

$$T(\tau) = T_n - (T_H - T_H) \times (1 - C_1 e^{-\alpha_1 \tau} - C_2 e^{-\alpha_2 \tau}), \quad (3)$$

where  $T_H$ ,  $T_K$  are the initial and final air temperatures in the working zone of the chamber ( $^\circ\text{C}$ );  $C_1$ ,  $C_2$  are the air cooling process constants;  $\alpha_1$ ,  $\alpha_2$  are the exponents ( $\text{sec}^{-1}$ );  $\tau$  is the process time (sec).

After approximation of the experimental curves reflecting the dynamics of the air cooling at the geometric center, we obtain the following values of the coefficients:

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$$C_1 = 2, 3, \alpha_1 = 0,6 \cdot 10^{-3};$$

$$C_2 = -1, 3, \alpha_2 = 0,1 \cdot 10^{-3}.$$

It has been established experimentally that  $T_k$  is  $+1.0^\circ \text{C}$  for an outside temperature of  $+22-26^\circ \text{C}$ . Substituting the experimental values of the constants in equation (3), we have the equation for the variation of the air temperature at the geometric center of the chamber in the transition mode:

$$T(\tau) = T_H - (T_H - 1,0) \times$$

$$\times (1,0 - 2,3e^{-0,6 \cdot 10^{-3}\tau} +$$

$$+ 1,3e^{-0,1 \cdot 10^{-3}\tau}). \quad (4)$$

Thus, as a result of the investigation of the law of variation of the temperature of the air environment in the climate chamber  $0.5 \text{ m}^3$  in volume with a heat load of 450-465 watts, the calculated relation was obtained for the temperature variation of making the transition from the day to night conditions.

On the basis of analyzing the experimental curves (see Figure 2) it was established that the value of the ratio of the delay time and the time constant is about 0.13. As a result of our calculations and the recommendations of A. P. Kopelovich [5] one may draw the conclusion that it is possible to use a position system of automatic air temperature control in the chamber.

The indicated system was introduced into practice in the climate chamber developed by the Odessa branch of the Agropribor Scientific Production Association.

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ECOLOGY

BIOLOGISTS, MATHEMATICIANS DESCRIBE ECOSYSTEMS

Sverdlovsk EKOLOGIYA in Russian No 2, 1979 pp 109-112

[Review by P. M. Brusilovskiy and G. S. Rozenberg, Institute of Biology, Bashkir ASSR Branch, USSR Academy of Sciences, of the book "Matematicheskoye modelirovaniye v ekologii. Materialy III shkoly po matematicheskoy modelirovaniyu slozhnykh biologicheskikh sistem" (Mathematical Modeling in Ecology. Proceedings of the Third School on Mathematical Modeling of Complex Biological Systems) edited by A. M. Molchanov, Moscow, Izdatel'stvo Nauka, 1978, 179 pages]

[Text] In 1975 Izdatel'stvo Nauka published a collection of articles edited by Prof A. M. Molchanov titled "Mathematical Modeling in Biology." This collection consisted of the works of the First School on Mathematical Modeling of Complex Biological Systems (March 1973) organized on the initiative of USSR Academy of Sciences Corresponding Member A. A. Lyapunov. Out of eight works in the collection, seven had a direct bearing on the modeling of ecological systems (populations, communities, ecosystems, the biosphere). Another distinguishing characteristic was the significantly greater contribution by mathematicians than by biologists. Works of the Second School (March 1974) were never published in full (4).

A new collection containing the proceedings of the Third School on Mathematical Modeling of Complex Biological Systems (January 1975) was published in 1978. The collection's title is somewhat different from the first. We believe that this change in title is unjustified. First a precedent has been set for the title "Mathematical Modeling in Biology," which embraces a broader range of biological problems for modeling (even in spite of the fact that a significant proportion of the works in the first collection were devoted to ecology). Second, the collection under review here is not limited to just works on ecology alone: It contains research papers and models dealing with epidemics and physiological processes associated with them. Most authors of papers in the collection are biologists, which makes it different from the first edition. A. M. Molchanov, the school's scientific director and the collection's editor, explains this in the foreword by saying that the main goal of the collection was to attract the attention of mathematicians to biological problems which, in the opinion of

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the authors, offers significant room for joint work, something that is acquiring increasingly greater significance as mathematics invades biology more and more.

The collection begins with a paper by B. Ya. Vilenkin, "Interacting Populations," which discusses some aspects of theoretical ecology. Analyzing different approaches to studying multispecific systems by reducing their dimensions, the author rejects two variants of the systems approach labeled by him extreme and moderate. The first approach (as defined by E. Odum) is rejected because it lacks the biological grounds of ecology; the second (as defined by D. Margalef) suffers from an absence of strictness and clarity despite its broadness and flexibility. Vilenkin believes that the solution to the evolved situation can be found by studying transformation of energy not in the ecosystem as a whole but rather in its individual blocks (for example in associations of organisms at different trophic levels), which corresponds to A. A. Lyapunov's micro-approach. Even further subdivision of these blocks into organisms or populations living at different times and in different spaces is possible as well.

This method, the mathematical foundation of which consists of a system of equations describing the law of conservation of matter and energy for each block, can result in creation of models that provide good predictions of the structure or dynamics of ecosystems; however, in view of their cumbersome and "vastness" we can hardly expect them to produce good conclusions--that is, ecosystem theories specifically. Moreover by avoiding the "curse of dimensions" (though in the end a number of the blocks may turn out to be very large anyway), we collide with a second fundamental difficulty typical of such approaches--the need for using a tremendous number of coefficients associating these blocks with each other. Therefore, leaving the right of prediction of the behavior of complex ecosystems to simulation models (as well as A. G. Ivakhnenko's self-organizing models), we would have to reserve the power of explanation for the potential effectiveness model (6,7). We would also have to take exception to Vilenkin's categorical assertion that there is no such thing as purposefulness in ecosystem development.

The article "A Structural and Functional Approach to Soil: Soil-Memory and Soil-Moment" by V. O. Targul'yan and I. A. Sokolov discusses the problem of "the soil's imitative capability" in relation to soil-forming factors (the geographical environment) from new positions. The authors introduced two new concepts--"soil-memory" (the set of stable and conservative properties of the soil profile, accumulated over the entire period of soil formation) and "soil-moment" (the set of dynamic properties resulting from the influence of environmental factors at the given moment or at moments close to it), which make it possible to group soil properties on the basis of stability. The paper also mentions the reasons for inadequate reflection of factors operating on soil. Basing themselves on these concepts the authors formulate three types of models necessary to soil science--functional models of soil-moment, historical-genetic models of soil-memory, and models of their interaction. We note that Geodakyan (1) and others have developed a

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theory, similar to the viewpoints of Targul'yan and Sokolov, differentiating genetic systems in relation to permanent and working memories, and that the qualitative conclusions of this theory may be found to be useful in soil science as well.

In his paper "An Ecosystem Theory of the Dynamics of Herbivorous Forest Insect Populations" P. M. Rafes presented a large number of experimental data concerning the formation, structure, and size of forest insect populations. Critically discussing the existing theories of population dynamics (the author does not consider mathematical models of population development), Rafes provides the grounds for a new approach--the ecosystem theory. He makes a detailed examination of the principles behind limitation of population dynamics by ecosystem processes governing interaction between herbivorous insects and the plants they eat, and by changes in the qualitative composition of the herbivorous insect populations.

The communication "Hierarchical Structure of Terrestrial Ecosystems" by I. V. Stebayev is devoted to the possible ways a hierarchical structure arose in terrestrial ecosystems. Analyzing the developmental stages of ecosystems forming on rock outcroppings and discussing the role of barriers to the entry of new substances into the ecological cycle and their redistribution, the author concludes that the "fate" of large ecosystems may depend on "barrier" ecosystems that are small in area and unnoticeable at first glance (the consortiums of T. A. Rabotnov and V. V. Mazing or the critical points of A. M. Molchanov), which must be considered in environmental protection.

In their paper "Unique Functional Features of Grass Ecosystems in Comparison With Forest and Desert Ecosystems" N. I. Bazilevich and A. P. Titlyanova present extensive comparative material (based on analysis and generalization of information gathered by Soviet and foreign researchers) on the concentrations of a number of chemicals in blocks contained within different ecosystems. Functional models are presented of exchange processes occurring in the "atmosphere-plant-soil" system of a mixed meadow grass ecosystem (Karachi Research Station, Western Siberia) in two meteorologically different times of the year. These models are diagrams of cause-and-effect relationships set up with the help of G. Forrester's methods of system dynamics. A mathematical simulation model of such a system has already been built by Gil'manov (2).

A paper by Yu. M. Aponin and A. D. Bazykin "A Model of Eutrophication in an Open Predator-Prey System" is devoted to quantitative analysis of a model describing the behavior of a "predator-prey-substrate" system. Analysis of a system of three differential equations permitted the authors to reveal four types of behavior of the system within the plane of flow rate parameters and the initial concentration of the substrate. The authors make an interesting conclusion concerning arisal of a stable limiting cycle (stable fluctuation of the density of prey and predator) at low flow rates and a high initial substrate concentration.

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The paper "Mathematical Models of Biochemical Oxidation of Organic Water Basin Contaminants" by V. A. Vavilin examines the use of models developed for the theory of microbiological synthesis to describe biological purification of sewage and the self-purification processes occurring in water basins. The main requirement imposed on self-purification models is that they must provide a good prediction of the concentration of dissolved oxygen in time and in space. This requirement permits transition from simple models to simulation models of self-purification processes. On the other hand if we are to "work" with the latter, we would have to know the values of a large number of constants, which are often impossible to determine experimentally. Therefore, the authors point out, a good mathematical model must be precise within the limits of changes experienced by parameters defining the conditions of the problems and, at the same time, it must be as simple as possible. Unfortunately the author neglected to examine self-organizing and stochastic models of self-purification processes in this review.

Ye. Ya. Frisman's paper "The Mechanism Behind Maintenance of Nonuniformity in Spatial Distribution of Individuals" is devoted to research on the distribution of individuals in space. The author hypothesizes that non-uniformity in colonization by individuals may be elicited only by interaction between population growth and migration of individuals. When the migration coefficient is sufficiently low, his analysis of a model showed, there are four stable stationary points. When seasonal migration is present, cyclic changes arise in the density of the system's populations.

The three last papers are devoted to analysis of models of tuberculosis epidemics. In his communication "Some Dynamic Models in Tuberculosis Epidemiology" M. D. Korzukhin builds a model consisting of four linear differential equations, and V. R. Levin utilizes classical regression analysis in his work "Computations Concerning Some Epidemiological Aspects of the Spread of Tuberculosis in a Population." In their article "The Role of Oppositely Acting Factors in Assessing the Condition of Open Biological Systems (Using a Hemostatic System as an Example)" L. B. Khudzik and Z. L. Shul'gina focus the reader's attention on the need for determining the direction of action of parameters in open biosystems.

The models examined in these works have prediction as their goal. We note that self-organizing models (3), which are already being employed in medicine (5), are also of interest to prediction.

We can note the following in conclusion. The works in this collection provide the reader a general idea of the nature of problems faced by researchers as they proceed from simple description of an object to construction of its models--that is, to creation of a theory. The value of this sort of ordering of information cannot be doubted. However, it would have been nice for the works to word the modeling goals and the requirements biologists impose on the possible models of the examined systems and processes more concretely.

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It should be remembered that in systemology, a theory is not the sole bearer of explanatory and prognostic elements: The more complex a system model is, as a rule the greater is its capability for prediction and the lower is its capability for explanation (6).

The collection reviewed here is one more step on the road of cooperation between biologists and mathematicians in the solution of complex biological problems.

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CONFERENCE RECOMMENDS WATER PROTECTION STEPS

Moscow GIDROLOZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 2, 1979 p 1

[Article: "Do Not Pollute the Rivers With Wastes From Hydrolysis Plants!"]

[Text] In November 1975 the Biryusinskiy Hydrolysis Plant held a combined scientific-practical conference at which ways to reduce pollution of the Biryusa, Oka, and Iya rivers by liquid wastes from hydrolysis plants were discussed.

Representatives of the Irkutsk State Medical Institute, the Baikal Basin Epidemiological Station Administration, the Fish Conservation Inspection, the Tayshet City CPSU Committee, the Tayshet City Executive Committee, the Biryusinskiy City Soviet of Peoples Deputies, the Vostokpromstroy Trust, the Tulun and Zima hydrolysis plants, and (Sibgiprobiosintez) took part in the conference proceedings.

Recommendations suggested in a report by A. N. Litvintsev, an assistant professor of the department of general hygiene at the Irkutsk Medical Institute, and in communications presented by representatives of hydrolysis plants and the Sibgiprobiosintez and adopted by the conference point out that the management and collectives of enterprises in the Irkutskgidrolizprom Association are devoting constant attention to reducing pollution of the Biryusa, Oka, and Iya rivers by industrial wastes and protecting the rivers. Much work has been done in this regard. Thus biological oxidation of postfermentation mash by highly effective fungal strains has been introduced, measures insuring the fullest possible utilization of organic substances in the hydrolysate are being developed and implemented, existing treatment plants are being reconstructed, and new ones with greater capacities are being built. However, continually increasing intensification of production is making it necessary to carefully study the sanitary condition of the rivers named above, into which treated industrial wastes are dumped.

The principal source of pollution on, for example, the Biryusa River above the place where the hydrolysis plant dumps its wastes is log drifting;

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foundering logs choke the river channel with rotting wood. The situation on other rivers is similar. It is in this connection that the conference participants suggested the following as the principal requirement--put an end to log drifting on the Biryusa, Oka, and Iya rivers and their tributaries; remove sunken logs from the river channels.

The scientific-practical conference also recommended the following:

Rebuild treatment plants belonging to the Biryusinskiy, Tulun, and Zima plants, automate the flow of wastes into the treatment plant, and install measuring apparatus to insure their uniform flow;

establish strict surveillance over the qualitative and quantitative composition of production wastes; automate and carefully monitor input of nutrient salts into yeast growing apparatus; chlorinate domestic sewage prior to its delivery to treatment plants;

develop and introduce sensible methods of dry building cleaning;

make partial use of postfermentation mash in place of pure water in hydrolysis,

aerate water in winter at places of secondary river pollution by pumping in air with compressors or by punching holes in the ice, using the resources of enterprises in Tayshetskiy and Nizhneudinskiy rayons;

minimize the concentration of organic nitrogen compounds in liquid wastes from hydrolysis operations with the goal of making the environment unfavorable to development of the fungus (*lentomitus*), which fouls water in rivers far from places at which wastes are dumped.

On the basis of the recommendations adopted by the conference, the administrations of enterprises belonging to the Irkutskgidrolizprom Production Association have been asked to develop an environmental protection program foreseeing reduction of the discharge of contaminants together with production wastes into the river basins, in comparison with 1978, without reducing production volume. The quantity of contaminants must be reduced by means of improvements in production processes, by production control, by introducing pretreatment of industrial wastes, and by raising the effectiveness with which treatment plants work.

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POSTFERMENTATION RESIDUE AS A FILLER FOR PREMIXED ANIMAL FEEDS

Moscow GIDROLOZHNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 2,  
1979 pp 3-4

[Article by Prof M. Ye. Tamarchenko and Graduate Student I. P. Rotarenko,  
All-Union Scientific Research Institute of Hydrolysis of Plant Material]

[Text] Wheat bran and nutrient yeast are the main fillers used in premixed animal feed. Inasmuch as defluorinated postfermentation residue (PFR) is now being transformed into a feed additive for animals, the issue of its possible use as a filler in premixed animal feed has come up.

The authors of the present article performed special experiments to establish the effectiveness of feeding such premixed feeds to animals. For this purpose two completely identical lots of premixed feed were prepared at the Yefremov Biochemical Plant, the only difference being that hydrolytic yeast was the filler in the first and PRF to which sodium bicarbonate was added was the filler in the second. Addition of this salt improves the macromineral composition of the filler. An optimum concentration of hydrogen ions close to neutral is created, insuring better preservation of biologically active compounds contained within the premixed feed. All micro-ingredients were introduced into both fillers in identical quantities.

Research Methods

The effectiveness of the fillers was tested comparatively in scientific maintenance and balance experiments performed at the Priroda Kolkhoz, Nemskiy Rayon, Kirovskaya Oblast. Two groups of young of local large black and urzhumskiy breed pigs participated in the experiments. The groups were similar, consisting of 12 prepared and selected 4-month-old animals each. The principal ration, which consisted of combined feed, was the same in both groups and had the following composition (percent): Wheat--26, barley--43, wheat bran--15, sunflower cake--5, yeast--3, PFR--2, grass meal--3, chalk--1, monocalcium phosphate--0.5, table salt--0.5, and premix--1.

Gilts in the first group served as the control, and they received the premixed feed in which yeast was used as the filler; the second group received premixed

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feed containing PFR. The pigs were fed dry combined feed as a group with unlimited access. The gilts were maintained in a pigsty, in two sections of identical area.

To monitor the health of the animals we selected four representatives from each group, subjecting them to analysis of the morphological and biochemical blood characteristics, body temperature, pulse, and respiration rate.

During the scientific maintenance experiment we determined the quantity of feed eaten and change in animal weight daily. The scientific maintenance experiment lasted 100 days. The physiological (balance) experiment was performed with the same design of that scientific maintenance experiment 2 months after the study was started. For this purpose we selected three castrated boars from each group. The experiment was performed in special metabolic cages according to the commonly accepted technique developed by the All-Union Institute of Animal Husbandry (VIZh).

The preparatory and experimental periods lasted 7 days each. The animals were fed and watered individually three times a day.

In addition to studying digestibility and utilization of nutrients, we observed the physiological condition of the animals.

At the end of the scientific maintenance experiment we slaughtered three animals from each group at the Kirov Meat Packing Plant for control purposes. The animals were slaughtered according to the commonly accepted procedure developed by the VIZh. At the time of slaughter we determined the weight of internal organs, and after the carcasses were stripped we took average samples of sausage, lard, and some internal organs and bones for detailed analysis.

#### Research Results

Animals in both groups readily ate practically identical quantities of feed during the experiment (Table 1).

The ration of the gilts was carefully balanced, and it contained all necessary nutrients in the need quantities and in the correct ratios. Table 2 shows change in live weight of the gilts.

As we can see from these data, animal weight gain was high and practically identical in both groups. In this case the following number of feed units was expended per kilogram of weight gained: First group--3.87 kg, second group--3.96 kg; the figures for digestible protein were 501 and 505 gm respectively.

During the balance experiment all of the animals were given the following ration (gm): Barley meal--1,290, wheat meal--780, wheat bran--450,

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Table 1

(1) Корм и добавка	Средневзвешенный рацион (в г) (2) по группам подсынок	
	первая (3)	вторая (4)
(5) Мука ячменная . . . . .	1003,6	1032,9
(6) Мука пшеничная . . . . .	606,8	624,8
(7) Отруби пшеничные . . . . .	350,1	360,3
(8) Жмых подсолнечниковый . . . . .	116,7	120,1
(9) Травяная мука . . . . .	70,0	72,1
(10) Дрожжи . . . . .	70,0	72,1
(11) ПДО . . . . .	46,7	48,1
(12) Мел . . . . .	25,3	24,0
(13) Монокальцийфосфат . . . . .	11,7	12,0
(14) Соль поваренная . . . . .	11,7	12,0
(15) Премикс . . . . .	23,3	24,0
(16) Содержание кормовых единиц . . . . .	2290	2360
(17) Переваримый протеин . . . . .	296,0	299,7

Key:

- |   |                           |
|---|---------------------------|
| 1. Feed and additive                          | 9. Grass meal             |
| 2. Weighted average ration (gm) in gilt group | 10. Yeast                 |
| 3. First                                      | 11. PFR                   |
| 4. Second                                     | 12. Chalk                 |
| 5. Barley meal                                | 13. Monocalcium phosphate |
| 6. Wheat meal                                 | 14. Table salt            |
| 7. Wheat bran                                 | 15. Premix                |
| 8. Sunflower cake                             | 16. Feed units            |
|   | 17. Digestible protein    |

Table 2

(1) Группа	Живая масса одного (2) подсыновка, кг		(5) Среднесуточный прирост массы за опыт, г
	(3) в начале опыта	(4) в конце опыта	
(6) Первая . . . . .	37,7	96,8	691
(7) Вторая . . . . .	37,8	97,2	694

Key:

- |                                |   |
|--------------------------------|---|
| 1. Group                       | 5. Mean daily weight gain during experiment, gm |
| 2. Live weight of one gilt, kg | 6. First  |
| 3. At start of experiment      | 7. Second                                       |
| 4. At end of experiment        |   |

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Table 3

(1) Группа подопытных	(2) Переваримые питательные вещества, г				
	(3) органические	(4) протеин	(5) жир	(6) клетчатка	(7) ДЭВ
{8} Первая . . .	1805,2	349,8	22,6	30,6	1462,3
{9} Вторая . . .	1984,6	368,8	24,9	36,9	1664,0

(10) Коэффициенты переваримости*					
{8} Первая . . .	80,8	78,8	42,7	23,2	87,0
{9} Вторая . . .	80,7	77,2	43,8	26,6	87,1

\* Relative value

Key:

- |                             |                             |
|-----------------------------|-----------------------------|
| 1. Gilt group               | 6. Cellulose                |
| 2. Digestible nutrients, gm | 7. Nitrogen-free extractive |
| 3. Organic                  | 8. First                    |
| 4. Protein                  | 9. Second                   |
| 5. Fat                      | 10. Digestibility factors*  |

Table 4

(1) Группа подопытных	(2) Среднесуточные балансы азота, г					(9) Исполнено, %	
	(3) потреблено	(4) выделено			(8) баланс	(10) от принятого	(11) от переваренного
		(5) в кале	(6) в моче	(7) всего			
{12} Первая . . .	71,0	15,1	23,0	38,1	32,9	46,4	58,9
{13} Вторая . . .	76,3	17,3	25,7	43,0	33,3	43,6	66,4

Key:

- |                                    |                      |
|------------------------------------|----------------------|
| 1. Gilt group                      | 7. Total             |
| 2. Mean daily nitrogen balance, gm | 8. Balance           |
| 3. Consumed                        | 9. Utilized, percent |
| 4. Eliminated                      | 10. Of ingested      |
| 5. With feces                      | 11. Of digested      |
| 6. With urine                      | 12. First            |
|                                    | 13. Second           |

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Table 5

(1) Группа под- свинок	Среднесуточные балансы кальция и фосфора, г (2)			
	(3) потреблено	(4) выделено с калом и мо- чой	(5) баланс	(6) использо- вано, %
	(7) Кальций			
Первая (8)	29,3	19,8	10,5	36,0
Вторая (9)	32,6	17,7	14,9	45,8
	(10) Фосфор			
Первая (8)	16,7	11,0	5,7	34,7
Вторая (9)	18,0	11,0	7,0	39,1

## Key:

- |   |                      |
|---|----------------------|
| 1. Gilt group                                     | 5. Balance           |
| 2. Mean daily calcium and phosphorus balances, gm | 6. Utilized, percent |
| 3. Consumed                                       | 7. Calcium           |
| 4. Eliminated with feces and urine                | 8. First             |
|   | 9. Second            |
|   | 10. Phosphorus       |

sunflower cake--150, grass meal--90, hydrolytic yeast--90, PFR--60, dicalcium phosphate--21, chalk--30, table salt--15, and premix--30. The filler in the premix was yeast for animals in the first group and PFR for animals in the second. The animals ate practically all of the feed.

