

**SECRET**

**Nº 78**

**ECONOMIC INTELLIGENCE REPORT**

**PRODUCTION OF SYNTHETIC FIBERS  
AND FABRICS MADE FROM SYNTHETIC FIBERS  
IN THE USSR  
1957**



CIA/RR 131  
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**CENTRAL INTELLIGENCE AGENCY  
OFFICE OF RESEARCH AND REPORTS**

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ECONOMIC INTELLIGENCE REPORT

PRODUCTION OF SYNTHETIC FIBERS  
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(ORR Project 30.1911)

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Office of Research and Reports

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FOREWORD

Production of synthetic fibers and of fabrics made from synthetic fibers is considered generally to be an industry of the West, especially of the US, where large corporations have made tremendous advances in research and in production. The USSR, nevertheless, is demonstrating remarkable progress in laboratory research, which follows the pattern of Western laboratory research. Although Soviet production of synthetic fibers is extremely small compared with US production, the potential for future growth in the USSR is great, and some Western scientists are alert to the possibility that Soviet laboratory research may offer future competition in this field.

Soviet development in synthetic fibers is being watched also by US manufacturers and by US economic research organizations. Research studies of these groups and examination of Soviet technical literature made for this report indicate that, instead of merely adapting Western achievements to its own needs, the USSR is now in a position to develop new types of synthetic fibers in its laboratories and ultimately to put the new fibers into production.

Some use of highly technical terminology in this report was unavoidable, although considerable effort was spent in simplifying terms. Some fibers and fabrics have names in the US, the UK, and Germany which differ from each other and from the Soviet names. In this report, ordinarily the Soviet term is used, but sometimes the context requires a US or other term foreign to the USSR. Explanations of technical terms are given in Appendix B.

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PRODUCTION OF SYNTHETIC FIBERS AND FABRICS MADE FROM SYNTHETIC FIBERS  
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Summary and Conclusions

Production of synthetic fibers and fabrics made from synthetic fibers\*\* is a development in which the USSR is not so far advanced as the US and some other Western countries. Production of synthetic fibers and fabrics in the USSR, although showing fairly large annual increases in percentages, is still extremely small in absolute amounts. It is estimated that in 1957 only 16,800 metric tons\*\*\* of synthetic fibers were produced in the USSR, whereas, in 1956, US plants produced more than 180,000 tons. Soviet plans for 1960 envision production of synthetic fiber of 44,000 tons and of artificial fiber of 286,000 tons. In 1957 the USSR is estimated to have produced 805 million linear meters of fabrics from manmade fibers\*\*\*\* compared with 5.6 billion linear meters of cotton. These increases will absorb 11 billion rubles† in investment, a sum one-fourth the investment in the entire light and food industries during the Fifth Five Year Plan (1951-55).

Although the USSR is far behind in production of synthetic fibers, the lag in research is not great, because much Western technology is

\* The estimates and conclusions contained in this report represent the best judgment of ORR as of 1 January 1958.

\*\* Soviet terminology distinguishes between synthetic and artificial fibers. Both synthetic and artificial fibers are manmade fibers. Synthetic fibers -- for example, nylon, orlon, and dacron -- are chemically based. Their basic chemicals are synthesized from such raw materials as coal, petroleum, and natural gas by a linking reaction known as polymerization. Artificial fibers (rayons) have a cellulose base, not a chemical base, and are formed by a rearrangement of the basic molecules. The term silk sometimes is used to include not only natural (silkworm) silk but also all manmade (synthetic and artificial) fibers -- for example, fibers known as synthetic silk, synthetic wool, synthetic cotton, and synthetic linen. For fuller explanations of these and other technical terms, see Appendix B.

\*\*\* Tonnages are given in metric tons throughout this report.

\*\*\*\* Including fabrics of natural silk and artificial and synthetic fibers.

† The ruble-dollar ratio for conversion of rubles to US dollars for total investment in the USSR is 6.8 to 1 (preliminary estimate). This ratio applies to all investment conversions in this report.

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available for the taking and because Soviet scientists have demonstrated their ability to apply such information in their own laboratories.

In the application of the methods resulting from laboratory effort, however, difficulties begin to compound. The shift of administrative control from the former ministerial level to the new position at the level of the regional Council of National Economy (Sovet Narodnogo Khozyaystva -- Sovnarkhoz) may have a retarding effect, and the relocation of research units at enterprises of the industry may bring opposition from scientists, thus increasing the delay. Machinery and equipment which were confiscated from East German factories following World War II are to be supplemented by purchases from the West, a development which indicates that the Soviet machine building industry is unable to expedite the design and construction of machinery needed for the new industry. Supplies of basic materials -- coal, petroleum, and natural gas -- present no problem, but the processes of producing and polymerizing the monomers (intermediate chemicals) are complicated, and the further stages of fabrication are exacting processes of extrusion and precipitation.

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## I. Introduction.

Synthetic fibers, generally considered to be materials for light industry, serve in addition many industrial and military purposes, most of which carry higher priorities than do consumer goods. For example, the use of kapron for production of parachutes served to stimulate growth of the new industry. Special properties which commend kapron for parachute material indicate also its superiority for other industrial uses. Examples of these uses are in tire cord, industrial filtering devices, and towropes. New applications constantly are being made for the use of kapron.

In light industry the need for supplementing supplies of natural fibers and fabrics is great, and the potential uses of synthetic fibers and of fabrics made from synthetic fibers appear very broad, according to Western experience. The Soviet textile industry, in line with world trends, is expected to lessen its dependence on production of natural fibers and to increase sharply production of manmade fibers, where expansion of production will be relatively easy compared with expansion of production of natural fibers. Shortages of wool are chronic, a problem made more serious because of extremely severe winters and the need for warm clothing in the USSR.