Figures for digestibility of nutrients in the ration are shown in Table 3.

We can see from Table 3 that the quantity of digestible nutrients and the digestibility factors were close, and a significant difference could not be established between the groups. The mean daily nitrogen balances are shown in Table 4.

We can assert on the basis of these data that both groups of animals utilized nitrogen practically identically.

It follows from the data in Table 5 that 9.8 percent of the calcium was utilized in the second group ( $P < 0.01$ ), while the second group used 4.4 percent more phosphorus than did the control group ( $P < 0.05$ ).

The hematological characteristics were physiologically normal. The blood of animals in the second group was found to have a somewhat greater acidity characteristic as well as larger concentrations of erythrocytes, hemoglobin, phosphorus, and total protein. However, the difference was insignificant, and it did not indicate any significant changes in metabolism.

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Control slaughter showed that the meat yield, the morphological composition of the carcasses, the weight of internal organs, and the chemical composition of meat and lard were practically the same in the groups. The dressed yield was 63.2 percent for the first group and 68.7 percent for the second. The chemical composition of meat and lard exhibited no deviations from physiologically normal.

Conclusions

The research showed that PFR is not inferior to hydrolytic yeast as a filler and that it can be used in production of premixed animal feed. Weight gain and the cost of feed were practically the same in both groups.

Feeding premixed feed containing PFR as the filler did not have an unfavorable influence on digestibility and utilization of nutrients in the ration. A significant difference was not established in the nutrient digestibility factors or in nitrogen utilization by the control and experimental groups of animals. The calcium and phosphorus balances were higher for gilts in the second group.

Considering that PFR cost less than yeast, its use as a filler would produce a large economic impact. A ton of premixed feed in which yeast was used as the filler cost 1,251 rubles, while feed with PFR as the filler cost 1,052 rubles, or 16 percent less.

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UTILIZATION OF HYDROLYTIC LIGNIN IN MEDICINE

Moscow GIDROLOZHNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 2, 1979 pp 11-12

[Article by Dr Tech Sci V. I. Sharkov, Dr Med Sci G. I. Tsobkallo, Cand Tech Sci V. P. Levanova, Cand Chem Sci E. N. Gvozdeva, and Cand Med Sci O. D. Vasil'yev]

[Text] There is considerable interest in using hydrolytic lignin in medicine, inasmuch as it has good sorptive properties. Thus Sholler proposed a method for preparing a medicinal preparation from lignin; it came into use under the name "porlizan" back in the 1940's by German clinicians to treat diseases of the gastrointestinal tract accompanied by diarrhea. The effectiveness of the lignin preparation can be explained in this case by its capability for adsorbing and securely arresting, on its sizable surface area, pathogenic bacteria and toxins contained in suspended matter or in the intestine, to be subsequently removed from the body together with the lignin by natural defecation. German researchers established that 1 gm porlizan could adsorb about 5 million *Escherichia coli* bacteria.

The activity of a medicinal preparation made from lignin apparently depends on the hydrolysis method, the form of plant material employed, and the methods for preparing and subsequently processing hydrolytic lignin with the goal of removing impurities--lignohumic and resinous substances.

To obtain their medicinal preparation, German researchers used lignin obtained from wood hydrolysis by the Sholler-Tornesh method and by Sholler's two-stage method. In the first case the lignin apparently had a high concentration of impurities, while in the second case it was low. Subsequent processing of the lignin involved cooking it for many hours in 2 percent caustic soda solution. Then it was meticulously rinsed, dried, pulverized, and used as a lignin paste containing 20-25 percent dry matter.

Hydrolysis plants in the USSR use methods and conditions for hydrolyzing raw wood that differ dramatically from the methods suggested by Sholler. These conditions promote production of high yields of sugar and hydrolysates of higher quality and, as a consequence, lignin with a lower concentration of impurities.

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The authors of the present article studied the possibility for using such hydrolytic lignin to obtain a medicinal preparation.

The research was performed with industrial lignin obtained after cooking conifer wood. Large unhydrolyzed wood particles and mechanical impurities were removed by screening. The lignin was cooked for 2-3 hours at 80 and 100°C in 2 percent aqueous caustic soda solution at a liquor ratio of 3. After cooking, the alkali was carefully rinsed away with distilled water; then it was rinsed with acetic acid to neutralize any remaining alkali, and once again with water. The obtained samples were dried and pulverized in a ball mill. Then we determined their fractional (Table 1) and chemical (Table 2) compositions.

Table 1

(1) Размер частиц, мм	(2) Содержание (%) в лигнине	
	медицинском (3)	техническом (4)
(5) От 1 до 10	0	49.0
0,5-1	0,5	16,5
0,25-0,5	24,0	14,1
<0,25	75,5	10,4

Key:

- |                                      |                 |
|--------------------------------------|-----------------|
| 1. Particle size, mm                 | 3. Medical      |
| 2. Concentration (percent) in lignin | 4. Industrial   |
|                                      | 5. From 1 to 10 |

Table 2

(1) Компоненты	(2) Содержание (в % к збс. сухой навеске) в лигнине	
	медицинском (3)	гидролизном (4)
(5) лигнин	77	60-70
Кислоты (в пересчете на H <sub>2</sub> SO <sub>4</sub> ) (6)	0	0,6-1,5
(7) Зола	2	До 3,0
Грудногидролизуемые полисахариды (8)	18	15-20
Редуцирующие вещества (9)	0	1,5-3,0
Смолистые вещества (10)	3	7-12,0

Key:

- |  |  |
|--|--|
| 1. Components  | 6. Acids (corrected for H <sub>2</sub> SO <sub>4</sub> ) |
| 2. Concentration (percent absolute dry weight) in lignin | 7. Ash   |
| 3. Medical   | 8. Unhydrolyzable polysaccharides                        |
| 4. Hydrolytic  | 9. Reducing agents                                       |
| 5. Lignin  | 10. Resinous substances                                  |

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As the data in Table 1 and 2 show, medical lignin differs from industrial lignin by having a significantly large concentration of fine particles (less than 0.25 mm), absence of acids and reducing agents, and a lower concentration of resinous substances. It should be noted that the densities of technical and medical lignin are equal, being 1.5 gm/cm<sup>3</sup>.

The medical lignin preparations were analyzed for toxicity in experiments on frogs and rabbits. It was found that even when large doses of this preparation are administered, there are no signs of toxic action.

The capability lignin preparations have for adsorbing microorganisms was studied in the deep mycosis scientific research section of the Leningrad Institute for Advanced Training of Physicians imeni S. M. Kirov. The following bacteria were used in the experiment: the intestinal bacillus *E. coli*, the hay bacillus *B. subtilis*, Merezhevskiy's *Salmonella*, cholera-like vibriion, and *Staphylococcus aureus*; fungi used in the experiment included yeast-like *Candida albicans* cells and *Trichophyton mentagrophytes* spores. These microorganisms were first grown in the appropriate nutrient mediums. Physiological solution suspensions were prepared from the microorganism cultures, and the microbial cells were counted in a Goryayev chamber using an MBI-3 microscope with a phase-contrast device. The suspension was diluted to facilitate counting. The concentration of microorganisms was approximately 10<sup>6</sup>-10<sup>7</sup> per milliliter.

Table 3

Microorganisms	Number of microorganisms adsorbed by 1 gm lignin, millions
<b>Bacteria:</b>	
<i>Escherichia coli</i>	7.3
cholera-like vibriion	17.7
<i>Staphylococcus aureus</i>	14.5
Merezhevskiy's <i>Salmonella</i>	2.3
<i>B. subtilis</i>	1.9
<b>Fungi</b>	
<i>Candida albicans</i>	0.365
<i>Trichophyton mentagrophytes</i> (spores)	2.88

The experiments were performed in the following way. A 5 ml batch of suspension containing a precisely counted quantity of microbial cells was mixed with 1 gm lignin powder and shaken; 1 hour later we took filtrate samples and counted the microorganisms in them. The adsorbability of lignin was evaluated from the amount the concentration of microbial cells decreased

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in the liquid, corrected for 1 gm lignin. All experiments had threefold replication.

Table 3 shows data on the adsorbability of the medical lignin preparation obtained after processing in alkali at 100°C, in relation to different bacteria and fungi.

As we can see from Table 3 the obtained medical lignin has a high adsorption capability. Thus 1 gm adsorbs up to 7.3 million *E. coli*--that is, much more than the German preparation porlizon, 1 gm of which can adsorb about 5 million of these bacteria. A medical lignin preparation obtained following processing with 2 percent caustic soda at 80°C is typified by similar data.

The data in Table 3 also show that 1 gm lignin adsorbs larger quantities of cholera-like vibriions, *Staphylococcus aureus*, Merezhkovskiy's *Salmonella*, *B. subtilis*, and the fungi *Candida albicans* and *Trichophyton mentagrophytes*. This is the first time such data have been obtained.

The research results were brought to the attention of the pharmacological committee of the USSR Ministry of Public Health Administration for Introduction of New Medicinal Agents and Medical Equipment, which gave permission to conduct clinical research on the medical lignin preparation using patients suffering infectious diseases of the gastrointestinal tract. The research was conducted in therapeutic institutions of Leningrad, Moscow, and Kiev, and it produced positive results.

The nomenclature commission of the USSR Ministry of Public Health's pharmacological committee gave the name "Polifepan" to the medical lignin preparation (meaning a polymer consisting of different derivatives of phenylpropane). We are presently working on the procedures for mass production of this preparation.

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THE ROLE OF THE DESIGN OFFICE IN INTRODUCTION OF NEW EQUIPMENT AND PRODUCTION PROCESSES

Moscow GIDROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 2, 1979 pp 21-23

[Article by M. F. Trintsukova, Former Chief Designer, Khor Hydrolysis Plant]

[Text] The design office of the Khor Hydrolysis Plant employs 17 engineers and technicians who are doing considerable fruitful work in close cooperation with production innovators to search for, develop, and introduce measures concerning new equipment and advanced production procedures. The design office collective devotes a great deal of attention to new processing systems, plans, and proposals that would eliminate "bottlenecks," mechanize labor, and improve production excellence.

Thus, in particular, the system for biological oxidation of postfermentation mash has been improved (a two-stage system has been developed). As a result the yield of commercial yeast was increased from 0.2-0.8 to 3-4 tons per day, and the degree of purification of production wastes, as determined from the BOD<sub>5</sub>, increased by 24 percent. The degree of contamination of liquid wastes was reduced further by adding a continuous furfural distillation column to the nutrient protein production operation and introducing a device trapping oil in purified water.

A new system for integrated processing of tree wood was developed with the participation of the design office's colleagues in connection with construction of a lower raw material warehouse. Introduction of this system will make it possible to dramatically increase labor productivity and the excellence of production.

The collective of designers and process engineers has been completing its planned assignments and satisfying its adopted socialist pledges from year to year. This means that beginning with the fourth quarter their work will be credited to the next year, and the planning and technical documents will be prepared ahead of schedule.

Our office prepared the drawings for many innovations that have been introduced into production. Here are a few examples. Jointly with the Monitoring

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and Measuring Instrument and Automation Equipment Laboratory we developed a plan for rebuilding the air distribution system for the yeast growing apparatus; the plan foresees lengthening the diffuser cone and introducing automatic control of nutrient yeast cultivation. This proposal, which was introduced by the chief mechanic's section and assimilated by the collective of the yeast shop, made it possible to increase the productivity of the yeast growing apparatus from 6 to 10 tons per day. Introduction of the air distribution system designed by the Ukrainian SSR Scientific Research Institute of Construction Industry produced an even greater economic impact. Conversion of just one yeast growing apparatus to this system saved 50,000 rubles per year.

In order to improve the work of the pure culture growing division we developed a 20 liter yeast growing apparatus with a remote air distribution system. This makes it possible to experimentally test the new air distribution system and significantly accelerate renewal of pure yeast culture in working apparatus.

The Khor plant was one of the first in the sector to introduce spray dryers, automatic remote control, and a gas contact yeast drying method. All of this had a positive reflection upon the quality of its products and production economics; moreover it freed a 100 kw transformer, 12 heaters, 2 furnace stacks, and a fan for other use. This was accompanied by a decrease in consumption of heating oil and steam and by a decrease in the danger of ignition and explosion of dry yeast during drying. The enterprise enjoyed a savings totaling 229,500 rubles per year.

Steam-oil burners, in which fuel oil is sprayed by a steam jet, were installed in the furnaces of the spray dryers. This necessitated a large quantity of fuel oil to create the steam that propelled the fuel oil into the furnaces. In 1977 one of the drying furnaces was converted on the basis of the design office's proposals to gas-oil burners in which the fuel oil is sprayed mechanically. A second spray dryer furnace was converted to mechanical fuel oil spraying during overhaul in 1978. Introduction of mechanical spray burners saves the enterprise 14,500 rubles per year.

Since 1977 our plant has been producing high-purity alcohol, which was awarded the State Seal of Quality on 3 July 1978. This was the result of rebuilding the apparatus division with a consideration for the experience of the Leningrad Hydrolysis Plant.

Colleagues of the design office prepared the appropriate technical documents to support improvements in the existing production systems. These improvements will make it possible to double the output capacity of yeast spray dryers, improve the work of the neutralization station and the settling unit, and so on.

The plant's heating system has been improved. Thus a boiler room has been installed in the TETs. The shops and homes of the plant town have been converted from steam heating to water heating. As result 5,880 Gcal

52

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of heat have been saved, and unproductive heat consumption has been eliminated. All of this produced a savings of 323,000 rubles per year for the enterprise.

A lignin drying system producing nonacidic high-calorie powder, suitable not only for combustion in a mixture with coal in steam boiler furnaces but also for use in many industrial sectors, was developed in an experimental plant. The new lignin drying system was demonstrated at the Exhibition of the Achievements of the USSR National Economy. After information describing the advantages of this drying method was published\* the plant received more than 30 requests from various institutes and enterprises in the country. To satisfy these requests the plant sent several tons of lignin powder with from 5 to 30 percent moisture content to various industrial sectors for experimental purposes.

According to a conclusion arrived at by the Irkutsk Institute of National Economy, use of powdered lignin as a briquet additive in place of coke produces a high impact in the production of high quality steel. Research conducted by the Kemerovo Scientific Research Institute of Chemical Industry, the Gidrolizprom Scientific-Production Association, and the Latvian SSR Institute of Wood Chemistry demonstrated the high reactivity of lignin flour produced by an experimental unit at the Khor Plant. Positive results were enjoyed in pyrolysis of powdered lignin. The Ministry of Nonferrous Metallurgy and Saratovenergo requested technical documents with the purpose of introducing the system for producing powdered lignin to be burned with coal. Work by the Kemerovo Scientific Research Institute of Chemical Industry established the good prospects of using lignin in the production of molding material. The institute has made plans to produce experimental industrial lots of molding material made from lignin, and to perform extensive tests at consumer enterprises. It should be noted that the TETs collective satisfied the pledge it adopted for 1978--begin operation of an industrial lignin drying unit in the boiler room of the TETs. The final adjustments for operation are now being made.

The furfural shop is housed in a modern five-story building. Production control is fully automated here: One instrument controller manages the entire production process. In the course of assimilating this shop the Khor plant became one of the sector's first to introduce a steam trapping system making use of inverters developed by our design office.

Using a plan developed by the (Sibgiprobiosintez) as our basis, we installed heat exchangers on the inverters with a heating surface of 40 m<sup>2</sup> each intended for condensation of steam produced in hydrolysate self-evaporation. However, they did not insure complete condensation of steam, they became

\* Trintsukova, M. F., and Boyev, V. V., "A New Lignin Drying Method," GIDROLIZNAYA I LESOKHIMICHESKAYA PROM-ST', No 3, 1976, pp 24-26.

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coated by resinous residue, and they were unable to separate furfural-containing condensate from hydrolysate.

This system was improved at the plant: Two reheaters (with a heat exchange surface area of 150 m<sup>2</sup> each) were installed in the inverters to operate in parallel.

The system of connections supplying the reheaters made it possible to:

Achieve full condensation of steam produced in self-evaporation and deliver furfural-containing condensate to the furfural shop by gravity flow;

use water heated to 45-50°C in production;

insure uninterrupted operation of the hydrolysate inversion unit;

purify the hydrolysate and prevent air contamination;

make the work of service personnel easier (a possibility arose for converting to chemical heat exchanger cleaning).

Plans of the system for utilizing steam produced by self-evaporation were sent to the All-Union Scientific Research Institute of Hydrolysis Industry, which after a few changes recommended the system for introduction at the sector's hydrolysis plants.

Before, two brand 8KhDYE pumps and one EKHM20/28M pump were used to deliver hydrolysate from the inverters to the neutralization station. Because of the high temperature and the caustic nature of the medium, the pumps and valves often broke down. The design office developed a system for delivering hydrolysate from the inverters to the neutralization station by means of a gravity flow line with a diameter of 300 mm made from stainless steel. As a result the pumps were no longer needed, hydrolysate could be transported without interruption, the time and volume of repairs were decreased, and electric power consumption was reduced. The economic impact was 17,000 rubles per year.

For a long time we had to dump the methanol we used because the impurities it contained prevented its use as a commercial product or a raw material. A system for combusting the ether-methanol fraction in yeast dryer furnaces, developed by the collective, completely precludes contamination of the air and water by toxic wastes, and the enterprise has enjoyed an additional profit of 6,900 rubles by saving on fuel oil.

The plant's engineers and technicians frequently travel on business to other enterprises and institutes. This broadens the outlook of the engineer and enriches his experience. Thus automation of many production processes in the hydrolysis department was the result of an exchange of experience at the country's leading enterprises. This also pertains to mechanization of many laborious operations.

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Workers of the design office visited several enterprises in the kray in order to study and subsequently improve the tank transportation and painting unit. This section makes use of small mechanical equipment which slows down the work, now that the production processes have been automated. Mention of this was made many times at workers' meetings, with valid criticism being levied against the design office. Our designers have now developed a new plan for full mechanization of operations involved in transportation and painting of carbon dioxide tanks satisfying modern requirements. Workers of the carbon dioxide shop approved the plan. It is now their turn to display the initiative and do everything to insure its fastest possible introduction.

The innovations made by the plant collective have been given a high evaluation: They have earned two certificates of the Exhibition of the Achievements of the USSR National Economy, and 20 workers to include four designers were awarded exhibition medals.

In 1978 the collective introduced 21 measures promoting technical progress at our plant. The main ones were automation of hydrolysis apparatus, replacement and improvement of the air circulating system in yeast production, and introduction of an integrated quality control system.

Much has been done by the plant collective, but there is still even more work to do to improve mechanization of the coal dumps of the TETs and the raw wood shop, and to improve the plant's production systems. The design office has prepared 50 working plans for 1979-1980 concerning introduction of organizational-technical measures and elimination of production "bottle-necks."

These plans and their implementation through the joint efforts of the enterprise collective will be our contribution to a common goal--that of developing production, increasing labor productivity, and upgrading product quality.

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NEW WOOD CHEMICAL PRODUCTS

Moscow GIDROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 2, 1979 pp 23-25

[Article by Engineer P. I. Zhuravlev, Orgsintez Production Association]

[Text] Production of a number of new wood chemical products based on processes developed by the TsNILKhI [Central Scientific Research and Planning Institute of Wood Chemical Industry] was assimilated in the last 5 years at the Gor'kiy Orgsintez Plant. These products include extractive, modified, clarified (EMC) colophony. It is obtained by heating extractive colophony in the presence of an alkylsulfide compound ((oktofor)S), in an amount 0.15-0.2 percent of the weight of the colophony load, at a temperature of  $260 \pm 5^\circ\text{C}$  for 40-60 minutes. Maleic anhydride or fumaric acid is added at a rate of 3-4 percent as the modifying agent. The obtained product differs from conventional extractive colophony by having a higher acid number and softening point; its color is three to four grades lighter than the initial extractive colophony. EMC colophony is used as sizing for high-grade writing paper, and it competes successfully with expensive resin.