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These problems of economic stress can be solved in great measure by developing specific types of fiber and by increasing production of these fibers to meet the growing demands. Kapron is a fiber similar to silk, but types of kapron can be produced which resemble cotton or wool. These may be woven in pure form or blended with natural fibers, using much of the existing textile machinery.

Production of synthetic fibers and of fabrics made from synthetic fibers in the USSR has developed only since World War II, although the USSR has conducted laboratory experiments in synthetics since the late 1930's. The growth of the industry until recently has been limited by its low priority in obtaining skilled manpower and by the slow development of the petrochemical industry, its main supplier of raw materials. Now, with Western countries setting a rapid pace, Soviet industrial leaders want to achieve increases in the quality and quantity of consumer goods by pressing for greater production of manmade fibers -- both synthetic and artificial.

In spite of the relatively low priority of most consumer goods in Soviet industry, rapid advances in synthetic fibers and in fabrics made from synthetic fibers now are being made. This increased effort is not merely for the purpose of benefiting the consumer, because industrial and military requirements are being served at the same time. The Soviet textile industry, however, has been criticized by the Soviet leadership for technical backwardness and obsolete machinery and for its failure to produce manmade fibers comparable to those which are popular abroad.

Although kapron, a type of nylon fiber, is the only synthetic fiber produced in the USSR in large quantity, a number of other types are in some stage of research or production by pilot plants. In this report the various fibers and fabrics discussed usually are identified by their Soviet names.\*

## II. Historical Background.

Development of the high-polymer chemistry of synthetic fibers since its beginning in the 1930's has progressed in a most spectacular manner, especially during 1948-58, when it provided new frontiers in the development of synthetic products such as fibers, rubbers, and plastics. Industrial advances have themselves stimulated research in high polymer chemistry. 1/\*\*

\* For US, Soviet, and other names for synthetic fibers and fabrics, see Appendix A. For an explanation of terms used in this report, see Appendix B.

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Soviet activity in the field of synthetic fibers, largely academic before World War II, had a fairly low priority during the immediate postwar period, and progress has been slow in consequence. Since the death of Stalin, and particularly during 1955-57, emphasis has been placed on "catching up to the West" in the area of synthetics.

A. Development in the West.

Until 1939, when polyamide (nylon) fibers were introduced to the market in commercial quantities, the only fibers of importance other than natural fibers were the artificial fibers, fibers made from chemically modified cellulose obtained from cotton linters or pulpwood. The polyamides were an entirely new class of fibers made from synthetic chemicals which had their genesis in coal tar and petroleum gases. Contributing almost equally and simultaneously to earlier development of synthetic fiber were E.I. du Pont de Nemours and Company, Incorporated, of the US, which marketed a product named nylon, and I.G. Farben Industry, Incorporated, of Germany, which marketed a product named perlon. These fibers were superior to any previously available, and during World War II almost all production was used for such applications as parachutes, glider towropes, and tire cord for military and aircraft tires.

By 1945, production of continuous filament nylon in the US had reached 11,400 tons and in the UK about 455 tons per year. Production of perlon in Germany reached a wartime peak of 1,050 tons in 1943. <sup>2/</sup> Since 1945 the demand for synthetic fibers in the US has continued to grow at a phenomenal rate. To meet this demand, production has been expanded from a few thousand tons in 1940 to almost 182,000 tons in 1956. <sup>3/</sup> The relative importance of the various types of synthetic fiber produced in 1957 in the US is shown according to approximate percentages as follows <sup>4/</sup>:

<u>Type</u> <u>of Synthetic Fiber</u>	<u>Percentage</u> <u>of Total Production</u> <u>of Synthetic Fibers</u>
Nylon	60
Dacron	17
Vinyl, acrylic, and other types	23

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B. Development in the USSR.

The Soviet synthetic fiber industry came into existence in the late 1940's as part of the spoils of war. East German plants for production of fiber of the nylon, or perlon, type were appropriated and moved to the USSR, thus providing a readymade start for a synthetic fiber industry. For example, soon after the close of World War II, a Soviet delegation was sent to East Germany to dismantle the chemical plant at Leuna/Merseburg. Approximately 75 percent of the perlon equipment, together with all of that used in making adipic acid (one of the components used in making the type of nylon developed by E.I. du Pont de Nemours and Company, Incorporated), was moved to Plant No. 96 at Dzerzhinsk. 5/ Polymerizing and spinning equipment also was removed from German plants located at Schwarza, Wolfen, Premnitz, and Landsburg-Warthe (52°44' N - 15°14' E). 6/ These acquisitions were sent for installation to the Klin artificial fiber plant located near Moscow.

At the same time, some 40 German experts were sent to Dzerzhinsk and Klin to supervise the erection of the confiscated equipment and to design additional machinery for the USSR. Thus by means of mass exploitation the USSR with considerable ease acquired the basis for a synthetic fiber industry.

Removal of so much machinery from the East German plants netted a double gain for the USSR. Not only was machinery acquired by the USSR, but removal of this machinery left no market in Germany for polymers produced at Leuna/Merseburg. Thus the USSR was able to add to production of its own industry most of the production of the East German plants left standing. Soviet imports of polymers at that time totaled 90 percent of German production. 7/

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Because of the excellence of kapron for parachute material, extensive use of it for production of parachutes in the USSR since World War II is reasonably sure. As early as 1952, [redacted] production of synthetic fiber constituted a major factor in "the Soviet parachute threat." 8/

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The extent to which kapron and similar synthetic fabrics have been used for military purposes in contrast with their use for industrial purposes or consumer goods cannot be judged in absolute terms, because little is known of the allocation of production. Nevertheless, the USSR has produced increasing amounts of synthetic fiber since 1950, with only small quantities going into consumer goods. Thus military and industrial uses presumably have taken priority, leaving only a token quantity of synthetic fiber for light industry and other consumer uses. More recently greater publicity is being given to these "miracle" fibers as another encouraging prospect for Soviet consumers.

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Notwithstanding the general economic replanning now under way, the original goal for 1960 remains the best guide to future Soviet developments in synthetic fibers and in fabrics made from synthetic fibers. Even as announcements were made of the decision to abandon original plans in favor of a revision dating to 1965, official statements referred to "unexpected industrial opportunities" afforded by the development of synthetic fiber and other plastic materials.

C. Comparison of Production in the US and in the USSR.

Production of synthetic fiber in the US, compared with production in the USSR since 1950, and the Soviet estimate for 1960 are as follows in thousand tons:

<u>Year</u>	<u>US*</u>	<u>USSR</u>
1950	56	Negligible
1955	172	9**
1956	182	11**
1960 Plan		44**

III. Organization.

Until the reorganization of the administration of industry in July 1957, Soviet production of synthetic fibers was subordinate to the Ministry of the Chemical Industry, headed by S.M. Tikhomirov, whereas the spinning and weaving processes were under the direction of the Ministry of Light Industry. The Minister of Light Industry, N.S. Ryzhov, who was appointed in September 1955 when the Ministry for Industrial Consumer Goods was split into Light Industry and the Textile Industry, was relieved of his duties in February 1957 so that he might take a diplomatic post. No reference was seen to a successor as Minister of Light Industry. 10/

In line with the reorganization of the administration of industry, the Ministry of Light Industry was abolished in July 1957. Thus the responsibility for administration passed to the new regional sovnarkhozy (plural of sovnarkhoz) in which the plants were located. The Ministry of the Chemical Industry is numbered among the four ministries of industry and construction which have survived into 1958. 11/

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\* 9/

\*\* Taken from Table 1, p. 13, below.

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The proposal by Khrushchev for reorganization, which was presented to the Supreme Soviet on 7 May 1957, pointed out that where ministries were to be abolished the State Planning Committee (Gosudarstvennyy Planovoy Komitet -- Gosplan) would be charged with (1) compilation of plans, including plans for interrepublic supply of raw materials; (2) rational distribution of enterprises throughout the country; (3) technological development; and (4) improvement of economic indexes.

Initiation of plans, Khrushchev pointed out, however, must start at the enterprises and be continued by the corresponding sovnarkhoz and the republic Gosplan. Only then would the plans be completed by Gosplan. According to Khrushchev, such a practice would make possible the maximum use of local resources and capacities for production and would insure the rational distribution of production.

Technical research, when ministries are dissolved, will be set up under the sovnarkhozy, thus moving important research closer to production. Khrushchev further stated that the technology of production must be increased at the level of the enterprise. Such an innovation requires that research institutes be set up at leading enterprises or that existing research institutes be turned over to such enterprises. 12/ It is expected that in the future, therefore, research facilities for developing synthetic fiber will be located at plants where these fibers are produced.

Research at the various enterprises will be directed by the Administration of the Industry of Artificial and Synthetic Fiber (Upravleniye Promyshlennosti Iskusstvennogo i Sinteticheskogo Volokna), a branch of the Ministry of the Chemical Industry. 13/ Publication of scientific achievements in the USSR and of accomplishments abroad is the responsibility, among other tasks, of the State Scientific and Technical Commission (Gosudarstvennaya Nauchnaya i Tekhnicheskaya Komissiya) under the Council of Ministers. This committee replaces the former State Committee for New Techniques (Gosudarstvennyy Komitet po Novoy Tekhnike -- Gostekhnika).

Direction of the program for production of synthetic fiber, which shifted at the time of reorganization, appeared at first to be balanced precariously between two industries: the chemical industry, for which a ministerial level was retained, and light industry, which had its administration "regionalized." In effect, however, the direction of both the chemical and light industrial phases of production are under the sovnarkhozy. This change occurred at the time of reorganization, when the administration of the plants and combines of the chemical industry passed to the sovnarkhozy, leaving for the Ministry of the Chemical Industry only the responsibility for coordinating plans and controlling technological advancement. Thus the administration for

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production of fiber is under either the sovnarkhozy or even more localized control.

The administration of the smaller plants and shops of light industry has been relegated to a lower level of control, usually a committee of local government. These committees may be either oblast, rayon, or city executive committees.

#### IV. Research and Technology.

Through 1957, Soviet specialists in the field of chemical fiber have been reasonably successful in developing various processes basic to production but considerably less successful in solving many technical problems. Although following the path of US research, the USSR leans heavily on the highly developed industry of East Germany for guidance in both the laboratory and the plant.

##### A. Laboratory Research.

Soviet laboratory research in the development of synthetic fiber in 1957 was behind achievements in the US by approximately 2 or 3 years. This difference is, however, not so great as is indicated by the vast difference in production of synthetic fiber in the two countries. In the chemical and light industries of the USSR, implementation of industrial methods which result from laboratory research has been slow. Soviet consumer industries lack the impetus of competitive effort which has paced the progress of the industry in the US and other Western countries. Now that the priority status of production of synthetic fiber has been raised, this gap presumably will begin to narrow in the near future.

Soviet research in the development of synthetic fiber is carried on in the chemical laboratories of establishments of higher education, in chemical institutes of the Academy of Sciences of the USSR (Akademiya Nauk SSR), and in the academies of the national republics. <sup>14/</sup> Some of the major research centers concerned with research in synthetic fiber are the following <sup>15/</sup>: College for Textile Engineers, Moscow; Karpov Institute, Moscow; Lomonosov Institute of Chemical Technology, Moscow; Mytishchi Institute, Mytishchi, near Moscow; Kirov Institute for Fiber Research, Leningrad; Leningrad Textile Institute, Leningrad; and Research Institute for Elementary Organic Compounds, Moscow.