Extractive colophony processed by only an alkylsulfide compound (EC) is a fabulous masticator in the production of household and toilet soap. The value of EC colophony is even higher in connection with the fact that it can serve as a dietary substitute.

The product obtained through interaction of extractive colophony with maleic anhydride or fumaric acid and formaldehyde is extremely interesting. The acid number increases to 170 mg KOH per gm colophony, and the softening point rises to  $80^\circ\text{C}$ . Such colophony is used as cardboard glue, in plastic wood, and in tire and industrial rubber industry.

Production of various forms of purified extractive colophony involves simple production processes. A reactor supplied with a propeller mixer is filled to two-thirds of its volume with colophony, to which 4 percent maleic anhydride is added. After this the rest of the colophony is added, and the temperature of the contents is raised to  $180-220^\circ\text{C}$  with the help of a high-boiling-point heat carrier (a diphenyl mixture) fed into a jacket

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surrounding the reactor. Live steam at a temperature of 135-140°C is fed at a rate of 2 m<sup>3</sup>/hr through a diffuser in the reactor to distill off oils that are contained in colophony and as a rule impart a dark color to it. Oktofor S is loaded into the reactor when the contents reach 220°C; live steam delivery is halted at this moment. The temperature in the reactor rises to 260±5°C, and then delivery of live steam is resumed. The reacting ingredients are kept at a temperature of 260±5°C in the reactor for 40-60 minutes, after which they are poured into a cooler. After being cooled down to 150-170°C, the product is poured into cardboard drums through a collecting main.

To produce EM-3 colophony, the amount of maleic anhydride added is increased to 5 percent of the colophony volume, formaldehyde is metered in at a rate of 2.5 percent for 1.5-2.5 hours at a temperature of 150°C, and the reaction ends when the temperature reaches 185-195°C.

In 1977-1978 our enterprise produced the first industrial lots of a glue made from EMC colophony for pulp and paper industry, and an EC colophony compound to be used by soapmaking industry.

The glue is the product of incomplete saponification of EMC colophony by caustic soda solution. The colophony is saponified by 70-80°C 37 percent alkali in a cooling unit with a working mixer. The reaction mixture is cooled to 90-100°C to avoid foaming and splashing. The quantity of caustic soda consumed to obtain 1 ton of glue is 6.7 percent. The obtained product has a dry matter weight fraction of 70±3 percent, and it is fully soluble in water.

The compound is a mixture of EC colophony and fatty acids at a 1:1 ratio. The fatty acids used for this purpose are from light vegetable oil soap stock and hydrogenated fat, distilled cottonseed oil, distilled tall oil, and fatty acids from tall with a solidification point of not more than 42°C and an acid number not less than 195 mg KOH/gm. EC colophony and the fatty acids are mixed in units outfitted with a mixer or diffuser used to blow inert gas through. The obtained product is light brown, its acid number is not less than 150 mg KOH/gm, and the solidification point is not greater than 30°C.

The glue and the compound are transported in rail tank cars, one-third of the volume of which is occupied by a steam jacket used to heat the product for its removal.

Industrial production of noncrystallizing modified cable colophony (KNMK-2) out of resin was introduced into the plant in 1975 on the basis of plans developed by the Bulgarian SSR Academy of Sciences Institute of Physico-Organic Chemistry. The production process involves partial esterification of resin by glycerin added in an amount 5 percent of the colophony volume. After the glycerin is metered in, the temperature of the reactor contents is raised to 200°C, and water and colophony oils are distilled through a



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condenser-cooler. Esterification proceeds at 260° for 4-6 hours. After the reaction the reactor heating system is turned off, a 400-600 mm Hg vacuum is created in the system, and the product is held (dried) for 1-1.5 hours. This results in removal of volatile neutral compounds, water produced in the reaction, unreacted glycerin, and colophony oils. After drying, inert gas is fed into the reactor and the product travels to the cooler by gravity flow. It is poured into cardboard drums through a collecting main at 160-170°C.

The volume resistivity of KNMK-2 colophony at 100°C is not less than  $2 \cdot 10^{12}$  ohms·cm, its softening point is not below 70°C, and a tendency toward crystallization is totally absent. This colophony is used to make impregnating compounds for electric cable industry.

Using plans developed by the same institute, in 1978 the plant was the first in the Soviet Union to begin production of an experimental industrial lot of modified balsam from deciduous trees intended for use in the manufacture of chewing gum in food industry. The production process entails deeper esterification of deciduous colophony by glycerin and meticulous removal of volatile substances, oils, and other such products at a 600-650 mm Hg vacuum.

Colophony oils obtained in the production of modified extractive colophony, KNMK-2 cable colophony, and deciduous balsam are used for deep drilling in geological exploratory operations. Thus there are practically no wastes in the entire production operation, and it does not pollute the environment.

In addition to developing the procedures for obtaining new products out of colophony, the plant's engineers and technicians introduced, in cooperation with TsNILKhI, a one-stage method for producing pine oil--the product of hydration of  $\alpha$ -pinene by formic acid.

An original technical concept made it possible to maximally simplify production of terpineol--a highly valuable raw material used in various products of perfume industry, and the high purity and the high concentration of the principal ingredient of the product made it possible to practically exclude the complex operations of purifying it prior to use.

$\alpha$ -Pinene is hydrated with 70 percent formic acid at a 1:2 ratio in a reactor at 55-60°C, without separating pinene from turpentine. The resulting ester is saponified by 25 percent alkali. The alcohol-terpineol obtained as a result of saponification is distilled in a fractionation column at a vacuum of 720-730 mm Hg. The resulting product contains 98 percent main ingredient. Intermediate fractions are returned for secondary fractionation. The pinene-free turpentine is used as a solvent, and the still residue (polymers) is used in geological exploratory drilling. Thus these wastes have useful application.

In collaboration with scientists of the Gor'kiy Construction Engineering Institute imeni V. P. Chkalov, in 1976-1977 the plant assimilated production

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of EKR-22 epoxy-terpene compound, which is a mixture of ED-20 or ED-16 epoxy resins and turpentine products (oxyterpene resin and pinene-free turpentine). The ingredients are mixed in a reactor furnished with a mixer at 70-80°C. The ratio of the components in the reactor is (percent): Epoxy resin--64.6; pinene-free turpentine--16.2; oxyterpene resin--19.2.

The product of this mixture contains not less than 10 percent epoxy groups, and its viscosity, as determined with a VZ-1 viscosimeter at 25°C, is not greater than 100-200 stokes. It is extensively employed as a binding compound for slab floors in acid-base shops, and to fill seams and gaps in floor coverings assembled out of individual units and experiencing wearing loads.

The unique properties of secondary products made from colophony and turpentine and their high quality result in a constant demand for them by various industrial sectors, and high production effectiveness guarantees enlargement of the assortment and constant growth in production volume.

Following the example of our plant and utilizing our experience, other plants of the All-Union Soyuzleskhimproduktsiya Production Association are assimilating production of new products made from colophony and turpentine.

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YEAST ASSOCIATION DEVELOPING IN YEAST GROWING APPARATUS OF THE KANSK  
BIOCHEMICAL PLANT

Moscow GIDROLIZNAYA I LESOKHIMICHESKAYA PROMYSHLENNOST' in Russian No 2,  
1979 pp 25-28

[Article by Kansk Biochemical Plant engineers L. V. Lebedeva, V. D. Krechetova, and Z. N. D'yakova, Cand Tech Sci I. I. Balashevich, Junior Scientist I. G. Shtepenko, and Cand Biol Sci T. N. Semushina, All-Union Scientific Research Institute of Hydrolysis of Plant Material]

[Text] It was demonstrated earlier (1) that the microflora of yeast growing apparatus at the Kansk Biochemical Plant is represented by four species of microorganisms--K-1 (*Candida scottii*), K-2 (*Zygomycetozoa marxiana*), K-3 (*Torulopsis aeria*), and K-4 (*C. mesenterica*). Among these, strain K-1 is the most productive, and it can still be encountered today in varying quantities in yeast growing apparatus.

It was established in observations made later on that the composition of the microflora depends in many ways on the quality of the substrate and the design of the air distribution system of the yeast growing apparatus (2). This is why we improved production of nutrient yeast at the Kansk Biochemical Plant by introducing progressive procedures for preparing the substrate, and by rebuilding the air distribution systems (3). Thus because hydrolyzate began to be added to postfermentation mash in 1967, aeration of the neutralizate for 2.5-3 hours was introduced at the plant. This made it possible to reduce its furfural concentration by 18.7 percent and the concentration of brominated substances by 27 percent. After conversion to a three-stage settling system, the initial concentration of reducing agents in the substrate increased from 0.62 to 1.0 percent.

The productivity of apparatus with a volume of 600 m<sup>3</sup> grew in 1976 from 6 to 8-8.5 tons per day as a result of improvements in the airlift air distribution system.

The authors of the present article studied the composition of microflora in yeast growing apparatus of the Kansk plant with the goal of selecting the most productive and stable yeast associations. Research performed over the

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last few years showed that the composition of the plant's microbial population is similar to that established in 1970 (1).

We can see from the histogram (Figure 1) that in 1976 the plant microflora was represented mainly by strains K-1 and K-2. This is why we devoted our main attention to them in our subsequent work.

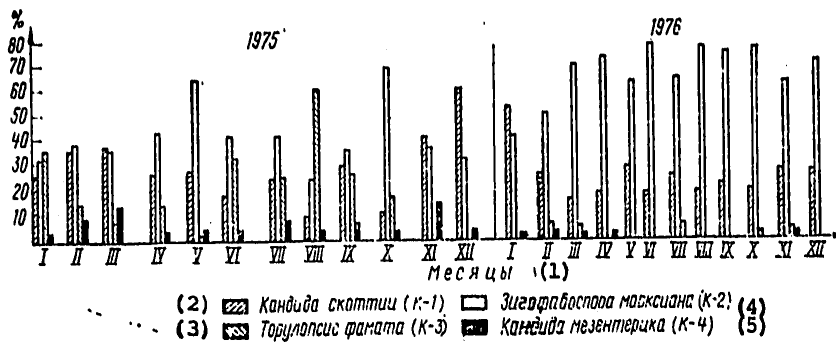


Figure 1. Histogram of Changes in Composition of Yeast Population at the Kansk Biochemical Plant

Key:

- 1. Months
- 2. *Candida scottii*
- 3. *Torulopsis phanata*
- 4. *Zygorhodospora marsiana*
- 5. *Candida mesenterica*

Table 1

Neutralysate	Biomass yield (percent of total RA) of strains:		
	K-1	K-2	K-3
Kansk Plant	55	30	weak growth
Leningrad Plant	40	weak growth	weak growth

Note: The RA concentration in neutralysate is 1 percent.

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Table 2

Yeast Strains	Culturing Conditions		
	Rocker	Laboratory fermenters	
	Absolutely dry yeast yield with respect to RA, percent	Absolutely dry yeast yield with respect to RA, percent	Crude protein concentration, percent
K-1	50.0	—	—
K-2	weak growth	28.7	45.5
K-1 + K-2	46.0	—	—
K-2 + Centrifugate of K-1	50.0	53.6	58.0

To determine the industrial value of these strains, we grew them on synthetic and industrial mediums contained in rocking flasks and in a unit outfitted with a controlled medium feed system (4) in accordance with procedures adopted by the VNIIGidroliz [All-Union Scientific Research Institute of Hydrolysis of Plant Material].

We can see from Table 1 that K-1 yeast was the most productive when cultured in hydrolysate from the Kansk plant: The biomass yield attained 55 percent of RA [reducing agent]. Yeasts K-2 and K-3, present as impurities, are typified by significantly lower growth activity. Strain K-2 (in the form of a monoculture) produces a biomass yield of not more than 30 percent of RA, and strain K-3 grows extremely weakly.

Table 1 also shows that hydrolysate from the Leningrad plant is a less favorable medium for growing yeast isolated from the Kansk plant's population. This once again attests to the adaptability of plant cultures to the substrate of a concrete enterprise, and to the suitability of performing selection in the plants themselves.

Table 2 presents data on the productivity of K-1 and K-2 monocultures and mixed cultures grown on synthetic Andreyev's medium in different culturing conditions--rocking flasks and laboratory fermenters subjected to intensive aeration. As we can see from these data, strain K-2 accumulates biomass significantly more actively when the medium is subjected to additional aeration; however, in this case the yield of absolutely dry yeast does not exceed 29 percent for this strain.

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It is interesting to note that growth of yeast strain K-2 is significantly intensified when K-1 yeast centrifugate is added to the nutrient medium. In this case the biomass yield increases to 50-53 percent, and the concentration of crude protein in the yeast increases as well. Thus stimulatory action of the metabolites of *C. scottii* on growth of associated cultures, noted earlier (5), manifests itself. The curves in Figure 2 graphically demonstrate stimulation of growth and sugar consumption by strain K-2 in response to addition of K-1 yeast centrifugate to the synthetic medium.

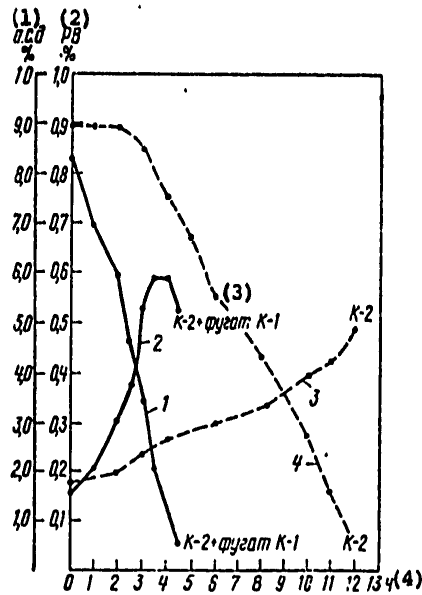


Figure 2. Growth in Yeast Biomass and Sugar Consumption by Strain K-2 (*Zygothabospora marxiana*): 1,4--Sugar consumption; 2,3--biomass accumulation

Key:

- |                         |                 |
|-------------------------|-----------------|
| 1. Absolutely dry yeast | 3. Centrifugate |
| 2. RA                   | 4. Hours        |

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Table 3

(1) Штeмь дрожжей	(2) Содержание в субстрате						(7) Содержание в отработанной бражке				D=K, ч <sup>-1</sup> (9)	α от P, % (10)	P, г/(г·ч) (11)	(12) Содержание спирота, %		Состав полу- лик через 35 ч, % (13)				
	(3) P, %	ЛК, %	N, мг/л (4)	P <sub>2</sub> O <sub>5</sub> , мг/л (4)	KCl, мг/л (4)	(5) бромиру- емь ве- щества, %	PВ, %	ЛК, %	N, мг/л (4)	P <sub>2</sub> O <sub>5</sub> , мг/л (4)				KCl, мг/л (4)	X, г/л (8)		α от P, % (10)	P, г/(г·ч) (11)	K-1	K-2
K-1	1.0	0.17	697	279	268	0.02	0.29	0.19	0.02	370	63	180	26.2	55.3	1.5	100.0	0.0			
K-2	1.0	0.14	909	306	211	0.02	0.19	0.24	0.05	800	206	—	24.7	61.8	2.1	100.0	0.0			
Искусственно созданный лик смесь K-1 + K-2	1.0	0.15	854	288	211	0.016	0.29	0.16	0.02	466	137	—	10.9	27.6	0.37	96.4	3.6			
Заводская ассоциация (15)	1.0	0.17	697	279	268	0.02	0.29	0.19	0.03	438	48.1	45.8	23.8	63.4	1.5	109.0	0.0			
								0.19					23.8	59.7	1.7	41.0	59.0			
								0.19					23.8	42.7	1.56	22.8	21.2			
								0.19					22.4	56.1	1.60	50.0	50.0			
								0.19					21.2	60.5	1.92	30.5	89.5			

Note: JIK--volatile organic acids; P--productivity; X--yeast working concentration.

- Key:
1. Yeast strain
  2. Concentration in substrate
  3. RA
  4. mg/liter
  5. Furfural
  6. Brominated substances
  7. Concentration in spent mash
  8. gm/liter
  9. Per hour
  10. α As percentage of RA
  11. gm/(liters·hr)
  12. Crude protein concentration
  13. Population composition after 35 hours
  14. Artificially created mixture of K-1 + K-2
  15. Plant association

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Table 4

(1) Штамм дрожжей	(2) Типоактивность, %	(3) Содержание веществ					(8) Содержание в образце			X, % (9)	D-м, % (10)	(11) С, от PB, %	P, r/(a-v) (12)	(13) Содержание в порошке, %	(14) Содержание в культуре, %		
		РВ, % (4)	N <sub>2</sub> , мг/г (5)	P <sub>2</sub> O <sub>5</sub> , мг/г (5)	KCl, мг/г (5)	Фурфурол, % (6)	Бромиды, % (7)	PB, % (4)	N <sub>2</sub> , мг/г (5)							P <sub>2</sub> O <sub>5</sub> , мг/г (5)	KCl, мг/г (5)
Тул-6 (из культуры ВНИИ-67) (17)	16	1,0	697	259,4	268,5	0,02	0,29	0,14	576	43,6	-	26,22	0,253	70,5	1,76	180	21,6
Тул-6 (из культуры ВНИИ-67) (17)	23	1,0	854	288,6	211,4	0,018	0,259	0,14	568	77,8	74,9	24,77	0,270	66,8	2,91	76,4	55,7
Тул-6 (из культуры ВНИИ-67) (17)	18	1,0	854	288,6	211,4	0,018	0,259	0,14	568	77,8	74,9	24,77	0,270	66,8	2,91	76,4	55,7
КС-1 (из культуры ВНИИ-67) (18)	18	1,03	851	300	347	0,019	0,24	0,18	-	Средн (20)	22,30	0,320	55,74	1,76	55,4	22,7	77,3
КС-1 (из культуры ВНИИ-67) (18)	16	1,03	851	300	347	0,019	0,24	0,18	-	Средн (20)	22,30	0,320	55,74	1,76	55,4	22,7	77,3
КС-1 (из культуры ВНИИ-67) (18)	17	1,03	851	300	347	0,019	0,24	0,18	-	Средн (20)	22,30	0,320	55,74	1,76	55,4	22,7	77,3
КС-1 (из культуры ВНИИ-67) (18)	18	1,03	851	300	347	0,019	0,24	0,18	-	Средн (20)	22,30	0,320	55,74	1,76	55,4	22,7	77,3
КС-1 (из культуры ВНИИ-67) (18)	18	1,03	851	300	347	0,019	0,24	0,18	-	Средн (20)	22,30	0,320	55,74	1,76	55,4	22,7	77,3
КС-1 (из культуры ВНИИ-67) (18)	18	1,03	851	300	347	0,019	0,24	0,18	-	Средн (20)	22,30	0,320	55,74	1,76	55,4	22,7	77,3

Key:

1. Yeast strain
2. Culturing time, hours
3. Concentration in medium
4. RA
5. mg/liter
6. Furfural
7. Brominated substances
8. Concentration in spent mash
9. gm/liter
10. Per hour
11. α As percentage of RA
12. gm/(liters·hr)
13. Crude protein concentration, percent
14. Microflora composition at end of of culturing time
15. Principal culture
16. Accompanying cultures
17. Tul-6 (from the VNIIGidroliz Museum)
18. KC-1 (from the VNIIGidroliz Museum)
19. KC-1 (adapted)
20. Trace

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Table 3 shows the results of continuous cultivation of K-1 and K-2 strains in the form of monocultures and mixed cultures in the unit outfitted with a controlled medium feed system.\* As in the experiment with the rocker, strain K-1 exhibited a high biomass yield ( $\alpha = 65.5$  percent of RV) at a specific growth rate of 0.25/hr. Yeast strain K-2 grew slowly as a monoculture on the plant substrate ( $\mu = 0.14$ /hr), and the biomass yield ( $\alpha = 27.6$  percent) and the productivity (0.37) were low.

When grown in the artificially prepared mixture with K-1, strain K-2 gradually assumed a dominant position in the culture. Thus while at the beginning of the process the total population was 41 percent K-1 and 59 percent K-2, after 35 hours K-1 was 22.8 percent while the quantity of K-2 increased to 77.2 percent. It should be noted in this case that the biomass yield, the growth rate, and the productivity of the process remained the same as with the K-1 monoculture.

In other words the population of strains K-1 and K-2 took form during lengthy continuous cultivation in such a way that presence of 22.8 percent strain K-1 was sufficient to stimulate growth of K-2 yeast as necessary; the productivity of the population did not decline in this case.

Similar results were obtained with growth of a plant association from yeast growing apparatus cultured in the laboratory in the unit outfitted with a controlled medium feed system.

As we can see from Table 3 the ratio of strains K-1 and K-2 in the plant association, which was initially 1:1, changed during cultivation, the K-2 factor rising to 69.5 percent. However, the yeast yield, productivity, specific growth rate, and protein concentration remained close to characteristics typical of strain K-1.

Table 4 shows the results of growing yeast strains Tul-6 and KC-1 (*C. scottii*) obtained from the pure culture museum of the VNIIGidroliz. The concentration of volatile organic acids in the medium varied from 0.17 to 0.15 percent, and only traces could be detected in spent mash.