In general the work done at the institutes tends to follow US research. During the last 2 or 3 years the Soviet press has contained announcements of Soviet "discoveries" which closely parallel the structure of synthetic fibers that are in production in the US.

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A notable exception to this pattern was contained in a recent Soviet announcement that the USSR had perfected the process for a new fiber called "ftorlon" made from copolymers containing fluorine. 16/ This claim, if correct, represents an achievement which is significant because the development of a fiber containing fluorine has been perfected only recently in the US. With this exception, Soviet research in this field is considered to be 2 or 3 years behind the US. 17/

#### B. Cooperation Within the Soviet Bloc.

Although contacts between the USSR and East Germany have been maintained throughout the postwar period on a casual basis, the past 3 years have shown a concentrated effort at close coordination between the 2 countries in particular, and among all countries of the Soviet Bloc in general, in developing research and processes for synthetic fiber. 18/

During this time, high ministerial officials in the USSR have held a series of conferences which demonstrate the importance that the USSR attaches to intra-Bloc cooperation for technical progress. The strongest bond in this area of interest is between the USSR and East Germany because of the relatively great East German advance in this field.\* Semiannual meetings are held between specialists of the two countries, a permanent acting committee on chemical fiber has been set up, 20/ exchange of materials has been agreed upon, and a free flow of technical information exists. 21/

More recently a sweeping attempt at complete cooperation of all member nations of the Soviet Bloc in developing manmade fibers was made by the Council of Mutual Economic Assistance (Sovet Ekonomicheskoy Vzaymopomoshchi -- CEMA). In April 1957, delegations of synthetic fiber specialists from all Communist countries convened for 10 days in East Germany. The stated purposes of these meetings were as follows 22/: (1) coordination of technical and scientific experimental work and work on designs and plans in the field of production of synthetic fibers; (2) mutual exchange of technical information, of most technical and scientific work, of basic data for drawing up plans, and of specialist literature in the above-mentioned fields; and (3) sending of specialists and scientists to research institutes and planning offices for 1 year for exchange of experience, joint work, participation in discussions, and specialist training.

\* Tasks for the synthetic fiber industry in East Germany under the East German Second Five Year Plan (1956-60) include (1) alteration of synthetic wool to make it more similar to wool, (2) development of fully synthetic fibers such as orlon and terylene, and (3) blending of synthetic and natural fibers to obtain optimum yarn characteristics because mixed yarn is preferable in many respects to pure wool. 19/

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Placement of Soviet technical and research personnel in Eastern Europe for training may be under way already. The proposed plan was to send persons from Soviet laboratories and plants in Klin, Kalinin, Leningrad, and Kiev to Eastern Europe for training periods of a year. Plants and institutes which would receive these trainees are in East Germany, Poland, and Czechoslovakia.

C. Interest in Western Technology.

Soviet interest in Western technological development of synthetic fiber was demonstrated in 1955, when the UK was approached by a delegation of textile representatives on the subject of its terylene process.\* Serious efforts were made to obtain a license agreement from Imperial Chemical Industries, Limited, of the UK for this process. Although a UK delegation was sent to the USSR to consider this possibility, agreement was never reached. Failure in this regard has been attributed to the UK's insisting on the presence of its representatives in plants under license from Imperial Chemicals Industries, Limited, for the purpose of checking, among other things, production records. This stipulation was so unpalatable to the Soviet delegates that they did not pursue the issue further. 23/

After the breakdown of the proposed negotiation with the UK, a conference between Soviet and East German specialists in fiber was held to consider further the terylene process. From this meeting came the resolution to carry on a joint German-Soviet project in terylene. To accomplish this project, a commission of high officials from both countries was appointed. The immediate goal was to erect, in the USSR, with the cooperation of German scientists, a terylene plant with a capacity of 10,000 tons per year. 24/

Just how far the USSR has gone in achieving this goal has not been determined, but another indication of progress is seen in Soviet activity in plant construction. The USSR recently concluded a contract with the West German steel company, Frederick Krupp, Incorporated, for the construction of a plant to produce the Soviet terylene fiber, lavsan. The value of the project has been stated at \$4 million 25/ although there is some question as to whether or not this price is high enough to cover the entire cost of the plant.

In March of 1957 the USSR showed in yet another way its eagerness to tap Western technological resources in the field of synthetic fibers by using existing connections in the Economic Commission for Europe (ECE). Specifically the Soviet proposal was to extend the

\* Terylene, or dacron, fiber was developed by the UK in 1941 but was not produced until after World War II.

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Industry and Materials Committee of the ECE into the field of artificial and synthetic fibers, establishing permanent working parties to facilitate exchange of experiences pertaining to production and use of artificial and synthetic fibers. The outcome of this proposal has not been determined; but the prospects for its materializing appear to be good, in line with the trend for a mutual exchange of ideas. 26/

V. Growth.

A. Production and Plans.

Although a major revision in economic planning was announced by the Soviet press late in 1957, production of synthetic fiber will not be affected adversely to any great extent. Details of the revision have not been made known, but a new 7-year production schedule for 1959-65 is supposed to be forthcoming in 1958. In spite of this apparent slowing down in economic development as a whole, growth in production of synthetic fibers will not fall too short of the goal for 1960. It is, indeed, conceivable that a greater increase could be achieved because even as the changes in planning were announced, the importance of synthetics was emphasized again. The goals for production as originally set forth for 1960 remain the best guide to the future for synthetic fibers in the USSR, and these goals are used in this report.

Speaking in November 1957 at the celebration of the fortieth anniversary of the Communist Revolution of 1917, Khrushchev called for the creation within the next few years of a powerful "synthetic fiber industry, which will enable us to use widely substitutes for vegetable and animal materials ... to increase considerably the production of good quality consumer goods and to bring down considerably their production costs." He stated furthermore, "We can speedily widen the production of artificial fiber and high quality substitutes for leather and fur in order to obtain, in addition to the growing stream of natural raw material from agriculture, new and vast sources of raw material."

Construction of new plants for producing fiber and renovation of existing plants during the period of the original Soviet Sixth Five Year Plan (1956-60), as planned, would add an annual productive capacity of 225,000 tons of fiber including both artificial and synthetic fibers. To finance this program of expansion, a substantial investment fund of 11 billion rubles was provided. 27/ This sum amounts to about one-fourth of the investment in the entire light and food industries during the Fifth Five Year Plan (1951-55).

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1. Fiber.

Soviet production of synthetic fibers in 1957 is estimated to be 16,800 tons. (See Table 1.\*) US production in 1956 exceeded 180,000 tons. The following tabulation shows the probable distribution of types of fibers in the total Soviet production of synthetic fibers.

<u>Type of Fibers</u>	<u>Metric Tons**</u>
Kapron (nylon 6)	8,000
Anid (nylon 66)	400
Nitron (orlon)	300
Khlorin and other	100
Total	<u>8,800</u>

Natural silk, the product of the silkworm industry, makes up about 2 percent of total production of natural and manmade fibers, as shown in Figure 1.\*\*\* Production of synthetic fibers compared with production of artificial and natural silk fibers in 1955 (according to Soviet announcements), in 1956 and 1957 (according to estimates), and in 1960 (according to Soviet plans) is shown in Table 1.\*

In the USSR the artificial fiber industry already is well developed, whereas the synthetic fiber industry is still in its infancy. It is not surprising, therefore, that the 1960 goal for production of synthetic fibers is highly ambitious, especially because the demand for synthetic fibers continues to mount. Production of artificial fibers by 1960 is planned to be almost 3 times that of 1955, whereas production of synthetic fibers will reach 5 times that of 1955, according to the plan. In absolute terms, production of synthetic fibers by 1960 is to be 44,000 tons in contrast with production of approximately 9,000 tons in 1955. Even if this goal is reached, synthetic fibers will amount to only 13 percent by weight of total Soviet production of manmade fibers.

A measure of progress of the fiber industry in the USSR is seen in the relationship between plans for production of artificial and synthetic fibers. In countries further advanced in this field,

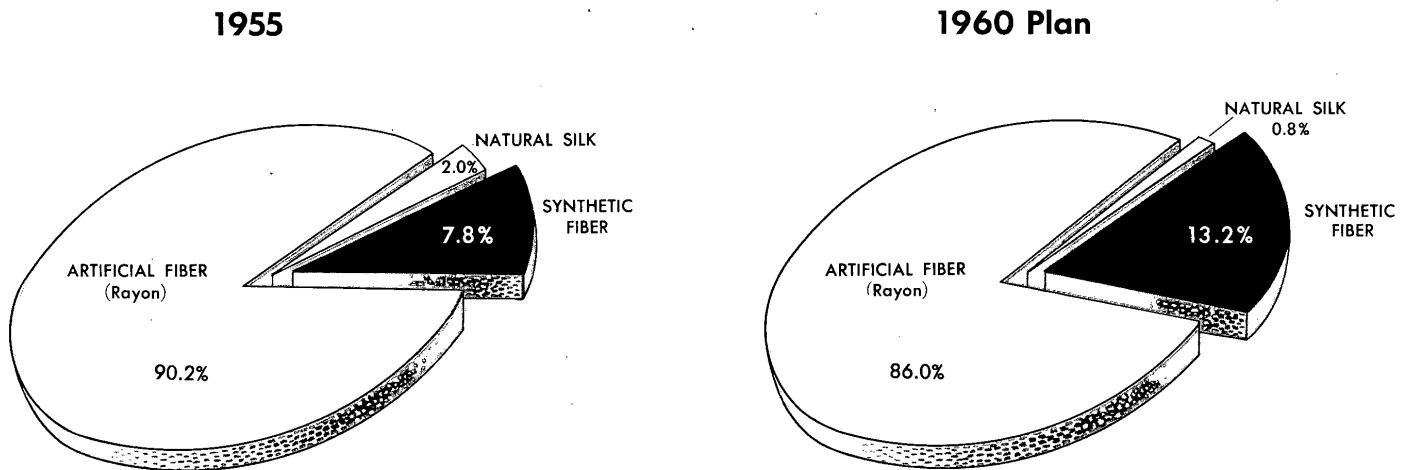
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\* Table 1 follows on p. 13.

\*\* The division of total production among the various fibers has been estimated on the basis of capacities of plants. For a list of these plants, see Appendix C.

\*\*\* Following p. 12.

**USSR: SYNTHETIC FIBERS AS PERCENTAGES OF TOTAL PRODUCTION OF MANMADE AND SILK FIBERS, 1955 AND 1960 PLAN**



(Percentage in terms of Metric Tons)

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Table 1

Estimated Production of Synthetic, Artificial, and Natural Silk Fibers  
in the USSR  
Selected Years, 1955-57, and 1960 Plan

Type of Fiber	1955	1956	1957	1960 Plan	1960 Plan as Percentage of 1955
	Thousand Metric Tons				
Artificial fiber	101.7 <u>a/</u>	118.6 <u>a/</u>	132.2 <u>a/</u>	286.0 <u>b/</u>	281
Synthetic fiber	8.8 <u>c/</u>	10.3 <u>a/</u>	16.8 <u>a/</u>	44.0 <u>b/</u>	500
Natural silk	2.2 <u>d/</u>	2.2 <u>e/</u>	2.3 <u>e/</u>	2.5 <u>e/</u>	114
Total	<u>112.7</u>	<u>131.1</u>	<u>151.3</u>	<u>332.5</u>	295

a. 28/. For methodology, see Appendix D.

b. 29/

c. 30/. For methodology, see Appendix D.

d. 31/

e. Estimated on the premise that no more than a gradual increase for the natural silk industry can be expected.

the trend is toward a slowing down of production of types of artificial fiber as production of synthetic fiber is developed. At this point in the development of Soviet production of fiber, however, production of artificial fiber, it is estimated, will almost triple between 1955 and 1960. In the US, since 1950 production of artificial fiber has declined, whereas the synthetic fiber industry has been expanding rapidly.