As we can see from these data, both strains--Tul-6 and KC-1--grew on the Kansk plant medium with a high productivity and a high biomass yield in relation to total RA. When the medium dilution rate was  $D = 0.23-0.25$ /hr, strain Tul-6 exhibited the higher yield of absolutely dry yeast and productivity--70.5 percent and 1.78 gm/(liters·hr) respectively. The biomass yield for strain KC-1 was 55.8 percent, and its productivity was 1.3 gm/(liters·hr).

---

\* The plant substrate--a mixture of postfermentation mash, neutralysate, and distillate from alcohol columns containing 1 percent RA.

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When the medium dilution rate was increased from 0.25 to 0.37/hr, the biomass yield in relation to RA was high for both strains, while productivity increased to 2.0-2.1 gm/(liters·hr), which was significantly more than for the naturally evolved plant association.

As follows from the data in tables 3 and 4, strain K-1 is the most stable. Strains KC-1 and Tul-6 were displaced by foreign yeasts by the end of the culturing time (even after KC-1 had adapted to the autoselection conditions).

As in the laboratory experiments, strains Tul-6 and Kc-1 were displaced by foreign yeasts when the strains were propagated separately in pure culture and then seeded in the industrial yeast growing apparatus. This is why strain K-1 from the pure culture division must be seeded periodically in the yeast growing apparatus. Seeding is performed during fermentation of the substrates in the yeast growing apparatus, after overhaul, and when the concentration of K-1 in the population decreases significantly.

Table 5

(1) Показатели	(2) Аппарат с системой воз- духораспределения	
	(3) рассе- яющей	(4) Укрниисп
(5) Рабочий объем, м <sup>3</sup>	166	166
Подача субстрата, м <sup>3</sup> (6)	56	79
РВ исходные, % (7)	0,98	0,98
РВ остаточные, % (8)	0,21	0,19
(9) Рабочая концентрация дрожжей, г/л	25,0	27,0
Содержание штамма К-1 в популяции, % (10)	24,0	39,0
Содержание сырого протеина, % (11)	52,4	54,4

Key:

- |   |  |
|---|--|
| 1. Characteristics                                  | 6. Substrate intake, m <sup>3</sup>                    |
| 2. Apparatus outfitted with air distribution system | 7. Initial RA, percent                                 |
| 3. Dispersed  | 8. Residual RA, percent                                |
| 4. Ukrniisp   | 9. Yeast working concentration, gm/liter               |
| 5. Working volume, m <sup>3</sup>                   | 10. Concentration of strain K-1 in population, percent |
|   | 11. Crude protein concentration, percent               |

Development of a stable association of K-1 and K-2 cultures in yeast growing apparatus depends on the design of the air distribution unit. Table 5 compares the work of two 600 m<sup>3</sup> yeast growing units (March-May 1976). The first apparatus contains an air distribution system developed by the

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VNIIGidroliz, though the quantity of cuvettes was increased to twenty. The second apparatus was outfitted with an air distribution system developed by the (Ukrniisp).

As we can see from Table 5, the stability of high-yield strain K-1 is higher in the apparatus with the Ukrniispair distribution system (up to 40 percent). This results in better characteristics for the work of the apparatus and better quality of the obtained product (the concentration of crude protein in the yeast increases from 52 to 54 percent).

Conclusions

1. A stable association of two yeast strains, K-1 (*Candida scottii*) and K-2 (*Zygothabospora marxiana*), evolved at the Kansk Biochemical Plant owing to improvements in substrate preparation and in the airlift air distribution system of the yeast growing apparatus; the concentration of the most productive strain, K-1, varies from 20 to 40 percent.
2. It was established that the industrial value of the association (in relation to biomass yield, growth rate, and productivity) is on par with the best *Candida scottii* monocultures (K-1, Tul-6, KC-1).
3. The suitability of performing selection aimed at arriving at high-yield, stable associated cultures at the particular plant is demonstrated.

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MICROBIOLOGY

UDC 576.851.48.098.396.332

ELECTRON MICROSCOPIC STUDY OF THE CONJUGATIVE PLASMIDS OF SEROLOGICALLY TYPED E. COLI AP1

Moscow BYULLETIN' EKSPERIMENTAL'NOY BIOLOGII I MEDITSINY in Russian No 4, 1979 pp 328-330

[Article by A.P. Kalyuzhnaya, N.I. Strizhov, N.I. Matvienko and V.P. Shchipkov, Department of Biology and General Genetics (Professor A.P. Pekhov, Chief), Peoples' Friendship University imeni Patrice Lumumba, Moscow, and the Laboratory for Virus Genetics (N.I. Matvienko, Candidate in Biological Sciences, Chief), Institute for the Biochemistry and Physiology of Microorganisms, USSR Academy of Sciences, Pushchino-on-Oka]

[Text] The cells of the serologically typed strain E. coli AP1 contain a transmissive F-like factor of conjugation previously known as the FV-1 plasmid [2]. In a study of the physical and chemical properties of this plasmid's DNA by the methods of sedimentation in a neutral gradient of glycerine and electrophoresis of its fragments in an agar gel, data was produced that makes it possible to assume the existence of a complex consisting of 2 different plasmids [1] within the cells of this strain.

For the purpose of verifying this assumption, this project undertook an electron microscopic study of the plasmid DNA in E. coli AP1.

Method of Investigation. Plasmid DNA was obtained from cells of E. coli AP1 by the method described earlier [1].

The DNA preparations for electron microscopy were made by the micro-technique suggested by Lang and Mitani [4]. A DNA preparation (0.1-0.2 mkg per ml in a 0.15M ammonium acetate buffer) with addition of 1.3 mkg/ml of cytochrome C and a solution of formaldehyde (0.02M in its final concentration) was used for this purpose. The DNA-protein film was shifted to screens coated with a carbohydrate substrate and then tinged with antimony at an angle of 7° from a distance of 10 cm by a turntable (30 rpm). The preparations were studied in a JEM-100B electron microscope (60 kilovolts, objective diaphragm of 30 mkm) with a magnification factor of 10,000. The "internal standard" method [3] was employed to measure the contour length of the plasmid DNA. A preparation of ColE1 plasmid DNA whose molecular weight equalled  $4.2 \times 10^6$  Daltons was used as the standard

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specimen. The plasmid DNA negatives obtained were examined in a projector with a magnification factor of 6.5. The plasmids took up an average of 4 ColE1 DNA molecules in each photograph per single molecule of DNA that was studied.

Contour dimensions for plasmid DNA in cells of E. coli AP1 and their molecular weights

(1) № образца	(2) Длина кон- тура 1-й плазмидной ДНК, см	(3) Длина контура плазмидной ДНК ColE1 см	(4) Молекулярная масса 1-й плаз- мидной ДНК (X 10 <sup>6</sup> дальтон)	(5) № образца	(6) Длина контура 2-й плазмидной ДНК, см	(7) Длина контура плазмидной ДНК ColE1, см	(8) Молекулярная масса 2-й плаз- мидной ДНК (X 10 <sup>6</sup> дальтон)
1	109,0	12,7	36,0	1	162,5	13,0	52,5
2	107,0	13,0	34,6	2	155,0	12,6	51,5
3	114,0	12,8	37,4	3	168,0	13,0	54,2
4	118,0	13,0	38,1	4	162,5	14,0	48,6
5	111,0	12,1	38,5	5	164,0	14,0	49,4
6	95,0	12,1	32,9	6	160,0	12,6	52,5
7	106,0	13,5	33,0				
8	106,0	12,8	34,2				
9	114,0	13,5	35,5				
10	118,0	13,1	37,9				
11	104,0	13,0	34,6				
12	124,0	14,0	37,2				
13	120,0	13,8	36,5				

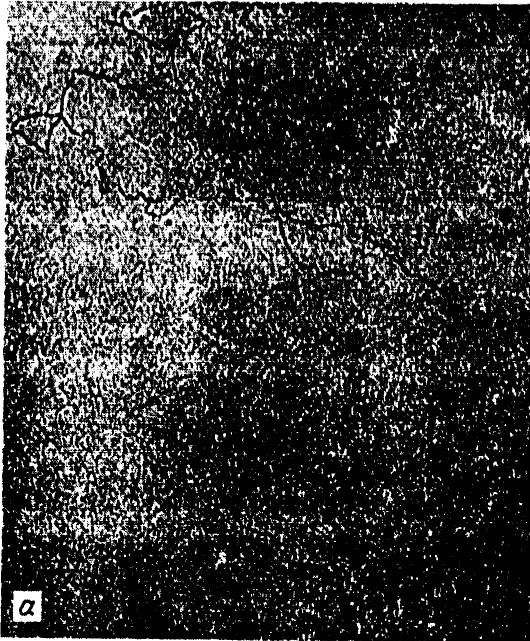
## Key:

1. Specimen number
2. Contour length of 1st plasmid DNA, cm
3. Contour length of ColE1 plasmid DNA, cm
4. Molecular weight of 1st plasmid DNA (X 10<sup>6</sup> Daltons)
5. Specimen number
6. Contour length of 2d plasmid DNA, cm
7. Contour length of ColE1 plasmid DNA, cm
8. Molecular weight of 2d plasmid DNA (X 10<sup>6</sup> Daltons)

Results of the investigation. The results from measuring the contour lengths of ColE1 DNA and the plasmids under study which provided the basis for calculating their molecular weights are shown in the chart. The data was processed statistically. The photograph shows electron microscopic pictures of the DNA plasmids being investigated.

The results obtained make it possible to clarify the premises that we stated earlier [1], according to which, two, or possibly a single plasmid with different types of molecules (superspiral, open, circular, closed, etc.) can be present in the preparations of plasmid DNA from E. coli AP1 cells being studied.

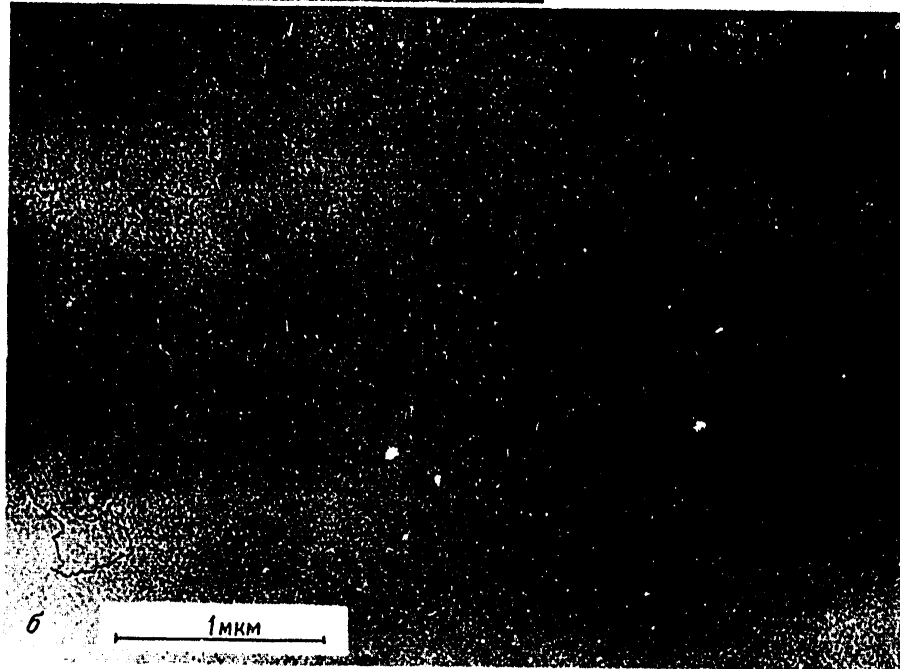
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Electron microphotographs  
of plasmid DNA from E. coli  
AP1 (mag. 10,000).

a) plasmid DNA (FBI-1) with  
a molecular weight of  $35.9 \pm 0.5 \times 10^6$  Daltons;

b) plasmid DNA (FBI-2) with  
a molecular weight of  $51.5 \pm 0.6 \times 10^6$  Daltons



71

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Electron microscopic study of the plasmid DNA preparation obtained confirms the correctness of the first assumption as to the existence of two different plasmids in cells of this strain. The average molecular weight value for a single plasmid (FBI-1) is  $35.9 \pm 0.5 \times 10^6$  Daltons whereas that for the other (FBI-2) is  $51.5 \pm 0.6 \times 10^6$  Daltons.

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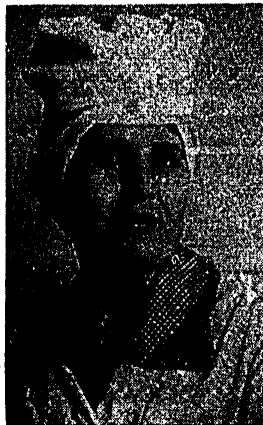
BEST PRODUCERS IN PHARMACOCHEMICAL INDUSTRY ANNOUNCED

Moscow KHIMIKO-FARMATSEVTICHESKIY ZHURNAL in Russian No 4, 1979 p 6

[Text] Galina Aleksandrovna Fofanova--Shock Worker of Communist Labor

Galina Aleksandrovna is a plastic article assembler at the Kurgana Sintez Medical Preparations and Articles Combine, a shock worker of communist labor, several times the winner of socialist competition, and the best in her occupation. The products assembled by G. A. Fofanova are always distinguished by excellent quality. Galina Aleksandrovna regularly surpasses the daily norm through sensible use of work time, good organization of labor at her workplace and improvement of her work habits.

G. A. Fofanova completed the plan for the first 4 years of the five-year plan in November 1978. She initiated the idea of completing the five-year plan in 3.5 years, and to complete her own five-year plan by 1 July 1979. G. A. Fofanova adopted personal socialist pledges for 1979 to insure acceptance of all of her products at their first presentation to quality control, to master the associated specialty of article welding operator, and to train two new students.



73

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Marina Yefimovna Bagryantseva--Shock Worker of Communist Labor

M. Ye. Bagryantseva works at the Moscow Moskhimformpreparty Pharmaceutical Production Association as an injection solution ampule quality controller, a job she has held since 1961.

M. Ye. Bagryantseva regularly surpasses the daily assignments. All of her products are accepted with the first presentation. M. Ye. Bagryantseva completed the 1978 plan by 1 December, and she was one of the first to pledge to complete her personal plan for the 10th Five-Year Plan by the 110th anniversary of V. I. Lenin's birth.

M. Ye. Bagryantseva has mastered several associated occupations during her working career. She has been awarded the title of shock worker of communist labor for her successes in socialist competition.



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UDC 661.12.067.3

CARTRIDGE FILTER WITH A MECHANIZED DRY RESIDUE UNLOADING SYSTEM

Moscow KHIMIKO-FARMATSEVTICHESKIY ZHURNAL in Russian No 4, 1979 pp 90-92

[Article by Z. B. Kristall and Yu. M. Khanukovich, All-Union Pharmacochemical Scientific Research Institute imeni S. Ordzhonikidze, Moscow, and the Leningrad Farmakon Pharmacochemical Production Association]

[Text] Cartridge filters are enjoying increasingly broader use in pharmacochemical industry. There can be no doubt as to their advantages over pressure filters. They include, first of all, lower outlays on their manufacture, shorter servicing time, the possibility for mechanized unloading of the residue both in the form of pulp and in dry form, and approximately 25 percent increase in productivity due to two-dimensional filtration, lower overall dimensions of the filter and, consequently, release of production space for other purposes and reduction of metal content.

Cartridge filters make use of both ceramic and fabric filter elements, as well as elements made from woven metallic mesh.

The Penza Decontamination and Chemical Equipment Plant has begun series production of PSI-12K-K filters with ceramic cartridges developed by the All-Union Pharmacochemical Scientific Research Institute operating at a pressure of up to 3 atmospheres (1,2). Use of a mechanical system to remove dry residue and presence of a fast-acting lower hatch cover lock makes it possible to filter liquids with a high solid phase concentration owing to the possibility for swift removal of the residue.

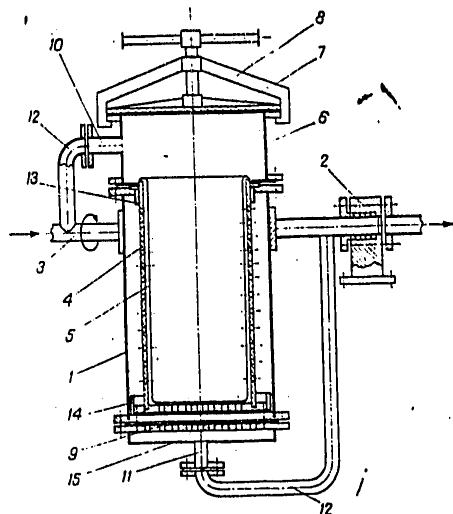
The Leningrad Farmakon Pharmacochemical Production Association has been using cartridge filters with a fabric filtering element for 15 years. At first these filters employed a hydraulic residue removal system, and they were employed in production operations of different output capacities. Despite their relatively small dimensions and high productivity they were nevertheless gradually supplanted by cartridge filters employing a dry residue unloading system, since they failed to satisfy requirements imposed on filtrate purity. We can conclude from the association's experience that they can nevertheless be employed when the residue being washed out dissolves in the washing agent and proceeds to the next production stage in solution form.

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Broad use is being made of cartridge filters in which there is a fabric bag inside a perforated cartridge, and the dry residue is removed by hand through a hatch shut with a screw clamp. When such filters are used, the time spent on opening them and, consequently, the production shutdown time during residue unloading decrease significantly. The plant is presently using 20 such filters manufactured locally.

An improved filter design has been proposed with the objective of mechanizing residue unloading through the hatch (3) (see Figure).



Cartridge filter with a mechanized dry residue removal system. See text for explanation.

The filter consists of housing (1) resting on hollow shafts (3) on supports (2), the filter head (6), and the filter sump (15). The housing contains a moveable perforated cartridge (4) with a fabric bag inside (5), the rim of which is secured between the upper flange of the housing and the lower flange of the filter head. The filter head has a lid (7) with a screw clamp (8), and a suspension feed nozzle (10). There is an additional filtering element between the lower flange of the body and the sump (9). There is a filtrate outlet in the sump (11). The feed nozzle and the outlet are connected to the hollow shafts by tubes (12).

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The initial suspension is fed to the filter under pressure through the hollow support shaft and the feed nozzle, and it is filtered through the filtering bag and (to guarantee quality) through the additional filtering element. The filtrate passes through the outlet into a connecting tube and then through the hollow supporting shaft. The residue accumulates within the filtering bag.

After the filtering and rinsing operations are completed the lid on the filter head is opened and the housing is rotated on its supports (180°). The moveable cartridge moves out of the filter's working zone by gravity, turning the fabric filtering bag inside-out and dumping the residue through the hatch. To avoid canting, the cartridge slides on a guide bushing (13), and its bottom bears a guide ring (14) made from sparkproof nonfriction material (fluoroplastic for example). After the residue is unloaded the filter housing rotates back to its initial position. The cartridge and its filtering bag are returned to their initial position simultaneously. Then the lid is shut, and the filter is ready to resume work. Our experience with the filter shows it to be promising in pharmacochemical industry.

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THE NEW PSYCHOTROPIC DRUGS PIRAZIDOL AND FENAZEPAM

Moscow KHIKHO-FARMATSEVTICHESKIY ZHURNAL in Russian No 4, 1979 pp 114-120

[Article by G. M. Rudenko based on the proceedings of an all-union symposium]

[Text] The USSR Ministry of Public Health Administration for Introduction of New Medicinal Agents and Medical Equipment conducted the all-union symposium "New Psychotropic Drugs" in L'vov in 1978 jointly with the Ukrainian SSR Ministry of Public Health L'vov Medical Institute. The All-Union Pharmacochemical Scientific Research Institute (VNIKhFI) imeni S. Ordzhonikidze of the USSR Ministry of Medical Industry and the USSR Academy of Medical Sciences Institute of Pharmacology were also direct participants of the preparations for and the conduct of the symposium. The symposium was devoted to the basic results of experimental and clinical research on the original domestic psychotropic preparations pirazidol (an antidepressant) and fenazepam (a tranquilizer). However, information on other psychotropic drugs was also communicated in a number of reports and in their subsequent discussion; some general problems of experimental and clinical psychopharmacology were touched upon as well.

Psychiatrists, neuropathologists, pharmacologists, and representatives of other specialties from the Ukrainian SSR, the RSFSR, and a number of other union republics took part in the symposium proceedings. In all, 30 reports were offered at the symposium by 20 scientific research institutes and medical institute departments in Moscow, L'vov, Leningrad, Tartu, Tbilisi, Alma-Ata, and Kazan'.

The first two meetings (16 reports) were devoted to the antidepressant pirazidol. They were initiated with an expanded review of the work that has been done by the VNIKhFI to seek and create antidepressants (USSR Academy of Medical Sciences Academician M. D. Mashkovskiy). Directed synthesis of a large number of polycyclic compounds and their subsequent investigation by means of a "battery" of pharmacological tests led to creation of the tricyclic antidepressant azafen, the bicyclic monoaminoxidase (MAO) inhibitor indopan, and the tetracyclic preparations pirazidol and inkazan. Following clinical tests, these preparations were approved by clinicians and recommended by the Pharmacological Committee of the USSR Ministry of Public Health for broad medical use. Information accumulated in the course of this work has

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important theoretical significance from the standpoint of revealing the mutual relationships between chemical structure, psychotropic activity, and the mechanism of psychotropic action of new classes of chemical compounds, which will doubtlessly play a significant role in subsequent research aimed at finding new effective psychotropic preparations.

The results of experimental research (pharmacological, electrophysiological, and biochemical) on pirazidol, presented by N. I. Andreyeva, showed that the preparation manifests distinct antidepressive properties and has a unique spectrum of psychopharmacological activity. This activity is based on a unique neurochemical mechanism of action--pirazidol's capability for simultaneously inhibiting both neuron capture of monoamines typical of tricyclic antidepressants, and oxidation of deaminated monoamines, inherent to MAO inhibitors. At the same time the preparation differs significantly from these two groups of antidepressants. In contrast to tricyclic antidepressants it does not have cholinolytic activity, and it is distinguished from typical MAO inhibitors (iproniazid, trinitiltsipronim, and others) by its reversible and short-term inhibitory action on oxidative deamination of monoamines. Moreover the preparation mainly inhibits deamination of serotonin and has little influence on deamination of tyramine, accumulation of which in body tissues is associated with the side-effects of "classical" MAO inhibitors. Comparative research on the effect of pirazidol and a number of antidepressants and neuroleptics (trimeprimine, khlo mipramin, trazodone, triperidol, and others) on rat behavior following lesion of limbic structures in the forebrain (L. S. Mekhilane) also confirmed the uniqueness of its psychotropic effect in experimental conditions. Its clearly pronounced sedative action on rat motor activity and its capability for having a weak cataleptic action caused it to resemble neuroleptics. At the same time a number of tests showed that at higher doses, pirazidol significantly activates animal motor activity.

Detailed toxicological research on different laboratory animals (S. A. Sharova et al.) showed that pirazidol is significantly less toxic than the broadly employed antidepressant imipramine (melipramin), that it is tolerated well by all animals when used over a long period of time, that it does not disturb the functions of the body's most important organs and systems, that it does not have teratogenic action, and that it does not influence organ development. The obtained data attesting to the preparation's low toxicity permit the hypothesis that pirazidol is tolerated well by patients suffering accompanying somatic diseases.

Clinical reports presented at this symposium fully confirmed the results of the experimental research and demonstrated the high effectiveness of pirazidol in the treatment of diverse depressive states. The discussion of pirazidol's therapeutic properties was opened with a report by E. A. Babayan et al., which thoroughly analyzed materials from clinical investigation of the preparation by the Pharmacological Committee. Analysis of the results of using the preparation on 1,330 patients made it possible to distinguish individual groups of depressive states characterized by different degrees of the preparation's effectiveness. It was demonstrated that pirazidol produces the maximum therapeutic effect among patients with mild depressive states, especially if hypoergic and anergic disorders occupy an important place, such as in

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neurotic, "diffuse" ("masked"), and adynamic depression and various asthenodepressive and dysthymic states. In these cases almost all patients enjoy a positive therapeutic effect, with complete disappearance of the depressive syndrome or significant improvement, making it possible to withdraw treatment or limit it to just maintenance therapy, being observed in more than 70 percent of the patients. The number of observations indicating such improvements gradually decreases correspondingly from 67 to 51.5 percent when the drug is used to treat patients with hypochondriacal, deep classical, anasthetic, and depersonizational depression. Finally the effectiveness of pirazidol is observed to be minimum (the number of patients exhibiting pronounced improvement is less than 50 percent) in the treatment of profound depression coupled with anxiety and agitation, depressive-delirious states, and severe inhibitory depression. On the whole, disappearance of depression or significant improvement was observed among 75 percent of patients who had cyclothymic or moderate depression and among 40 percent with severe depressive states.

Subsequent reports significantly broadened and refined the data presented earlier. Using several psychiatric rating scales in a methodologically meticulous investigation, U. M. Saarma et al. demonstrated that at a dose of 200-300 mg/day pirazidol has pronounced antidepressive action and is effective against depression of varying psychopathological structure and origin. Unique traits of the preparation's antidepressive effect include a broad spectrum of psychotropic activity coupled with somewhat preferential action on an inhibited mood specifically (melancholy affect) and motor inhibition. A broad spectrum of action of pirazidol's antidepressive activity was also noted in reports by G. Ya. Avrutskiy et al., Ye. T. Danilenko et al., L. G. Ursova et al., B. R. Naneyshvili et al., A. P. Muzychenko, and others.

The report given by G. Ya. Avrutskiy et al., which was based on extensive clinical material, emphasized that at a dose of 150-300 mg pirazidol is not inferior in its antidepressive action to preparations such as amitriptyline, imipramine, anafranil, and others, meaning that it can be classified as one of the most active, "major" antidepressants. The authors believe that pirazidol's "balancing" effect is the product of a combination of powerful thymoanaleptic action and moderate sedative and stimulatory activity. This property explains the high effectiveness of its use not only in relation to typical forms of depression but also in the presence of various sorts of atypical depressive states. The authors observed the most favorable results in treatment of simple melancholy present as a factor of endogenous affective psychosis. Good results were also enjoyed against anxious and anxious-hypochondriacal depression, in relation to which medicinal therapy usually produces the least number of positive results. It was also indicated that the capability pirazidol has for effecting profound endogenous depression developing as a factor of manic-depressive psychosis or schizophrenia depends to a significant extent on dose. While prescription of 150 mg of the preparation is sufficient for the treatment of mild depression, with profound depression the dose should reach 400 mg (50-150 mg more than the amitriptyline or imipramine doses necessary for a similar effect).

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L. G. Ursova et al., confirming the broadness and expressiveness of pirazidol's psychotropic action (the combination of powerful thymoanaleptic action with sedative and stimulatory effects), point out that the sedative component of its action surpasses its activating influence. In this connection the effectiveness of therapy increases constantly and significantly in the following order--apathic, asthenic, classical, and anxious depression; it decreases abruptly in the treatment of depression coupled with delirium, hypochondria, and other productive disorders.

Ye. I. Barnshteyn et al. obtained somewhat different results; they referred to pirazidol as an antidepressant having a dominant stimulatory component of action, as is evidenced by cases, observed by the authors, of transition from depression to mania, disturbance of sleep when pirazidol is prescribed for the night and in the evening, and intensification of anxiety in the treatment of anxious-depressive states in some patients. The authors believe that in relation to the potency of specifically its thymoanaleptic action, pirazidol is nevertheless somewhat inferior to preparations such as amitriptyline and imipramine, which is confirmed by the fact that its effectiveness is greatest against mild depression. Describing the spectrum of pirazidol's psychotropic activity in similar fashion, B. P. Naneyshvili et al. also adhere to the opinion that in relation to the potency of its antidepressive properties, the preparation is inferior to amitriptyline and imipramine. This caused G. P. Panteleyeva et al. to classify the preparation as a "minor" antidepressant. The authors concurrently note the "softness" of pirazidol's antidepressive action (especially of its stimulatory component), in connection with which improvement of the condition of patients and growth in overall composure and working ability are not accompanied by intensification of agitation or aggravation of psychotic symptoms.

Studying the preparation in comparison with norpramin and inkazan, N. M. Mikhaylova et al. demonstrated that the antidepressive effect of pirazidol is inferior to that of norpramin and superior to that of inkazan. Their results allowed them to suggest that prescription of the preparation is most indicated for the treatment of adynamic depression, to include depression accompanied by internal anxiety and restlessness. A certain amount of caution must be observed in this case in connection with rapid onset of the effect and possible abrupt transition into a manic state. This research demonstrated the productivity of clinical analysis of the effectiveness of new antidepressants not only on the traditional plane (revealing the relationship between their sedative and activating influences) but also on the plane of comparisons made within groups of preparations having a similar spectrum of psychotropic action (in this case the "activator" antidepressants).

Ye. T. Danilenko et al. also note that the stimulatory action of pirazidol is significantly stronger than its sedative action, the former being manifested in parallel with its specifically thymoanaleptic action. This was reflected in the higher effectiveness of the drug in relation to simple and adynamic depression. Significantly, the authors note that in their opinion, reduction of the preparation's dose following attainment of a reaction against psychopathological symptoms does not influence the degree of improvement achieved, making continued treatment of patients in ambulatory conditions following



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release from the hospital unnecessary in a number of cases. V. V. Veselovskiy et al. point out that swift onset of improvement accompanying treatment of neurotic and reactive depression with pirazidol manifested itself primarily as an increase in communicativeness and improvement of contact between physician and patient, which significantly broadens the possibilities for psychotherapeutic influence.

The results of strictly controlled research on pirazidol in comparison with amitriptyline, ludiomil, and trazodone (G. M. Rudenko et al.) go a long way in explaining, in our opinion, some of the discrepancies indicated above in evaluation of the preparation's properties. Rudenko et al. demonstrated that by its thymoanaleptic action, which manifests itself faster than that of all other preparations, pirazidol is on the whole somewhat inferior to amitriptyline and is closer to ludiomil, that it surpasses all other preparations in terms of its stimulatory activity throughout the entire course of treatment, and that it is noticeably inferior to amitriptyline and less so to ludiomil in its sedative effect, on the whole being more similar to trazodone. Moreover analysis of the dependence of pirazidol's effectiveness on the depth and type of depression revealed that treatment effectiveness grows in the following order--severe, moderate, and mild depression, and anxious, classical, and anergic depression. However, it is noteworthy that while amitriptyline is ineffective against mild depression and depression at the anergic pole while trazodone is effective only against anxious mild depression, as with ludiomil, pirazidol has a significant effect against all types of depression irrespective of their severity, though its effectiveness does vary.

Most reports emphasized inconsequential side-effects for pirazidol, even with very large doses--up to 700 mg/day (L. G. Ursova et al.). Owing to this the preparation can be prescribed to elderly patients (G. I. Panteleyeva et al.) and to patients suffering accompanying somatic diseases, to include glaucoma (G. Ya. Avrutskiy et al., L. G. Ursova et al., and others). Absence of side-effects and the mildness of its psychotropic action also make its use in outpatient practice safe (Ye. I. Barnshteyn et al.). A relatively high frequency of side-effects, especially among elderly patients (headaches, dry mouth, dizziness, nausea, and so on), preventing continuation of treatment in some cases, was noted only in a report by B. R. Naneyshvili et al.. Comparative research (G. M. Rudenko et al.) revealed that in terms of the frequency and expressiveness of side-effects, pirazidol is closest to the least toxic of the preparations studied--trazodone. It is also pointed out that the preparation is tolerated well by patients when combined with other psychotropic drugs; in this case purposeful combination of this drug with neuroleptics, tranquilizers, and other antidepressants significantly broadens its therapeutic possibilities in a number of instances (L. G. Ursova et al., G. Ya. Avrutskiy et al., and others). The effectiveness of pirazidol, amitriptyline, and ludiomil does not differ significantly when these drugs are combined with neuroleptics to treat depressive-anxious states (G. M. Rudenko et al.).

Thus the reports showed that pirazidol has pronounced antidepressive properties, that it is effective against various depressive states, and that it is endured well by patients, eliciting only an insignificant number of side-effects.

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The results of research on an original tranquilizer of the benzodiazepin series--fenazepam--were discussed in the next three meetings of the symposium (23 reports). The pharmacological properties of the preparation were meticulously analyzed in a report by U. I. Vikhlyayev et al.. It was demonstrated that as with other benzodiazepins, this preparation exhibits tranquilizing, sedative, activating, soporific, anticonvulsive, and myorelaxant properties in experimental conditions. Its tranquilizing, soporific, and anticonvulsive effects are most important, with the tranquilizing one dominating. In relation to the features and expressiveness of its pharmacological activity fenazepam is similar to lorazepam, the most potent of the benzodiazepin tranquilizers used today; moreover fenazepam even surpasses it in relation to a number of characteristics of its tranquilizing action (conflict situations, antiaggressive action). When fenazepam is administered over a long period of time, pronounced tolerance to the sedative, anticonvulsive, and especially the myorelaxant action of the drug and absence of habituation to its tranquilizing effect are observed, which broadens the preparation's therapeutic spectrum of action as a tranquilizer. Other important characteristics of the preparation include its low toxicity, its distinct selectivity, and the specificity of its individual effects. When compared with other drugs (T. A. Voronina), it is noted that fenazepam is superior to known preparations of the benzodiazepin series in relation to its soporific effect, that it is similar to lorazepam and superior to other tranquilizers in relation to its tranquilizing and sedative effects, and that it is inferior to clonazepam and lorazepam but more effective than diazepam in relation to its anticonvulsive and myorelaxant action.

Clinical reports by individual institutions were preceded with a report by E. A. Babayan et al. providing a detailed analysis of the results of clinical tests run on the preparation by the Pharmacological Committee. These tests, which were performed in the country's leading psychiatric and neurological institutions, confirmed fenazepam's pronounced psychotropic properties and its high effectiveness against various neurotic (neurosis-like), affective, paroxysmal, algic, and other states. Its comparison with tranquilizers such as lorazepam, oxazepam, chlordiazepoxide, diazepam, meprobamate, trioxazine, niazepam, and others established that in relation to soporific, anti-obsessive, sedative, and myorelaxant action and its capability for having a positive influence on senestohypochondriacal disorders, fenazepam surpasses all preparations with which it has been compared, that in relation to its anxiety-relieving activity it is equivalent to lorazepam and superior to other drugs, and that it is inferior only to grandaksin in its vegetotropic effect and to tacitin in its antidepressive effect. An analysis of the results of using the preparation on 1,782 patients made it possible to distinguish the group of states in relation to which fenazepam was effective to one degree or another. The most favorable results were observed with patients suffering diverse agrypnotic disorders and simple neurotic states, to include those coupled with asthenic and obsessive-phobic states, with abstention and dysphoria syndromes, and with masked depression. In these cases the number of patients exhibiting pronounced improvement is not less than 75-80 percent, while in relation to agrypnotic disorders improvement comes close to 100 percent. The results were somewhat worse for complex neurotic (neurosis-like) states, mild anxious depression, and especially polymorphic

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neurosis-like and psychopathy-like states, though distinct improvement was observed in not less than 55-65 percent of the patients.

G. Ya. Avrutskiy et al. pointed out that the therapeutic effect of fenazepam was expressed in its most general form as rapid reduction (within 1-2 days) of the intensity of the emotional aspect of neurotic experiences, disappearance of anxiety, fear, trouble in falling asleep, and other nightly sleep disturbances, and reduction of autonomic (predominantly paroxysmal) disorders, senesthohypochondriacal disorders, and obsessiveness, which was most evident when the preparation was prescribed to patients suffering neurotic states. It was noted that fenazepam surpasses other tranquilizers in its positive therapeutic action against obsessiveness and senesthohypochondriacal disturbances. Moreover the action of fenazepam affected not only phobic disturbances and graphical, sensually colored obsessive experiences, but also obsessive thoughts and actions (including those of schizophrenics) having a torpid, "emotionally cold" nature, which are the most resistant to psychotropic preparations.

Questions of greater generality--concerning the role of anxiety symptoms in the development and stability of a number of borderline psychopathological states--were touched upon in F. B. Berezin's research conducted with the use of the methods of multifactor personality analysis and Kettler's 16-factor test. It was demonstrated that as with other benzodiazepins, the therapeutic effect of fenazepam is based on its influence on the intensity of anxiety, irrespective of whether the anxious disturbances predetermine the clinical pattern of the patient's state directly or they are the basis of other psychopathological phenomena. It is precisely the tranquilizing effect of fenazepam, which is more potent than that of other benzodiazepins, that permits it to either correct the state as a whole, if it is basically a state of anxiety, or, by improving the patient's state, to promote an increase in the effectiveness of other psychotropic drugs (antidepressants for example). Similar results were presented in a report by G. M. Rudenko et al. devoted to comparative clinical analysis of a group of benzodiazepin derivatives. It was demonstrated that if a number of strict methodological conditions are satisfied, comparative analysis of tranquilizers makes it possible to reveal some general laws governing their clinical action upon borderline psychopathological disorders--mainly the dependence of the effectiveness of the preparations on their principal, anxiety-relieving effect. Discovery of this law made it possible to arrange the preparations in order of growing potency of anxiety-relieving action and, consequently, effectiveness in the treatment of any homogenous group of patients suffering borderline states (oxazepam, diazepam, klorazepat, lorazepam, bromazepam, fenazepam).

The fact that fenazepam had the greatest tranquilizing action in comparison with all other tranquilizers employed today allowed Yu. L. Nuller et al. to use it to treat a number of psychotic states (anxious-depressive, melancholic, paranoid, depressive-depersonalizational, and others) coupled with phenomena of pronounced anxiety and tension in the syndrome structure of schizophrenia, manic-depressive and involuntional psychoses, and other nosological units. Positive results were obtained in 67 percent of the observations, in which case 42 percent of the patients exhibited complete

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disappearance of psychopathological symptoms while another 25 percent exhibited significant improvement. The more acute the psychotropic attack and the closer to its beginning that fenazepam treatment is started, the higher is the drug's effectiveness against acute psychotropic attacks. V. S. Chudnovskiy et al. also used fenazepam against psychotic states accompanying schizophrenia, manic-depressive psychosis, and other diseases. The authors observed a positive therapeutic effect in a number of cases, not only against subacute states (obsessive-phobic and senestohypochondriacal states coupled with rudimentary delirious disorders and individual mental automatisms), but also against protracted catatonic and pseudohallucinatory syndromes. The report pointed out that fenazepam was sometimes effective following unsuccessful treatment of these patients by neuroleptic drugs.

A number of reports examined the clinical action of fenazepam against various borderline states in different nosological categories. Thus V. F. Matveyev et al., who successfully used the preparation to treat patients with neurotic (neurosis-like) and unexpressed affective states accompanying neuroses, psychopathies, pathological personality development, organic diseases of the central nervous system, and so on, point out that the greater the share of anxiety, emotional tension, and sleep disturbance in the clinical pattern of the patient's state, the higher is the drug's therapeutic effect. M. Kh. Gonopol'skiy et al. showed that fenazepam has especially selective action against neurotic obsessions, in which case absence of a positive effect against an obsession may even serve as a unique diagnostic test indicating presence of a schizophrenic process. V. I. Oleynikov et al. noted that by eliminating or reducing manifestations of neurotic symptoms, the preparation makes it easier to subject patients with atherosclerosis and with neurosis-like disorders to psychotherapeutic measures and social rehabilitation. E. B. Dubnitskaya et al. found that in the treatment of patients with neurotic hypochondriacal disorders accompanying mildly progressive schizophrenia, fenazepam was most active against manifestations of the hysterical hypochondria syndrome, while the preparation's effect against the senesthoalgic syndrome was significantly lower.

All reports indicated the high effectiveness of the preparation in comparison with diazepam (seduxen), which was demonstrated especially clearly in a special comparative investigation by Ye. T. Danilenko et al., who showed that in clinical conditions fenazepam exhibits more-pronounced anxiety-relieving, hypnosedative, and myorelaxant properties than seduxen. The unique features of fenazepam's action against asthenic disorders accompanying various neurotic states were compared with those of other tranquilizers in a report by N. G. Shatrova.

Another group of reports illuminated the results of using fenazepam against patients who have various neurological illnesses, and against epilepsy. A. S. Kadykov showed that the preparation favorably affects neurosis-like and agrypnotic disorders in patients suffering cerebrovascular diseases (hypertension, atherosclerosis, rheumatism) accompanied by disturbances in cerebral circulation. Noting that fenazepam is sufficiently effective when combined with basic antiepileptic drugs in relation to epileptics suffering generalized convulsive seizures, V. A. Karlov et al. also point out that

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it significantly promotes reduction of the pain syndrome accompanying neuralgia of the trigeminal nerve. Ye. I. Polyakova et al. also used the preparation successfully in the treatment of patients with focal epilepsy who exhibited, in addition to disappearance or reduction of the frequency of attacks, improvement of general mental state. P. M. Saradzhishvili et al. provided the most complete data concerning the sphere of application of fenazepam in neurological practice and in the treatment of epileptics; they demonstrated that the preparation's pronounced anticonvulsive, sedative, analgesic, and myorelaxant activity permits its use in the treatment of various convulsive states in epileptics, various autonomic crises, hyperkinesia, pain syndromes, psychopathological disorders resulting from organic injury to the central nervous system, and so on.

Reports given by N. N. Bazhanov et al. and N. A. Trekova et al. noted that in addition to other tranquilizers, fenazepam may be used in integrated premedication both in the hospital (patients with cardiovascular diseases) and in outpatient conditions (stomatological patients).

Some of the reports touched upon the place of fenazepam in the treatment of chronic alcoholics. Basing themselves on extensive clinical material, N. N. Ivanets et al. showed that fenazepam is an effective drug in relation to patients suffering chronic alcoholism, and against various disorders observed both within the structure of abstinence and outside it. The preparation was especially successful in the treatment of psychopathological disturbances threatening "failure" of remission and recurrence of disease--tension, anxiety, psychogenic depression, sleep disturbance, and so on, which trigger the pathological drive for alcohol. T. N. Dudko found that the preparation significantly alleviates disturbances accompanying abstinence--anxiety, tension, emotional instability, insomnia, and autonomic dysfunction. It was possible to suppress a pathological desire for alcohol whenever it was obsessive in nature; the results were worse, however, when the desire for alcohol exhibited traits of similarity with exaggerated ideas. Attempts at using fenazepam to curtail alcoholic delirium (M. Kh. Gonopol'skiy et al.), though they did reveal the possibility of attaining positive results, demonstrated that the preparation does not have advantages over other psychotropic drugs in this area.