Soviet production of synthetic fiber per capita in 1955 was approximately 50 grams, an amount equal to only 5 percent of US production per capita. Soviet production of artificial fiber per capita amounted to about 500 grams in 1955, a quantity equal to approximately 14 percent of US production per capita.

## 2. Fabric.

In the over-all production of fabrics from natural and manmade fibers, fabrics made from artificial and synthetic fibers are gaining in relative importance, as shown in Figure 2.\* Moderate increases in production of cotton and wool fabric were scheduled during the original Sixth Five Year Plan (1956-60), but "silk"

\* Following p. 14.

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fabric (all types of artificial fibers, synthetic fibers, and natural silk fibers) is expected to increase more than 100 percent. According to official statements, only about 10 percent of the category, total "silk," was natural silk fabric in 1955, and no special emphasis on expansion of this phase of the industry is expected.

Production of fabric from silk and manmade fibers in relation to production of other textiles by the Ministry of Light Industry is shown in millions of linear meters in Table 2.

Table 2

Estimated Production of Fabrics Made from Manmade and Natural Fibers  
in the USSR  
Selected Years, 1955-57, and 1960 Plan

Type of Fabric	Million Linear Meters				1960 Plan as Percentage of 1955
	<u>1955 a/</u>	<u>1956 a/</u>	<u>1957 b/</u>	<u>1960 Plan c/</u>	
Cotton	5,905	5,452	5,600	7,270	123
Linen	306	383	425	556	182
Manmade fibers d/	526 e/	754	805	1,074	204
Wool	252	268	282	363	144

a. 32/b. 33/c. 34/

d. Including fabrics of natural silk and artificial and synthetic fibers.

e. In 1955, 90 percent of all "silk" fabrics were made from artificial and synthetic fibers, according to official statements.

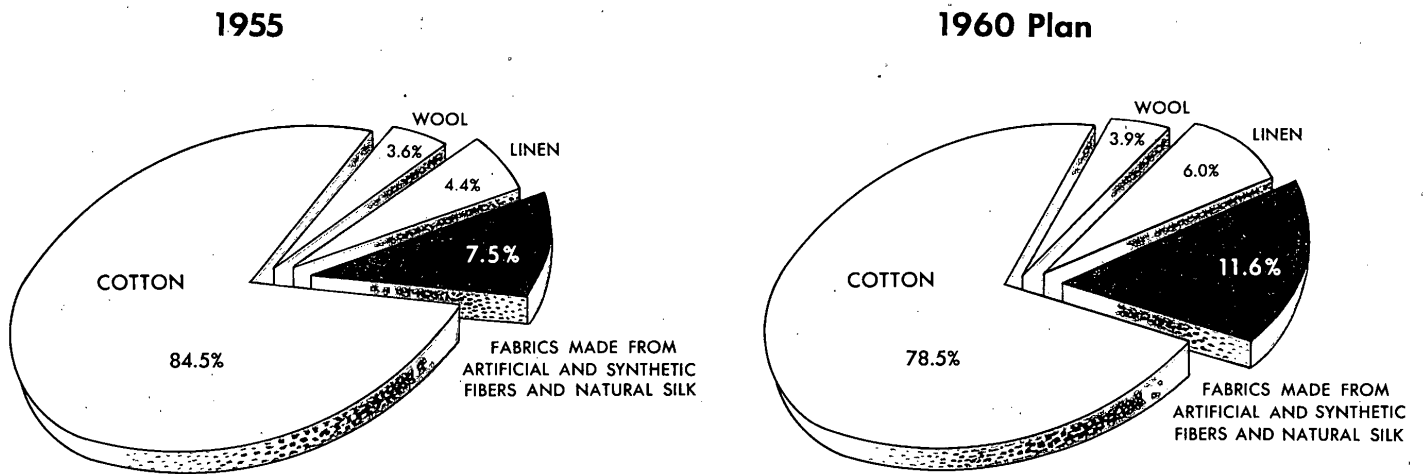
In line with the Soviet policy of developing alternative sources of raw materials to supplement agricultural raw materials used by light industry, substantial increases will be realized through increased production of types of synthetic fiber already developed and by introducing new types into production.

It is important that the plan for total production of "silk" fabrics (including all fabrics made from artificial and synthetic fibers) in 1957 allowed for a mere 6-percent increase in comparison with

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**USSR: FABRICS MADE FROM MANMADE AND SILK FIBERS  
AS PERCENTAGES OF TOTAL PRODUCTION OF TEXTILE FABRICS  
1955 AND 1960 PLAN**



(Percentage in terms of Linear Meters)

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production in 1956, a development which forecast difficulty in achieving the original goal for 1960. Annual increases of approximately 15 percent during 1956-60 would be required to raise production to the level of 1,074 million linear meters by 1960. Because production of "silk" is relatively small, however, a large percentage change could result from the activation of 1 or 2 additional plants.