As far as the frequency and expressiveness of side-effects accompanying the use of fenazepam are concerned, most speakers stated that the probability of their arising depends to a greater degree on the preparation's dose. Side-effects pointed out most frequently included greater sleepiness, sluggishness, muscle weakness, and ataxia, which arose as a rule at doses of 3-5 mg and higher. When the dose was increased to 5-10 mg and above, (prosonochnyye) states and delirium-like syndromes were observed. When the therapeutic effect was distinct, slow growth in dosage and prescription of only 1.5-3 mg of the preparation per day helped the overwhelming majority of patients to avoid side-effects. Of course many speakers did note that undesirable action often appeared at lower doses as well, especially in relation to neurological patients and elderly patients (Ye. T. Danilenko et al., and N. M. Saradzhishvili et al., G. Ya. Avrutskiy et al., and others), making it necessary to select

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the optimum doses for these patients cautiously (A. S. Kadykov, V. P. Oleynikov et al., and others).

Thus the reports demonstrated with great persuasiveness that the original domestic tranquilizer fenazepam has a potent psychotropic action, that it is effective in the treatment of various psychopathological and neurological states, epilepsy, and alcoholism, that it can be used in premedication, and so on. It is superior to most tranquilizers in the benzodiazepin group used today in relation to its psychotropic properties.

The symposium reflected the dramatic growth experienced in recent years in the level of experimental and clinical studies on new psychotropic medicinal agents, making it possible to evaluate them adequately from many aspects, and to recommend the best of them for extensive medical use.

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PHARMACEUTICALS

MEDICAL SUPPORT PLANTS ANNOUNCE 1979 SOCIALIST PLEDGES

Moscow KHIMIKO-FARMATSEVTICHESKIY ZHURNAL in Russian No 4, 1979 pp 3-5

[Text] Socialist Pledges of the Collective of the Akrikhin Order of the Red Labor Banner Pharmacochemical Plant for 1979

Avidly approving the decisions of the November (1978) CC CPSU plenum and session of the USSR Supreme Soviet and implementing the historic decisions of the 25th CPSU Congress, the collective of the Akrikhin Order of the Red Labor Banner Pharmacochemical Plant completed the plan for the first three years of the five-year plan ahead of schedule in relation to all technical-economic indices.

The collective has adopted the following socialist pledges for 1979:

To complete the production volume plan for four years of the five-year plan by the 62d anniversary of Great October;

to complete the 1979 assignment by 28 December 1979, thus raising production growth rate by 9.6 percent over the previous year's rate, and to raise labor productivity to the level planned for the end of the five-year plan;

to increase production of the following items by introducing new production processes and by improving and reconstructing existing production operations, in comparison with 1978: Metacycline hydrochloride--by 21 percent, nitroxo-line--by 41 percent, parmidin tablets--by 60 percent;

to introduce 470 efficiency proposals into production, to implement 31 measures mechanizing laborious processes, and to achieve a savings at an annual rate of two million rubles;

to organize work on personal creative plans, encouraging not less than 400 engineers and technicians to write such plans;

to economize the following amounts by introducing personal effectiveness accounts in the shops: Raw materials and other materials--360,000 rubles, electric power 1.1 million kw·hr, thermal energy--8,000 Gkal, comparison fuel--1,000 tons;

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to promote continued cooperation with scientific organizations with the purpose of improving and assimilating new production operations;

with the objective of improving environmental protection: Improve the nitrogen oxide absorption system in the nitrobenzamide production operation; reduce dichlorethylene expenditure in azidin production; preclude the use of methanol in salazopyridazine drying;

to complete construction of an equipment warehouse, to complete construction of water treatment facilities at the Pioneer Camp, and to complete construction of an oxygen pipeline;

to finish construction of an eighty-apartment house and expand the plant dining hall for a special diet service;

to raise the general education level of 1,412 persons;

to continue making improvements on the plant and town, which will mean asphalt road paving operations worth 20,000 rubles, and planting 30,000 flowers, 500 trees, and 1,000 shrubs;

to sign a contract and assume patronage over Noginskiy Sovkhoz;

to prolong the socialist competition with the Leningrad Farmakon Camp Association, the Belgorod Vitamin Combine imeni 50-letiya SSSR, and the Shchelkovo Vitamin Plant. The socialist pledges were adopted by active members of the plant's party administration.

Socialist Pledges of the Collective of the Moscow Order of the Red Labor Banner Mosmedpreparaty Production Association imeni L. Ya. Karpov for 1979

Implementing the historic decisions of the 25th CPSU Congress, the collective of the Mosmedpreparty Association completed the plan for the first three years of the five-year plan ahead of schedule in relation to all technical-economic indices.

The collective has adopted the following socialist pledges for the current year:

To finish the production volume plan for four years of the five-year plan by USSR Constitution Day; to sell products worth 5,000 rubles in excess of the 1979 assignment;

to surpass the labor productivity growth plan by 10.6 percent; to complete the five-year assignment for growth in labor productivity in four years;

to produce 150 kg semisynthetic antibiotics, 200 billion units of antibiotics, and one million flasks of injection preparations in excess of the plan;

to introduce 500 efficiency proposals into production and to achieve a savings at an annual rate of 480,000 rubles;



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to reduce the cost of commercial products by 90,000 rubles, including by economization of 60,000 rubles worth of raw materials and other materials;

to save 2.11 million kw·hr electric power, 1,350 tons of comparison fuel, and 9,000 Gkal thermal power;

to obtain 100,000 rubles profit in excess of the plan;

to introduce new equipment automating and mechanizing production, and to achieve an economic impact totaling 130,000 rubles;

to assimilate production of two new medicinal preparations ahead of schedule;

to organize a new bottle rolling section in Shop No 10 three months ahead of schedule;

to assimilate a third mechanized hard gelatin capsule production line ahead of schedule, by 1 July;

to work 42,000 hours without compensation to make improvements on the association and microregion, and to work 40,000 hours without compensation to build an Olympic complex;

104 persons will improve their general education in secondary and higher special training institutions, 59 will attend youth work schools, and a total of 1,440 laborers, engineers, and technicians will undergo training;

to provide all-out assistance to the sovkhos sponsored by the association. The socialist pledges were adopted at an expanded session of the trade union committee with the participation of the best producers and representatives of the administration and party organization.

Socialist Pledges of the Collective of the Klin Order of the Badge of Honor Glass Plant for 1979

Striving to make an honorable contribution to successful implementation of the decisions of the 25th CPSU Congress and decisions of the November (1978) CC CPSU Plenum, the collective of the Klin Order of the Badge of Honor Glass Plant has initiated a socialist competition to raise production effectiveness and work quality under the slogan "A Worker's Guarantee for the Five-Year Plan of Quality." In order to complete the 1979 plan ahead of schedule, the collective has adopted the following socialist pledges:

To complete the annual product sales and production plans by 27 December 1979;

to sell commercial products worth a total of 2,000 rubles in accordance with a counterplan;

to produce articles exceeding the planned requirements by the following amounts, in natural terms:

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**20 JULY 1979**

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**2 OF 2**

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Bottles for antibiotics--8 million; syringe cylinders--2,000; tablet packaging tubes--one million; (shtinglaznaya) ware--20 outfits; commercial glass tubing--20 tons out of NS-3 glass, 20 tons out of Kh-T glass, and 50 tons out of AB-1 glass; Rekord syringe cylinders--500,000;

to raise labor productivity 0.8 percent above the planned figure;

to increase the output of products bearing the State Seal of Quality to 38 percent of the total production volume, or to 68 percent of the volume of products subject to certification;

to obtain an excess profit of 60,000 rubles;

to set up personal effectiveness accounts for 1,038 persons, thus insuring an economic impact totaling 125,000 rubles;

to upgrade the qualifications of 1,060 laborers and 120 engineers, technicians, and office workers;

to economize:

comparison fuel--1,150 tons, electric power--750,000 kw·hr, raw materials and other materials--25,000 rubles worth, thermal power--1,200 Gkal, ferrous metals--16.5 tons;

to attain an annual economic impact by introducing: new equipment--77,000 rubles; efficiency proposals and inventions--187,000 rubles; scientific organization of labor--48,000 rubles;

to support commissioning of the Belozherka Dispensary with a capacity of 100 persons;

to achieve full mechanization of one shop;

to introduce:

progressive highly productive equipment--3 units; progressive production processes--1 unit;

to achieve up to 50 percent labor mechanization in the plant as a whole;

to provide assistance in agricultural work to the sovkhos sponsored by the plant;

to challenge the Solnechnogorsk Glass Plant, the main enterprise of the Tsentrmedsteklo Production Association, to a socialist competition.

The socialist pledges were adopted at an expanded session of the plant trade union committee in the presence of the plant and shop administrations and the plant's active party members.

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91

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SCHIZOPHRENIA PROGNOSIS BASED ON CLINICAL AND GENETIC RESEARCH DATA

Kiev TSITOLOGIYA I GENETIKA in Russian No 2, 1979 pp 137-140

[Article by A. N. Kornetov, Ye. D. Mayburd, and V. P. Samokhvalov, Crimean Medical Institute, Simferopol']

[Text] Research on the clinical pattern of schizophrenia, conducted over a period of many years by this country's scientists, embraces a number of clinical and genetic problems, and the results now permit us to substantiate the prognosis of this disease (1-3). This research has made it possible to conclude that a prognosis of the unique features of the disease's clinical pattern must be based on an integrated analysis of the role of the entire diversity of factors modifying the clinical pattern of the disease. Such factors have been studied within the context of multifactor analysis of schizophrenia (4). Investigation of the modifying role of sex and age (5) and of exogenous factors (6) on certain characteristics of schizophrenia once again confirmed that the schizophrenia prognosis must be individualized to the maximum extent possible. The proof of hereditary aggravation has an extremely important role in the prognosis (7,8).

In our present communication we limit ourselves to describing a group of schizophrenics in which aggravation is deemed to be a factor among less than half of the patients, and pairs of genetically aggravated patients--siblings and "parents-children."

#### Material and Methods

The first group consisted of 785 schizophrenics. The objective was to clarify the time of development of the clinical defects depending on sex.

The second group of siblings consisted of 109 schizophrenics in 50 families (with 57 persons or 52.3 percent being sisters and 52 persons or 47.7 percent being brothers). In 10 of the families the parents had schizophrenia, while in the rest of the families the parents provided indirect indications of psychopathic, usually schizoid characteristics taking the

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form of eccentricity, introversion, and coldness. Among siblings, younger brothers and sisters fall ill at a younger age than do older ones (66.6 percent). Onset of disease was concurrent for two brothers and two sisters in four families.

The third group of patients consisted of 118 parent-child pairs suffering schizophrenia. These included 40 fathers, 78 mothers, 50 sons, and 68 daughters. The objective was to use special statistical methods to arrive at a group prognosis and an individual prognosis for the younger generation. The clinical pattern of disease was documented for each of the patients as recommended by domestic authors (9) using the following groups of characteristics: Age at the onset of disease, additional hereditary aggravation by psychoses, exogenous factors, the form and type of schizophrenia, the degree of social adaptation, the quality and duration of the first remission, specific features of therapy, premorbid personality characteristics, the duration of the initial period, the dominant syndrome in the initial period, alteration of syndromes, to include the manifestation syndrome, the time of formation of disease symptoms, and the specific features of the disease symptoms. The total number of characteristics in the group was 89. Statistical comparison was performed in two stages: Comparison of the weight of each characteristic in mother-daughter, mother-son, father-daughter, and father-son pairs with the help of a coefficient of pair correlation for dichotomous two-dimensional data; development, on the basis of set theory, of a classifying algorithm, which was used to obtain numerical probabilities to be used in prediction of the signs of disease in the child when certain signs are known to be present in the parents. The statistics were processed with a Yes-1020 computer.

## Research Results and Discussion

The following was established: The average age at which the defect took shape in the first group was  $35.9 \pm 5.1$  years for men and  $39.5 \pm 4.4$  years for women. Moreover we revealed significant dominance of asthenic and hypersthenic forms of disease in women, and of apathic-abulic forms in men. These data indicate that age and sex have a modifying influence on the types and times of development of disease characteristics, which has important prognostic significance.

Comparison of the clinical disease pattern of siblings in the second group revealed the following. The clinical patterns of schizophrenia were discovered to be the same for most part among siblings of the same sex. The rate of development of schizophrenia was greater for brothers than for sisters. Examining siblings, we discovered that presence of disease among three descendants is not as rare as suggested by Virsh (10). We revealed seven families in which three siblings had schizophrenia, and one family with four schizophrenic siblings. These data indicate that clinical and genetic mutual relationships are significant to schizophrenia prognosis.

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On comparing the weight of each of 89 schizophrenia signs (in the third group) for the younger generation we revealed that on the whole there are no significant differences between parents and children. The following facts are an exception. The average age of disease onset is 37.1±3.5 years for parents and 22.7±2.2 years for children,  $P < 0.001$ . Differences were noted in the pairs in relation to the signs of manifest symptoms, which reveal themselves in comparisons of mother-daughter and mother-son groups. Manifest hallucinatory-paranoid and hebephrenic symptoms dominated among daughters, while paranoid symptoms dominated among fathers. Differences in the weight of the signs of manifest symptoms depending on sex are insignificant within the parent group (mothers-fathers) and the child group (sons-daughters), which was confirmed by means of the Dixon-Mood elementary test at  $n = 11$ , the limiting values at the 5-percent level being 2 and 9 (7 and 4 in Table 1).

Table 1. Pair Correlation of the "Weight" of Syndromes in the Manifest Period, in Related Groups

(1) Сопоставляе- мые группы	(4) Синдромы										
	Аффек- тивный (5)	Пара- ноид- ная (6)	Гебеф- ренный (7)	Галлю- цина- торно- парано- идная (8)	Пара- ноидаль- ная (9)	Пара- френи- чная (10)	Оней- родный (11)	Нега- тивные синдро- мы (12)	Невро- зопод- обный (13)	Психо- пато- подоб- ный (14)	Катато- нический (15)
(2) Матери— отцы	0,018	0,125	0,081	0,086	0,084	0	0,058	0,099	0,100	0,003	0,041
(3) Дочери— сыновья	0,235	0,064	0,170	0,136	0,015	0,040	0,016	0,115	0,119	0,053	0,023

Key:

- |                           |                            |
|---------------------------|----------------------------|
| 1. Groups compared        | 9. Paranoid                |
| 2. Mothers-fathers        | 10. Paraphrenic            |
| 3. Daughters-sons         | 11. Oneiric                |
| 4. Syndromes              | 12. Negative syndromes     |
| 5. Affective              | 13. Resembling neurosis    |
| 6. Paranoid               | 14. Resembling psychopathy |
| 7. Hebephrenic            | 15. Catatonic              |
| 8. Hallucinatory-paranoid |                            |

We also noted cases of preponderance of the signs of lengthy remissions (more than 2 years) in fathers and short remissions (less than 1 year) in children. No significant differences were noted in the related groups in relation to the remaining 83 signs of disease. Thus we can hypothesize that the group prognosis should be based on constancy of schizophrenia in the younger generation, and that the sex and anteposition factors do not change the group prognosis, though their modifying influence is nevertheless manifested in the nuances of the clinical pattern. Study of transformations in the signs of disease by means of the classifying algorithm demonstrated

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Table 2. Prognosis of the Types of Schizophrenic Course in Children When Type of Course in Parents is Known

(1) Типы тече- ния у детей	Типы течения у родителей (2)		
	1	2	3
1	0,21	0,21	0,11
2	0,58*	0,28	0,34
3	0,21	0,51*	0,55**

Note: Sign number: 1--Recurrent course, 2--seizure-like, progressive, 3--continuously progressive. A probability exceeding equiprobable prediction ( $P = 0.33$ ) was noted at significance level  $t > 1$  (\*) and  $t > 2$  (\*\*).

Key:

- 1. Types of course in children
- 2. Types of course in parents

Table 3. Prognosis of Forms of Schizophrenia in Children When the Forms are Known in Parents

(1) Формы у детей	Формы шизофрении у родителей (2)		
	1	2	3
1	0,78**	0,35	0,38
2	0,18	0,40*	0,10
3	0,04	0,15	0,42*
4		0,10	0,10

Note: Sign number: 1--Paranoid form, 2--simple, 3--catatonic, 4--hebephrenic. A probability exceeding equiprobable prediction ( $P = 0.25$ ) was noted at a significance level of  $t > 1$  (\*) and  $t > 2$  (\*\*).

Key:

- 1. Forms in Children
- 2. Forms of schizophrenia in parents

that it is possible to isolate signs that can be predicted in the younger generation with a high probability, and signs for which the prediction probability is equally low. Stable signs were revealed in parent-child pairs--schizoid personality characteristics in the premorbid period, the

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psychopathy-like syndrome in the initial period, a duration of up to 1 year for the initial period, the paranoid form of schizophrenia, a continuously progressive course, and apathic-abulic disease symptoms. Comparison of the dominant characteristics of the process in the younger generation--types of courses and forms of schizophrenia--demonstrated the following. The most stable sign is a continuously progressive course; the remaining types undergo transformation within the limits of evolutionarily similar variants (Table 2). Among forms of schizophrenia, the most stable is paranoid; in this case dominance of the paranoid form in the younger generation is the result of transformation of the simple and catatonic forms (Table 3). Out of the pairs we examined, we isolated 37 pairs that were concordant in relation to the form and type of course of schizophrenia, 39 pairs concordant in relation to the form of schizophrenia and discordant in relation to the type of course, 14 pairs concordant in relation to course and discordant in relation to form, and 28 pairs discordant in relation to form and type of course. We found that 22 out of 28 pairs discordant in relation to both characteristics readily exhibit the effects of exogenous factors and additional aggravation inherited from a clinically healthy parent; the number of these factors was significantly lower ( $P < 0.05$ ) in other groups of partially discordant and completely concordant pairs.

## Conclusions

It was demonstrated that the schizophrenia prognosis must account for the entire complex of factors modifying the clinical pattern; clinical and genetic research has important significance in this regard. When distinct hereditary aggravation is revealed, we can be certain of a definitely stabilized process. The sex, age, and disease onset time factors cause variations in this stability within certain limits.

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

FIRST ALL-UNION CONFERENCE ON TERATOLOGY, 'THE GENETICS OF DEVELOPMENTAL ABNORMALITIES'

Kiev TSITOLOGIYA I GENETIKA in Russian No 2, 1979 pp 151-152

[Article by I. R. Barilyak, V. F. Levanyuk, and V. V. Anfrashko]

[Text] The First All-Union Conference "Genetics of Developmental Abnormalities" was held from 10 to 13 October 1978 in the city of Mukachevo, Zakarpatskaya Oblast on the initiative of the Ukrainian SSR Society of Geneticists and Breeders, the Ukrainian SSR Academy of Sciences Scientific Council for the Problem "Cytology and Genetics," the USSR Academy of Sciences Leningrad Scientific Research Institute of Experimental Medicine, and the Mukachevo branch of the Ukrainian SSR Ministry of Public Health L'vov Scientific Research Institute of Pediatrics, Obstetrics, and Gynecology.

The conference was devoted to four basic pressing problems: Epidemiology of developmental abnormalities; principles and methods of testing teratogenic activity of environmental factors; the mechanisms of injury to the intrauterine fetus; the genetics of developmental abnormalities and medical-genetic consultation.

The conference participants showed great interest in the program reports "Experimental Teratology and the Needs of Medical Theory and Practice" by Prof A. P. Dyban (USSR Academy of Medical Sciences Scientific Research Institute of Experimental Medicine, Leningrad), "Pressing Problems in Medical Teratology" by Prof G. I. Lazyuk (Minsk Medical Institute), and "Cellular Mechanisms of Induced Teratogenesis" by Candidate of Medical Sciences I. R. Barilyak (Kiev Scientific Research Institute of Pediatrics, Obstetrics and Gynecology).

In his report on the "Epidemiology of Developmental Abnormalities" problem Prof A. K. Pokotilenko (Kiev Scientific Research Institute of Otolaryngology) demonstrated the irregular nature of the incidence of congenital pathology in the Ukrainian SSR, indicated the basic reasons for this phenomenon, and noted the ways for raising the level of scientific research in this area of medical science. Congenital developmental abnormalities occupy an

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important place in the pathology of the intrauterine fetus; this is why investigation of the causes of their arisal and introduction of modern diagnostic methods is an urgent task of modern public health (Prof L. V. Timoshenko et al., Kiev Institute for the Advanced Training of Physicians; I. V. Lopushan and M. M. Derzhko, L'vovskaya Oblast Public Health Division; I. V. Vakhlamova, Moscow Institute of Obstetrics and Gynecology).

Ye. D. Cherstvoy (Minsk Medical Institute) illuminated the nature of hereditary diseases in man caused by mutations in genes, chromosomes, and genomes. An original classification of multiple congenital developmental defects not related to chromosomal syndromes elicited special attention and interest.

Early diagnosis has special significance to prevention of congenital developmental abnormalities. Prof I. S Rozovskiy and his coauthors (Moscow Institute of Obstetrics and Gynecology) shared their results on prenatal diagnosis of this pathology.

During the discussion on this problem, mention was made of the importance of considering the possible mutagenic and teratogenic action of a number of environmental factors, including *Staphylococcus* (Ye. Ya Grechanina et al., Khar'kov Medical Institute), cytomegalic inclusion disease (V. M. Kuruts et al., Mukachevo branch of the L'vov Scientific Research Institute of Pediatrics, Obstetrics, and Gynecology), influenza (N. T. Kucherova et al., T. F. Byshovets, Kiev Scientific Research Institute of Pediatrics, Obstetrics, and Gynecology), some pesticides and hormonal preparations (V. V. Andrashko, M. A. Kampo, Mukachevo branch of the L'vov Scientific Research Institute of Pediatrics, Obstetrics, and Gynecology), and some industrial factors (I. A. Vasil'yeva, Ya. P. Sol'skiy, Kiev Scientific Research Institute of Pediatrics, Obstetrics, and Gynecology). Alcohol, which, as S. Yu. Kozachuk et al. showed, has pronounced lethal action on the embryo, which affects postnatal development of laboratory animals, and which causes damage to the chromosomal apparatus of somatic cells in offspring, has important significance among these agents.