B. Supplementing of Natural Fibers.

The Soviet textile industry, if it is to continue to expand from 1957 on, must lessen its dependence on production of the natural fibers -- cotton, wool, silk, and linen -- and must increase supplies of manmade fibers or turn increasingly to imports. Although the USSR is faced with plans for rapid growth of the textile industry, basic domestic raw materials for this industry are inadequate to support expansion. Because the basic materials for the textile industry are agricultural products, the expansion program for production of synthetic fiber is fundamentally related to agriculture. Weakness in the supply of basic material was demonstrated recently in production of cotton cloth. Because of a poor yield of cotton in the previous year, production of this important fabric in 1956 failed to meet the plan and even dropped to less than 1955 production by more than 400 million linear meters. 35/

Synthetic fibers have many advantages as supplementary materials to the natural fibers which now principally support the textile industry. The chief advantage, once the industry is developed, will be that of economy, because the materials basic to production of synthetic fiber are largely coal, petroleum, and natural gas. Thus the supply of raw materials is not expected to become a problem. Furthermore, synthetic fibers may be blended with natural fibers or woven unmixed, using much of the textile machinery already existing. For example, not only is blending synthetic fiber with wool possible, but the processes of spinning and weaving are actually facilitated by blending. A further advantage is that synthetic fibers may be produced in numerous forms with many combinations of desirable properties, some of which are not found in natural fibers. For example, resilient, woollike fibers from lavsan or nitron for knitted or worsted fabrics are quick drying and do not shrink; strong monofilament types, such as kapron, are superior for hosiery, lingerie, and other knitwear because of their wearing qualities; and various staple types are suitable for many kinds of artificial furs.

Textiles for industrial and military uses require numerous special properties which may be developed from synthetic fibers. Some important properties in which various synthetic fibers show to advantage over other competing fibers are (1) tensile strength, (2) resistance

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to wear, (3) resistance to shrinkage, (4) resistance to wrinkling, (5) ability to withstand high temperatures, and (6) resistance to mildew and moth damage.

An additional advantage to the USSR in solving shortages of fabric by use of synthetic fiber is that 1 metric ton of fiber is sufficient to produce up to 15,000 meters of cloth, or almost twice the amount produced on the average from an equivalent weight of cotton. In linen and woolen materials the difference is even greater.

## VI. Types of Fibers.

Although kapron is at present the only synthetic fiber in the USSR important from the point of view of production, Soviet technical literature contains much material on most of the types well known in the US. In addition to kapron, a few types are in limited commercial production or are produced on the basis of pilot plants. Other types may be in some stage of laboratory research. For some types, the progress of Soviet researchers hardly has gone further than mere perusal of Western journals.\*

### A. Types of Nylon.

#### 1. Kapron.

Kapron is the Soviet name of a fiber that belongs to the nylon, or polyamide, group. Kapron is one of the two main types of polyamides produced in the world to date, the other being nylon 66, which was developed by E.I. du Pont de Nemours and Company, Incorporated, of the US, and chosen for commercial production in the US. Perlon was developed by Germany from the caprolactum base and became available in that country by 1940. It is the chief synthetic fiber in the European Satellites, where it is produced under several different names.

Caprolactum for Soviet production of kapron is manufactured at Plant No. 96 in Dzerzhinsk. Production by this plant of caprolactum supplies the Klin plant and possibly the Kiev plant for their polymerization and extrusion processes. The plants at Klin and Kiev produce no caprolactum.

#### 2. Anid.

The USSR recently has developed a type of nylon 66 named anid, and small amounts are being produced. According to Soviet laboratory experience, anid surpasses kapron in strength, resistance

\* For a listing of types of fiber and their components, see Appendix A.

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to light, heat stability, and resilience. Intended uses for anid are largely industrial although its merits for use in light industry are recognized. 36/

3. Enant.

The USSR has reported development of another fiber of the nylon group.

50X1  
50X1

Soviet scientists claim that enant fiber is superior to kapron in elasticity, durability, and simplicity of production.

4. Rilsan.

Rilsan, which was developed in France from castor beans, is becoming increasingly important in that country and to some extent abroad. Although the USSR has claimed mastery of this process, a thorough study of the possibilities of production results in the conclusion that no rilsan is being made in the USSR. Reasons for this conclusion are that (a) the process is more costly than other processes for producing nylon, though physically simpler, and (b) the basic commodity, castor beans, are a strategic item already in short supply throughout much of the world.

B. Lavsan.

Lavsan, which is of the polyester type, is at present the only fiber-forming polyester of commercial significance in the USSR or in any country. 38/ In the UK, where the polymer was discovered and the process developed, the fiber is named terylene.

The USSR in 1955 initiated an intensive campaign to perfect a method for producing lavsan. Having failed to negotiate successfully for the British process with Imperial Chemical Industries, Limited, of the UK, the USSR made arrangements with East Germany for a joint effort to develop a process for lavsan. By the end of 1956, East German scientists in their research on lavsan had reported progress successful enough to begin commercial production. 39/ Following this development the USSR in 1957 negotiated a contract with Frederick Krupp, Incorporated, in West Germany for construction of a \$4-million plant in the USSR to produce lavsan.

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Lavsan has been chosen by Soviet experts on textiles as the best synthetic fiber which may be substituted for wool. <sup>40/</sup> This decision accounts for the magnitude of effort which the USSR has exerted to obtain the process for lavsan because wool is generally a scarce commodity.

C. Orlon and Related Types.

Orlon and related types of fibers, of which the USSR produces small quantities, are known scientifically as the vinyl and acrylic group and are related by the nature of the basic chemicals involved rather than by a similarity of properties of the fibers themselves. This group includes not only such woollike fibers as orlon and acrilan, which are suitable for clothing, but also the smooth, tough monofilaments such as saran, which are used in luggage, footwear, and upholstery. The USSR is producing small quantities of two of the fibers of this group, nitron and khlorin, and is experimenting with others of these fibers.

1. Nitron.

Nitron is of great importance because of its woollike properties. Discovery of this fiber is claimed by Y.S. Roskin of the Leningrad Textile Institute. After 4 years of research in synthetic fibers, he reportedly produced polyacrylonitrile using coal, petroleum, lime, and nitrogen. <sup>41/</sup> The process actually was developed by the US, and pilot production began in 1946.