Problems of the biosphere are attracting universal attention. Our country was the first to undertake an effort to stabilize and improve the habitat and prevent the harmful consequences of environmental factors on future generations of people. In this connection the search for optimum and adequate methods for testing the teratogenic activity of the environment is an important task facing specialists of different profiles; this pertains especially to numerous chemical compounds (Prof I. V. Sanotskiy, Moscow Institute of Labor Protection and Occupational Diseases; Doctor of Biological Sciences V. F. Puchkov, Leningrad Institute of Experimental Medicine; D. G. Krasil'shchikov et al., Vil'nyus Institute of Microbiology, Hygiene, and Epidemiology). The testing of chemicals for teratogenicity is regulated by the "Methodological Directives on Testing the Teratogenic and Embryotoxic Activity of New Medicinal Preparations" (USSR Ministry of Public Health, 1972) and the "Methods of Experimental Analysis to Establish the Thresholds

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of the Action of Industrial Poisons on the Generative Function With the Goal of Hygienic Standardization" (USSR Ministry of Public Health, 1977).

We can no longer limit ourselves to evaluating the influence of some particular factor on the intrauterine fetus; we must study the way the action of the particular agent affects the state of the chromosomal apparatus in germ cells and in sex cells (V. S. Baranov, N. A. Chebotar', Leningrad Scientific Research Institute of Experimental Medicine), on immunological reactivity, on the functional state of the central nervous system, on metabolic characteristics (I. R. Barilyak et al., Kiev Scientific Research Institute of Pediatrics, Obstetrics, and Gynecology), on the state of hemopoiesis in embryos (L. P. Kalinovskaya, Kiev Scientific Research Institute of Otolaryngology), on behavioral reactions (A. M. Kotin, Leningrad Scientific Research Institute of Experimental Medicine), and others; moreover, extrapolation of experimental data to man requires comparison of data from experiments performed *in vitro* and *in vivo* (A. P. Kiryushchenkov, A. M. Skosyreva, Moscow Scientific Research Institute of Obstetrics and Gynecology).

The report "Programmed Cell Death and Its Role in Normal and Pathological Development of Animals and Man," given Prof G. D. Berdyshev (Kiev State University) in the section "Mechanisms of Injury to the Intrauterine Fetus," elicited lively debate. A report by A. M. Zabar et al. (Kiev Scientific Research Institute of Pediatrics, Obstetrics, and Gynecology) presented data on the significance, to the mechanisms of cell death, of disturbances in the lysosome segregation apparatus of embryonic cells in response to chemical teratogens. In the opinion of the authors it is possible to study permeability of the lysosomal membrane in a screening test as a means for evaluating the teratogenic action of chemical agents.

V. A. Aleksandrov (Leningrad Scientific Research Institute of Oncology) presented the results of research on metabolism of nitroso-compounds and on their teratogenic and carcinogenic effects, and he pointed out the need for a cautious, differentiated approach to research on these phenomena.

Prof Ye. S. Detyuk (L'vov Medical Institute) demonstrated the significance of the mother's thyroid to the resistance of offspring to injurious effects, and A. N. Shnyrev (Oblast Children's Hospital, Donetsk) cited persuasive data on the mechanism of ureterohydronephrosis.

The meeting on the problem "Genetic Developmental Abnormalities and Medical Genetic Consultation" was opened with a report by I. V. Lur'ye (Minsk Medical Institute), who discussed the organizational principles and work results of medical-genetic consultation in Minsk. Information on the experience of medical-genetic consultation was reported by Ye. A. Benikova et al. (Kiev Scientific Research Institute of Endocrinology), Ye. A. Trepakov (Moscow Scientific Research Institute of Obstetrics and Gynecology), and N. G. Bogdashkin et al. (Khar'kov Medical Institute). A number of reports were devoted to various genetic factors in the development of pathology in

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pregnant women, and in arisal of developmental defects in offspring (V. F. Levanyuk, Mukachevo Branch of the L'vov Scientific Research Institute of Pediatrics, Obstetrics, and Gynecology; A. G. Kolomytseva, S. P. Pisareva, Kiev Scientific Research Institute of Pediatrics, Obstetrics, and Gynecology; Ye. A. Kirillova et al., Moscow Scientific Research Institute of Obstetrics and Gynecology; L. A. Chirkova, Kiev Scientific Research Institute of Pediatrics, Obstetrics, and Gynecology).

The conference proceedings were concluded by meetings of three working groups, which determined the basic directions in work on the theoretical and practical problems of teratology, particularly the genetics of developmental abnormalities. The conference deemed the following to be the most significant in this aspect: Further improvement of the country's medical-genetics service network, creation of interoblast medical-genetic offices (centers), expansion of scientific research on medical teratology, and unification of the epidemiological, pathoanatomical, and clinical approaches to evaluating congenital developmental deformities. The conference recommended creating a problem coordinating group with the goal of achieving further coordination on the principles and methods of evaluating the action of harmful environmental factors on offspring and the fetus; it also recommended encouraging specialists of different profiles (geneticists, embryologists, toxicologists, hygienists, obstetrician-gynecologists, and others) to work on the problems of protecting future generations from the harmful action of chemical factors. Attention must be turned to a multifaceted approach that would include concurrent use of functional, morphological, and other research methods. In order that the selectivity of the harmful action of particular factors could be determined, integral reactions of the body and specific reactions in the "mother-fetus" system must be compared and the thresholds of the toxic action of environmental factors on development of fetus and offspring must be found. It would be expedient to determine the influence changes in the male body, resulting possibly from the effect of chemical agents, could have on development of offspring. The search for adequate quick methods for evaluating the effects of environmental factors on the fetus must be continued, and the principles and methods of extrapolating data from animal experiments to medical practice must be developed.

Further development of medical teratology would be possible following introduction of the methods of medical genetics into public health practice and improvement of these methods; this in turn will promote better quality and higher effectiveness of medical assistance to the public.

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101

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

ALL-UNION CONFERENCE ON COMMERCIAL INVERTEBRATES IN ODESSA

Vladivostok BIOLOGIYA MORYA in Russian No 1, 1979 pp 87-89

[Article by Yu. P. Zaytsev and K. N. Nesis]

[Text] The All-Union Scientific Conference on the Use of Commercial Invertebrates for Dietary, Feed, and Industrial Purposes was organized by the Ichthyological Commission, the All-Union Hydrobiological Society, and the Odessa branch of the Ukrainian SSR Academy of Sciences Institute of Biology of the South Seas, and it was held in Odessa on 22-25 November 1977. In contrast to the previous conference, which was held January 1974 in Kaliningrad,\* the Odessa conference was devoted not only to marine and oceanic but also to freshwater commercial invertebrates. This made it broader and more representative. The conference participants included 106 specialists from 26 scientific institutions of 16 cities--Moscow, Leningrad, Odessa, Kiev, Murmansk, Vladivostok, Kaliningrad, Kerch', Vil'nyus, and others. Fifty-six reports were given and discussed, and about 90 reports were presented to the conference in all, which was over two times more than in the preceding conference.

In his introductory report conference organizing committee chairman B. G. Ivanov reviewed the principal achievements in research on marine and freshwater commercial invertebrates in the last 5 years, and he dwelled on the tasks of further research on their biology, their reserves, their sensible use, and their protection and reproduction.

A. V. Zhirmunskiy described research on invertebrates of the USSR's Far Eastern seas, which became much more intense following establishment of the Institute of Marine Biology at the Far East Scientific Research Center, and he noted the great prospects for growing commercial invertebrates on the shelves of Far Eastern seas.

\* Burukovskiy, R. I., Ivanov, B. G., and Nesis, K. N., OKEANOLOGIYA, Vol 14, 1974, p 3.

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Reviews were given on the abundance and harvesting prospects of crustaceans (B. G. Ivanov) and cephalopod mollusks (K. N. Nesis) of the World Ocean, on mathematical modeling of the status of commercial invertebrate resources in the North Pacific (B. I. Pokrovskiy, V. Ye. Rodin), on the prospects for organizing controlled marine farms in the northwestern part of the Black Sea (V. A. Sal'skiy), and on the biochemical composition of commercial invertebrates on the Black Sea's northwestern shelf (T. A. Petkevich et al.).

A large proportion of the conference reports (42) were devoted to decapod crustaceans, with communications on crayfish dominating among them (24). Discussions were held on determining the abundance of the long-ridged and wide-ridged crayfish (S. Ya. Brodskiy, K. Yu. Lyustochkin, V. N. Nefedov, et al.), the population structure, intraspecific differentiation, fertility, and behavior of crayfish (S. Ya. Brodskiy, Yu. V. Doroshenko, V. N. Skvortsov, K. B. Stavrovskiy, A. V. Suprunovich, et al.), reproductive biology of the young (V. F. Dem'yanenko, V. I. Liferov, V. Ye. Roshchin, Ya. M. Tsukerzis, N. Ya. Cherkashina, V. G. Mushchinskiy, et al.), and diseases and their vectors (L. K. Grapmane, V. V. Mosolov, I. V. Popov, Ya. M. Tsukerzis, et al.). Eight of the reports were devoted to prawns. The distribution and biology of prawns were examined in relation to the Southeast Atlantic (R. N. Burukovskiy, L. L. Romenskiy), the Barents Sea by Western Greenland (B. I. Berenboym, L. I. Serebrov), and the Black Sea (Yu. N. Makarov). The biology, respiration, and metabolism of acclimatized freshwater prawns in natural conditions (K. R. Nabiyeva) and in the laboratory (Yu. G. Giginyak et al.) were discussed. A report was given on a matrix model of a Kamchatka crab population (B. I. Pokrovskiy et al.). Reports were also given on the results of acclimatizing the Kamchatka crab and on the possibility for acclimatizing the blue crab in the Bering Sea (A. M. Sennikov, Yu. I. Orlov), and on determination of the age of the beetle crab (B. I. Pokrovskiy, A. G. Slizkin). Several communications were devoted to the general problems of crustacean biology and development.

Second in quantity were reports on cephalopod mollusks: There were 24 reports, 22 of them being on squid and one on cuttlefish and octopi. A large number of communications were devoted to research on intraspecific associations and the population structure of cephalopods (K. N. Nesis, R. N. Burukovskiy, A. N. Vovk, G. V. Zuyev, Ch. M. Nigmatullin, M. A. Pinchukov, G. A. Shevtsov). New information was acquired on the distribution, nutrition, reproduction, and larval development of cephalopods (S. A. Aristovich, V. I. Vinogradov, A. N. Vovk, T. S. Dubinina, V. P. Zalygalin, Ch. M. Nigmatullin, A. A. Ostapenko, Ye. V. Slobodskoy, Yu. A. Fedorets, Yu. M. Froyerman, et al.) and their parasitic fauna (A. V. Gayevskaya). There was much interest in reports on the use of the methods of biochemical genetics to identify populations and suprapopulation groupings of squid (L. I. Koval', S. P. Shevtsova).

Fourteen of the reports were devoted to other classes of mollusks, with communications on marine bivalves dominating (11). Data discussed pertained to growth, reproductive cycles, and variability of Far Eastern

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and Black Sea mussels, oysters, sea scallops, Swift's scallops, and (maktr) (Ye. B. Yevdeyeva-Markovskaya, L. S. Garba, Yu. F. Kartavtsev, T. Kh. Naydenko, S. M. Nikiforov, S. K. Ponurovskiy, N. I. Selin, A. V. Silina, S. V. Yavnov, Yu. M. Yakovlev, et al.). One report was devoted to gastropods (A. V. Zhirmunskiy, V. L. Kas'yanov, and V. I. Lukin on the sea ear shell *Haliotis* as a possible object of cultivation), and two reports were devoted to sea urchins (Z. I. Baranova on the Japanese (kukumaria), and Yu. S. Khotimchenko on sea urchin oogenesis).

Special emphasis was placed on a discussion of the microflora (including pathogenic) of commercial invertebrates (V. V. Gubanov, V. P. Tul'chinskaya, N. G. Teplinskaya).

The conference noted the importance of well organized surveillance over the condition of populations of industrial invertebrates, and the prospects for using mathematical models to evaluate reserves, study age and growth, and develop the optimum harvesting strategies. Emphasis was placed on the importance of studying the biochemical composition of commercial invertebrates, and on the importance of studying their parasitology, microbiology, and the public health aspects of their use and cultivation. The conference turned the USSR Ministry of Fish Industry's attention to the danger of excessive intensification of harvesting in territorial waters and on the continental shelves of the USSR, which is especially pressing in the new conditions for regulating fisheries in the World Ocean. It expressed great concern for intensified pollution of coastal zones of the sea, which is threatening commercial fishing and development of mariculture.

The conference delegates took a trip to the coast of Odessa Bay and acquainted themselves with transformations occurring in coastal ecosystems as a result of extensive development of coastal reinforcement operations, expansion of beaches, and growth in recreational use; they also acquainted themselves with research being conducted by the Odessa branch of the Ukrainian SSR Academy of Sciences Institute of South Seas Biology concerning recovery of the abundance of filter-feeders and other "scavengers" of the sea with the goal of improving the hydrobiological conditions in major vacation zones near the Black Sea health resorts.

A 1-day school-seminar on the state, methods, and prospects of research on cephalopod mollusks was held on 24 November under the conference's sponsorship. Its participants included R. N. Burukovskiy (Kaliningrad), A. N. Vovk (Poltava), K. N. Nesis (Moscow), Yu. A. Filippova (Moscow), S. P. Shevtsova (Leningrad), G. A. Shevtsov (Vladivostok), young scientists employed by the USSR Ministry of Fish Industry, and university colleagues and students--more than 20 persons in all. The main attention was turned to the most important commercial squids--*Loligo* and (Ommastrephid). The reports were combinations of reviews and methodological discussions: The speakers presented both the modern methods for studying squid and the results obtained by these methods. A significant part of the reported material was new, the methods and results not having been published yet.



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Oogenesis and the stages of squid maturity, larval development and identification of larvae, research on squid migration and nutrition, and use of biochemical methods to study taxonomic problems, population structure, and so on were discussed in the school. The school was a good supplement to the work of this conference's section on cephalopod mollusks. Unfortunately this first attempt at such a school in the country was not successful in all ways: There was not enough time, and some of the reports had to be discarded. We would hope that this type of school-seminar will nevertheless be found to be useful as a means for acquainting young scientists with the latest achievements of science, and for unifying research procedures.

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105  
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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

SELECTED TRANSLATIONS FROM SYMPOSIUM ON STRESS AND ADAPTATION

Kishinev STRESS I ADAPTATSIYA (TEZISY VSESOYUZNOGO SIMPOZIUMA) (Stress and Adaptation (All-Union Symposium Abstracts)) in Russian 1978 signed to press 18 Oct 78 pp 66,67,416

[Table of Contents and two abstracts from the book edited by N. N. Mironov, L. S. Simov, and I. V. Degtyar', Izdatel'stvo Shtiintsa, 416 pages]

[Text]

Contents		Page
Section I	Principles of Analysis and the Laws Governing Development of Stress and Adaptation . . . . .	5
Section II	The Role of the Nervous and Endocrine Systems in Development of Stress and Adaptation . . . . .	72
Section III	Adaptive Regulation of Functions and the Ways for Increasing the Body's Resistance . . . . .	156
Section IV	Clinical Aspects of Stress and Adaptation, and Prenosological Diagnosis . . . . .	204
Section V	Changes in Organs and Systems in the Presence of Stress and During Adaptation . . . . .	271
Author Index	. . . . .	407

Neurophysics of Stress at the Membrane Level, by Yu. V. Chugayevskiy, UDC 612.014.3

The linear dependence  $\sigma = \sigma_0 + \gamma v$  between the conductivity of a cell membrane  $\sigma$  and the action potential  $v$ , which is a good approximation of the well known experiments by Hodgkin, Cole, and others, leads to the quadratic parabolic equation  $v_{xx} - \beta v_x - \alpha v + \gamma v^2 = 0$ . Two unexcited levels of the axon,  $v_{0,1} = 0, \frac{\alpha}{\gamma}$  correspond to the closed and open states of the membrane. Pulsed signals, or membrons, exist within the window  $v_1 < v < 1,5 v_1$ . For nonmyelinated axons in cerebral gray matter, the minimum length of membrons is on the order

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$$h_{min} = \frac{2}{\nu_a} \sim 0,1 \text{ MM},$$

while the maximum frequency of the impulses transmitted and their rate are, respectively:

$$\omega_{max} = \frac{a}{\beta} \sim 10^3 + 10^4 \text{ Hz}; C_{max} = \frac{\sqrt{a}}{2\beta} \sim 0,1 + 1 \text{ Msec}^{-1}.$$

Subthreshold ( $\nu < \nu_1$ ) local excitations at level  $\nu_0$  correspond to diffusely decomposing parabolic states.

Breakdown of an arbitrary perturbation of suprathreshold intensity causes formation of at least two diverging membrons, if the amplitude and the length of the area of excitation  $L$  satisfy the conditions

$$\nu_{sm} \geq \frac{3\pi}{\varphi}, L \geq \frac{4}{\nu_a}.$$

The membrons thus formed bear the information function of quanta of the mental code, and the subthreshold remainder is identified as the emotional background.

Disturbance of membrane homeostasis due to either change in cellular metabolism or the direct effects of external stress factors of varying origin (chemical, thermal, mechanical, and galvanic agents, electromagnetic radiation, and so on), leads to variations in the fundamental cell parameters  $\beta, u, \varphi$ . The end result is straying of lability parameters of the nerve channels beyond normal coupled with abnormal width and location of the window  $\nu_1$  ( $\nu_1 \sim 5 \nu_0$ ) which manifests itself as tremendous number of neurophysiological phenomena--from a decrease in reaction rate to arisal of perception and consciousness splitting syndromes.

Stress and Pulsed Radiation, by Yu. V. Chugayevskiy and N. Ye. Fedorenko, UDC 612.014.3

Excitation of cell membranes is accompanied by emission of electromagnetic pulses in the ultraviolet, infrared, and superlong-wave ranges.

Proton-sodium plasma squirts out of the membrane's interlipid space through micropores formed in the excited portion of the membrane into the cell protoplasm, where it quickly undergoes partial or complete bonding and neutralization. Binding of the plasma carriers is accompanied by emission of electromagnetic solitons with wavelength on the order of  $L \sim 10^{-2}$  cm.

Stressful overexertion of the membrane leads either to a sharp decline in membrane potential or on the other hand to arisal of critical fields within it close to the rupture point ( $E \sim 10^7 - 10^8$  volts/cm). Irreversible membrane rupture, accompanied by escape of electron plasma into the intercellular

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environment and by generation of uv-solitons ( $\hbar\nu 10^{-4}-10^{-5}$  cm) lies at the basis of mitogenic luminescence, which is accompanied by destructive cellular alterations--cytokinesis, mitosis, necrosis. The bulk of the ir- and uv-pulses fall within the band  $10_{m_e}^{-7} < m < 10_{m_e}^{-4}$ .

Superlong pulses ( $\hbar\nu 10^{-7}-10^{10}$  cm) are generated by neuron structures following annihilation of nerve impulses in the parabiogenic portions of axons and synaptic endings. Having a vortical narrowly directed structure, such pulses have subatomic cross sections ( $\sim 0.1-1 \mu^2$ ) and a weight on the order of  $10-10^2 m_e$ , and they can propagate for significant distances without noticeable attenuation.

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108

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PUBLICATIONS

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MEANS OF INDIVIDUAL PROTECTION FOR WORK WITH RADIOACTIVE SUBSTANCES

Moscow SREDSTVA INDIVIDUAL'NOY ZASHCHITY DLYA RABOT S RADIOAKTIVNYMI VESH-  
CHESTVAMI (Means of Individual Protection for Work With Radioactive Sub-  
stances) in Russian 1979 signed to press 24 Nov 78 pp 2, 3-9, 293-294

[Annotation, table of contents and introduction from book by S. M. Gorodin-  
skiy, Atomizdat, 5,700 copies, 294 pages]

[Text] In the book light is shed on the principal theoretical and practical  
questions in the individual protection of man during work with radioactive  
substances. The basic designs of means of individual protection of organs  
of respiration and the skin are described that are finding application in  
work with radioactive materials under various production conditions, and  
also in the operation of atomic reactors and atomic power plants.

Many years of experience of research and design work done by the laboratory  
under the author's leadership in the area of individual protection are gen-  
eralized.

In the book much attention is given to methods of physiological and hygienic  
evaluation, verification of protective effectiveness and the proper operation  
and decontamination of means of individual protection.

Contents	Page
Introduction	3
Chapter 1. Purpose and Classification of Means of Individual Protection	10
Chapter 2. Investigation of Materials Intended for the Construction of Means of Individual Protection	21
Basic requirements	21
Procedures for investigation of polymeric materials	26
The investigation of film materials	35
The investigation of rubber-based materials	51
The investigation of materials for rigid parts of means of individual protection	62

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<b>Chapter 3. Methods of Physiological and Hygienic Evaluation of Means of Individual Protection</b>	<b>67</b>
The selection of procedures	67
The investigation of ability to work	69
Determination of energy expenditures	76
Method for investigating the thermal state of the organism in means of individual protection	78
Estimating the intensity of diaphoresis	83
Investigation of the state of the cardiovascular system and the system of respiration	84
Microclimatic chambers	85
<b>Chapter 4. Methods of Investigating the Protective Effectiveness of Means of Individual Protection</b>	<b>89</b>
Basic requirements	89
Method of evaluation based on radioactive indication	92
Method of evaluation based on non-radioactive aerosol	106
Method of evaluation based on an oil fog	110
<b>Chapter 5. The Creation and Investigation of Isolating Suits for Repairs and Emergency Work Under Conditions of Radioactive Contamination</b>	<b>113</b>
Basic requirements	113
Isolating hose and autonomous suits	120
Physiological and hygienic tests of pneumatic suits and isolating suits with autonomous air supply sources	141
Selection of parameters of the microclimate of isolating suits	153
Investigations of the protective effectiveness of isolating suits	162
<b>Chapter 6. The Creation and Investigation of Means of Individual Protection of Organs of Respiration During Work With Radioactive Substances</b>	<b>167</b>
General requirements	167
Specific properties of means of individual protection of organs of respiration against radioactive aerosols	178
Hose isolating means (pneumatic jackets, suits and masks)	199
<b>Chapter 7. Everyday Protective Clothing, Intended for Work With Radioactive Substances</b>	<b>207</b>
General information	207
Distinctive features of the use of cotton special clothing for everyday wear	208
The development and evaluation of everyday special clothing of synthetic fabrics	215
Physiological and hygienic investigations of special clothing of lavsan fabrics	224
<b>Chapter 8. Gloves and Film Additional Protective Clothing for Work With Radioactive Substances</b>	<b>230</b>
<b>Chapter 9. Footwear for Work With Radioactive Substances</b>	<b>238</b>

FOR OFFICIAL USE ONLY

Chapter 10. Decontamination of Means of Individual Protection	243
General considerations	243
Decontamination of cotton protective clothing	254
Decontamination of lavsan protective clothing	260
Decontamination of individual means of protection made of polymeric materials, rubber and rubberized fabrics	263
Decontamination of footwear	267
Quality control of the decontamination of means of individual protection	269
Appendix	271
Bibliography	275
Subject index	291

Introduction

It is now difficult to name any sort of branch of industry in which radioactive substances are not used in one form or other. One of the main difficulties, that of protecting against the harmful effect of ionizing radiation on the human organism, arises during the industrial processing and practical use of radioactive substances. The entry of radioactive aerosols or gases into the organism is especially dangerous.

Of great importance is the correct solution of questions of radiation safety and the implementation of an entire group of protective and preventive measures [20,59,64,137,151,172, 184].

Along with the protection of man against the external effect of ionizing radiation, of great importance for the preservation of the lives and health of workers is prevention of the penetration of radioactive substances into the organism. General hygienic and general technical measures are not always effective. Therefore a large, and sometimes a deciding, role is being acquired here by the individual protection of the organs of respiration and skin of man.

In the system of radiation safety individual protection constitutes one of the most important sections. The application of means of individual protection is one of the intrinsic technical solutions in a complex group of preventive measures directed toward assuring safe working conditions and the prevention of occupational diseases. Means of individual protection, as a rule, are used in cases where work safety cannot be assured by the design of equipment, the organization of production processes, architectural and planning solutions or collective means of protection.

Means of individual protection is the term used for protective clothing, footwear, various instruments and devices (respirators, pneumatic suits and shields) used individually and providing protection of the worker against various harmful factors of the external environment. Means of individual protection used during work with radioactive substances protect

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man against the entry of radioactive substances into his organs of respiration and digestion and directly on his skin. The selection of means of individual protection, as a rule, must be based on careful inspection of the working conditions of personnel and the radiation situation, which is determined by the character and volume of the work being done and also on study of the level of contamination of the air and working surfaces by radioactive materials [64,186,228].

Characteristic of work connected with the extraction, processing and application of radioactive materials is the entry into the environment of radionuclides in the form of aerosols, gases and vapors and considerable contamination by them of the surfaces of rooms, equipment and instruments. In addition, depending on the production process, harmful accompanying substances enter the air: vapors of acids and alkalies, and neutral dust. Those factors can act for a long time, at times daily in the course of the entire working shift.

Dangerous and harmful production factors acquire special importance during repairs and emergency work, when the technological equipment is unsealed. In that case such measures of radiation safety as containment of the equipment, remote control, ventilation and others cease to play the main role and individual protection occupies a leading place. Therefore means of individual protection acquire paramount importance during the execution of various repairs and emergency work done directly in the zone of technological equipment contaminated by radioactive substances [47,59], including at atomic power plants.

The effect of ionizing radiation on the organism is manifested in the form of external and internal irradiations. The mutual role of those two types of effect can be different under different conditions, and experience in the study of working conditions during work with radioactive substances indicates that danger very serious in its amount and at the same time very difficult to monitor is connected with the possibility of internal irradiation of workers [151].

Radioactive substances, depending on their aggregate state, penetrate into the organism mainly through the respiratory and digestive tracts. Some compounds of radioactive nuclides, especially those that are volatile and readily soluble (compounds of tritium, radium, strontium, etc) enter the organism also through the undamaged skin. However, of paramount importance is inhalation--the entry of radioactive substances through the organs of respiration.

In the analysis of possible paths of entry of radioactive substances into the organism it should be noted that by means of means of protection of the organs of respiration and skin it is in principle possible to prevent the entry of radioactive substances into the organism and contamination of the surface of the human body.

112

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However, the rigid maximum permissible doses of radioactive substances provided for by the radiation safety standards [159] have stipulated the specific requirements for individual protective technology which differ substantially from the requirements for individual means of protection that have found application in other areas of the national economy. This is connected with the high biological activity of radioactive substances in small quantities and the difficulty of their decontamination.

The means and methods of individual protection used in work with industrial poisons and toxins prove to be unsuitable for protection against radioactive contaminations; their use, with rare exceptions, has not been successful for several reasons. In most cases those means and methods of individual protection have not assured adequate protective effectiveness under the effect of radioactive aerosols and gases. Protective effectiveness is characterized by the penetration coefficient, which shows how many times the used individual set or instrument reduces the entry of a gas or aerosol into the space under the suit.

The design and materials from which means of individual protection have been made have not made it possible to decontaminate successfully, as it is a very complex matter to cleanse them of radioactive contaminations.

The designs of many means of individual protection used in the chemical, mining and other branches of industry have also not satisfied the general hygienic requirements, specific for work with radioactive substances. Isolating suits have caused disturbance of heat and moisture exchange. Anti-dust respirators have made respiration difficult because of the high resistance of filters, the facial parts of respiratory instruments have pressed strongly on the soft skin of the head and face, and many designs have been heavy and inconvenient to turn. As a result of that the workers reject the means of protection or use them in cases of extreme necessity and during a very limited time interval.

The development of atomic technology, the creation of nuclear power reactors and atomic power plants, and the wide use of radioactive substances in different branches of industry--all these things have caused a need to create new means of individual protection that have exceptionally high effectiveness (tens and hundreds of times greater than that required in ordinary chemical production facilities) and a low sorption coefficient. New individual means of protection must protect workers against having their skin sprayed with acids and bases often used in laboratories.

The creation of new means of individual protection against radioactive substances was a complex and laborious task that was solved in several stages.

1. The creation and selection of various materials with minimum sorption, readily cleansed of radioactive contaminations, technological suitable for the creation of means of individual protection and resistant to the effect of strong oxidizing and reducing agents.

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2. The direct development of rational highly effective and uncomplicated designs that assure under specific production conditions reliable protection of workers against the falling of radioactive contaminations on the skin and into the organism. The creation of specialized means of individual protection for repairs and emergency work under various production conditions.

3. The conducting of physiological-hygienic laboratory and operating tests to estimate the design suitability and the selection of the best models of means of individual protection on the basis of detailed investigation of the working conditions and the determination of the active aggressive factors of the external environment.

4. The development of the main theoretical requirements, hygienic parameters and procedures for dynamic estimation of the state of a man in individual means of protection. Those investigations were the basis for the creation of very improved designs that meet contemporary production conditions.

5. Rational organization of the entire system of operation and purification of used means of individual protection, based on careful study of the working conditions of the personnel.

Complex investigations conducted in those directions have made it possible in the course of 10 years to create in the Soviet Union basic means of individual protection of man from radioactive substances and to organize their mass production [20,64,172,228].

The theory and practice of the creation and use of means of individual protection against radioactive substances are based on knowledge in the area of occupational hygiene and physiology, radiobiology, physics, chemistry and the technology of specific production facilities for which individual protective technology is being created.

Frequently in the creation of means of individual protection the high requirements for protective characteristics require sacrificing to a certain degree the general hygienic standards. For example, the barrier between the environment and man that is created during the use of isolating means of individual protection not only plays a positive role by guarding against harmful external effects but at times also disturbs processes of transfer of products of the vital activity of the organism to the environment: metabolic heat, moisture, anthropotoxins (carbon dioxide, carbon monoxide, ammonia, phenol, etc). In addition, toxic products can enter the space under the suit as a result of gas evolution of polymeric materials used to make the means of individual protection. All this leads to a reduction of the personnel's ability to work and, consequently, also to a reduction of labor productivity.

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The need to assure homeostasis of the organism requires scientifically substantiated normalization of the physical and chemical parameters of the gaseous medium of the space under the suit. That normalization is based on the dependence between the parameters of the medium and the functional state of the organism with consideration of the intensity and duration of the performed work.

Protective clothing, footwear and other means of individual protection constructed with consideration of the microclimatic features of the production medium permit expanding the zone of thermal comfort, protect the man from cold and extreme overheating and increase his ability to work, since under the conditions of thermal comfort physiological reactions proceed with very little reduction of ability to work. Of great importance in the clarification of these questions are physiological and hygienic investigations in laboratories and under production conditions. Those investigations determine the advisability and design suitability of individual means of protection and permit introducing necessary modifications.

Physiological-hygienic investigations of isolating means of protection have made it possible to determine the allowable length of stay in them and to study functional shifts in the organisms of personnel working under definite microclimatic conditions. Those investigations help to find ways to maintain the thermal balance of man and the necessary microclimate in the course of long working time.

Experience in the creation of means of individual protection testifies that in cases where the developers studied the conditions of application and observed a scientifically substantiated approach to the results of physiological investigations, better models of means of individual protection were created [58,62,69,73,106,122].

The large variety of forms of application of radioactive substances in different areas of the national economy makes it impossible to give universal recommendations for each production process, and so the persons engaged in organization of the system and of measures for radiation safety must decide directly on the spot which means and methods of individual protection should be used. However, the principal technical decisions remain general, and they must be the basis of the application of means of individual protection.

As is validly pointed out in Soviet works and in the recommendations of the International Atomic Energy Agency [322], the use of means of individual protection can be effective only when they are used properly and the necessary maintenance of them is assured. Workers must take special courses on the rules of use of means of individual protection and must also know their maximum possibilities. Special attention must be given to constant monitoring of the protective effectiveness of means of individual protection after cleansing and repair [56,153].

115

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The system of operation must correspond to the working conditions of the workers. With each substantial change of the character of the work done it is necessary to make an additional examination of the working conditions and give corresponding recommendations on the application of means of individual protection. Of great importance are high qualifications of the personnel responsible for the correct use, repair, cleaning and storage of means of individual protection, and also for instructing the workers. In connection with this special attention must be given to the training of specialists in the use of means of individual protection under specific production conditions.

Many years of experience have now been accumulated in the use of radioactive substances, and it has shown that strict observance of the rules for the use of means of individual protection can eliminate practically completely the entry of radioactive substances in the organism during complex maintenance work [20,64].

Presented in the present book are the basic principles of individual protection during work with radioactive substances, the designs of means of individual protection are described and the results of many years of research on the creation and evaluation of new isolating suits, respirators, gas masks, everyday protective clothing intended for protection against radioactive substance used in Soviet atomic engineering.

Much attention is given to the creation and hygienic evaluation of construction materials used to protect the organs of respiration and the skin. Also examined are some questions of the decontamination of means of individual protection. In a comprehensive evaluation in the process of developing means of individual protection it was necessary to apply many known technical and hygienic methods of investigation. However, the specific conditions of the application of those means also required the development of new procedures for investigating the protective effectiveness of isolating suits, respirators and gas masks by means of radioactive indicators.

The results of the investigations conducted with the use of procedures described in the corresponding sections of the present book permitted giving a complex hygienic evaluation of the created means of protection against radioactive substance and selecting the most optimal for given production conditions, based on the medical requirements. Materials obtained in many years of investigations by collectives of coworkers headed by the author were used mainly in the book, and also published Soviet and foreign data on questions of individual protection. The third edition of the book has been supplemented by the new State Standards on Labor Safety, normatives, requirements and results of work of recent years done in the Soviet Union and abroad in the area of individual protection of man.

I wish to express my deep appreciation to D. S. Gol'dshteyn, Yu. V. Sivintsev, I. M. Gorskiy, I. G. Romanova and S. F. Karnaukh for examining the

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manuscript, valuable advice and help in the preparation of individual chapters of the third edition of the present book.

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117

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PUBLICATIONS

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CONTROL THEORY AND BIOSYSTEMS

Moscow TEORIYA UPRAVLENIYA I BIOSISTEMY. ANALIZ SOKHRANITEL'NYKH SVOYSTV (Control Theory and Biosystems. Analysis of Preservative Properties) in Russian 1978 pp 2-5

[Annotation and table of contents from book by V. N. Novosel'tsev, Nauka. Izdatel'stvo Main Editorial Board of Physical and Mathematical Literature, 320 pages]

[Text] In recent years control theory has been used more and more widely to study processes in biological systems and books written about that area have found new readers in the persons of biologists and medical men.

The book discusses contemporary methods of control theory and their application to investigate living systems. The main ideas of the method of the spacing of states and compartmental modeling of biosystems. Those methods have been used to analyze the preservative properties of biological systems. The account is accompanied by examples from the area of physiology (systems of temperature regulation, oxidation regimes and energy balance) and other areas of biology.

The book is intended for specialists in the areas of biocybernetics, bionics and biophysics, and also for biologists, medical men, physiologists and engineers.

Contents	Page
Introduction	6
Part 1. Control Theory and Living Systems	
Chapter 1. Specifics of Living Systems	15
1.1. The living system	15
1.2. The structure of a biosystem	17
1.3. The principle of biological epimorphism	20
1.4. Open systems	21
1.5. Passive and active control in living systems	23
1.6. Rates and levels	27
1.7. Hierarchies of goals in living systems	30
1.8. Thermodynamic models of living systems	37

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	Page
<b>Chapter 2. Preservative Properties of Living Systems</b>	<b>42</b>
2.1. The concept of self-preservation and living systems	42
2.2. Homeostasis	43
2.3. The homeostatic curve	45
2.4. Preservative properties	48
2.5. Homeostasis on different levels of organization of life	50
2.6. Some general properties of homeostatic mechanisms on different levels of organization of biosystems	63
2.7. Homeokinesis, homeorhesis and genetic homeostasis	66
<b>Chapter 3. Classical Control Theory and Biosystems</b>	<b>68</b>
3.1. Methodology of the theory of automatic control	68
3.2. Dynamic systems. Modeling diagrams	74
3.3. Linear systems and linearization	78
3.4. Feedback	80
3.5. Stability	85
3.6. Sensitivity	89
<b>Chapter 4. Optimality and Adaptation in Biosystems</b>	<b>97</b>
4.1. Optimal systems	97
4.2. Adaptation	99
4.3. The concept of optimality of biosystems	101
4.4. Criticism of the concept of optimality in biology	104
4.5. The principle of satisfaction	113
4.6. Good, poor or optimal?	121
<b>Chapter 5. The Spacing of States Method</b>	<b>124</b>
5.1. Vectors and matrices	124
5.2. The concept of the state in the biological sciences and in control theory	135
5.3. Equations of state	136
5.4. Solution of equations. The stationary regime of the system	140
5.5. System stability and transitional regimes	142
5.6. Sensitivity	144
5.7. Observability and controllability	146
5.8. Equations of state for a passive heat-transfer system	150
<b>Chapter 6. Compartmental Models of Living Systems</b>	<b>159</b>
6.1. Definitions	159
6.2. Transposition of components	164
6.3. Interaction and transformation of components	170
6.4. Utilization of components	177
6.5. General diagram of a compartmental model	182
6.6. Compartmental model of the energy system of the organism	186
6.7. Compartmental model of an ecological system	192

FOR OFFICIAL USE ONLY

<b>Part 2. Analysis of the Preservative Properties of Biosystems</b>	
<b>Chapter 7. Modeling the Homeostatic Properties of the Organism</b>	<b>199</b>
7.1. Comments on the modeling of preservative properties of the organism and its systems	199
7.2. Two approaches to the modeling of biosystems	205
7.3. The modeling of homeostasis by methods of the classical theory of automatic control	210
7.4. The modeling of homeostasis by methods of the spacing of states	215
7.5. The influence of the structure of a compartmental system on its homeostatic properties	220
7.6. The conjunction of parallel control channels	225
7.7. The conjunction of serial control channels	230
7.8. Homeostasis in physiological systems with active regulation	235
7.9. Stabilization of the levels of matter and energy	238
<b>Chapter 8. Qualitative Evaluation of the Homeostatic Properties of Systems</b>	<b>245</b>
8.1. The index of homeostatic capacity of a system	245
8.2. Homeostasis of nonlinear systems. The homeostatic curve	250
8.3. Integral evaluation of the homeostatic properties of a system	256
8.4. Resources of preservative properties in a system	257
8.5. Preservative resources of a system of temperature regulation	260
8.6. Logarithmic coefficients of sensitivity	267
8.7. Formalized concept of the index of homeostatic capacity	269
<b>Chapter 9. The Phenomenology of Homeostasis</b>	<b>272</b>
9.1. Typical situations in homeostatic systems	272
9.2. The influence of direct connections on the properties of systems	276

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2174  
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BRAIN PHYSIOLOGY MANUAL FOR COLLEGE STUDENTS

Kiev FIZIOLOGIYA GOLOVNOGO MOZGA (Brain Physiology) in Russian 1976 signed to pref 11 May 76 pp 102-103

[Table of Contents from book by V. A. Cherkas, N. N. Oleshko, N. I. Vakolyuk, and Ye. P. Lukhanina, Izdatel'skoye ob'yedineniye "Vishcha shkola", 4,000 copies, 104 pages]

[Text]

Contents	Page
From the Authors . . . . .	3
<b>Chapter 1. Making the Electrodes</b>	
Making and Preparing the Conductors . . . . .	6
Isolating the Conductors . . . . .	9
Making Conductors From Insulated Wire . . . . .	11
Single Deep Electrodes for Cats and Rats . . . . .	12
Multiple Deep Electrodes for Cats . . . . .	13
Superficial (Cortical) Electrodes for Cats . . . . .	16
Electrodes for Dogs . . . . .	17
The Indifferent Electrode . . . . .	20
Deep Electrodes Intended for Lesion of Brain Tissue . . . . .	21
<b>Chapter 2. Selecting the Animals and Preparing Them for Brain Surgery</b>	
Selecting the Animals . . . . .	22
Cats . . . . .	22
Dogs . . . . .	22
Rats . . . . .	23
Rabbits . . . . .	23
Preparing the Stereotaxic Instrument . . . . .	24
Preliminary Determination of Stereotaxic Coordinates . . . . .	29
Selecting the Surgical Instruments and Anesthesia . . . . .	32
Securing the Animals . . . . .	36
<b>Chapter 3. Brain Operations</b>	
Preparing the Bone Area for Surgery . . . . .	38

FOR OFFICIAL USE ONLY

Implanting the Electrodes . . . . .	39
Implanting Deep Electrodes Into Cats and Determining the Correction Factors . . . . .	39
Simultaneously Implanting Multiple Electrodes in Cats . . . . .	44
Implanting Deep Electrodes in Rats . . . . .	44
Implanting Deep Electrodes in Dogs With Nonstandard Head Dimensions (Mongrels) . . . . .	47
Implanting Single Electrodes in Dogs . . . . .	53
Implanting Multiple Electrodes in Dogs . . . . .	55
Computing the Coordinates for Introducing Electrodes into Dogs at an Angle . . . . .	57
Implanting Superficial (Cortical) Electrodes . . . . .	59
Implanting the Indifferent Electrode . . . . .	59
Electrolytic Lesion of Deep Brain Structures . . . . .	61
Multistaged Removal of the New Cortex (Neocortex) . . . . .	63
The Extirpation Procedure . . . . .	65
The Postoperative Period . . . . .	68
 Chapter 4. Behavioral and Electrophysiological Reactions of Animals in Chronic Experiments	
Brief Discussion of the Behavioral Reaction Concept . . . . .	68
The Food Acquisition Reflex in Cats . . . . .	69
Concurrent Registration of Several Characteristics of Dietary Reflexes in Dogs . . . . .	73
Reproduction of the Food Acquisition Reflex by Direct Stimulation of the Brain . . . . .	75
The Brain Self-Stimulation Method . . . . .	77
The Avoidance Reflex in Cats and Rats . . . . .	79
The Flexor (Defensive) Reflex in Cats and Dogs to Electrocutaneous Stimulation . . . . .	82
Registration of Spontaneous Motor Activity in Animals . . . . .	83
An Experimental Model of Convulsive Activity in Rats . . . . .	84
Recording the Galvanic Skin Response . . . . .	86
Registration of Brain Bioelectric Activity in a Chronic Experiment	89
 Chapter 5. Determination of the Locations of Implanted Electrodes and of Brain Lesions	
Morphological Control. Photographing Brain Sections . . . . .	95
 Bibliography . . . . .	100

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