Nitron has been produced commercially on a limited basis in the USSR since 1955. Some quantities of nitron are produced at the Kalinin Artificial Fiber Combine, north of Moscow. Although knowledge on the use of nitron is incomplete, some consignments are known to have been made to plants of the woolen industry, where nitron fibers presumably were blended with wool before weaving. Nitron is noted for its resemblance to wool in qualities of warmth, high durability, resistance to shrinkage and creasing, and ease of laundering.

2. Khlorin.

Khlorin is a polyvinylchloride fiber already in production in the USSR. Khlorin is made from a thermoplastic material, which means that it is softened by heat and hardened into shape by cooling. Properties of khlorin include resistance to chemicals, stains, abrasion, corrosion, and moisture. Khlorin, which is not flammable, is tough and flexible. Although the specific use of this fiber in Soviet

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industry cannot be determined, its application in the US is made largely in the footwear and upholstery industries.

3. Vinyon and Acrilan.

Other types of vinyl and acrylic fibers mentioned in Soviet research literature are vinyon and acrilan (the US terms are used by Soviet writers). These fibers are still in experimental production in the USSR: there is no commercial production.

Vinyon in staple form blends with cotton or wool for use in felt and in fabrics in which creases or folds must be retained. Fabrics of vinyon monofilament yarn are suitable for acid- and alkali-resistant clothing, shower curtains, fireproof awnings, and other industrial uses.

Vinyon is a silklike filament suitable for dress goods, rainwear, and a number of industrial uses. In its staple form (monofilament cut to the length of wool or other natural fiber), vinyon is an excellent substitute for wool in clothing and blankets.

Acrilan is also woollike in character and blends well with natural wool fiber or with rayon.

D. Other Types.

Casein fiber and glass fiber are synthetic fibers, which, although of lesser importance in production of consumer goods, are known to be produced in the USSR.

1. Casein Fiber.

Several plants in the vicinity of Moscow reportedly were producing casein fiber in 1955. <sup>42/</sup> Casein fiber is significant in the over-all fiber industry only because the process is known and production has been accomplished. Because production of casein fiber is based on the important and still-somewhat-scarce food product, milk, it has been doubtful from the start that interest in this fiber would become more than academic.

This doubt was confirmed by Khrushchev in 1956 when at the Twentieth Party Congress he said, "Up to now a great quantity of foodstuffs have been used for the production of technical items ... All these things can be successfully substituted for with byproducts from the refining of oil, coal, and natural gas. By all means, by the end of the Sixth Five Year Plan [1956-60] we must insure that foodstuffs used for technical purposes are supplanted by synthetic raw materials." <sup>43/</sup>

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2. Glass Fiber.

Glass fiber is principally an industrial commodity used as insulating material in electrical installations, as building insulation and soundproofing, and as filtering material in air cleaners. In the area of consumer goods, glass fiber is used in curtain and draping cloth and in fireproof fabric.

In the USSR, glass fiber is used exclusively for industrial purposes, although glass fiber fabrics may be used for production of consumer goods in the future. The lack of glass fiber textiles may be a result of the greater precision required to produce fiber pure enough for production of textiles -- a purity which must equal the better grades of optical glass. <sup>44/</sup> The molten glass must be free of bubbles, which ultimately would weaken the fabric, causing breaks in the weave.

The USSR claimed to be increasing production of glass fiber under the original Sixth Five Year Plan (1956-60). Production in 1960 is scheduled to total 5,000 tons. <sup>45/</sup> Previously, only about one-half of the Soviet demand had been supplied by Soviet industry, the remainder coming from plants in Czechoslovakia producing glass fiber.

VII. Uses.A. Light Industry.

Synthetic fiber has been welcomed as a superior raw material by Soviet light industry because it offers a combination of cheapness, fineness, and strength in yarn materials. The great bulk of synthetic fiber produced goes to the traditional textile mills where it is processed into pure synthetic yarns or blended with other fibers. The silk industry at present receives the greater part of synthetic fiber although the woolen industry will receive an increasing share as production of substitutes for wool increases.

In spite of problems of adaptation to conventional machinery, the various types of synthetic fibers are being processed on existing spinning and weaving equipment. In certain cases, mechanical alterations are necessary. In other cases, adaptation is achieved by altering the character of the fiber itself.

1. Silk Industry.

A UK textile man has stated that "there is no trade where one is more aware that the old name has lost all real meaning than in

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the silk trade." This statement is no less true in the USSR than in Western countries, where the silk industry is concerned almost entirely with manmade fibers.

Between World War I and World War II, artificial fiber and fabric made from artificial fiber proved such an attractive substitute for natural silk that the industry in the Western world was revolutionized. During the era after World War II, with the advent of synthetic fibers in quantity, a second revolution has been under way. <sup>46/</sup> In the USSR this new revolution is just beginning, at a time when the first revolution -- that in artificial fiber -- has not yet reached its peak.

In the USSR, as in the West, synthetic fiber entered the consumer goods market as a product of the knitwear industry, particularly in the manufacture of full-fashioned hosiery. Supplies recently have been more abundant than in earlier postwar years, but prices continue to be prohibitive for general wear on a scale comparable to that in the West.

In Western textile trades it is considered unique that raw material for production of hosiery has changed twice within 30 years -- from silk and cotton to artificial fiber and from artificial fiber to nylon. In the USSR this development has not occurred. Of the raw materials which supported Soviet hosiery mills in 1955, only 9 percent was kapron, whereas 10 percent was rayon, 79 percent cotton, and 2 percent wool. <sup>47/</sup>

## 2. Wool Industry.

Although synthetic fiber of woollike character is produced in the USSR in extremely limited quantities, the potential of synthetic fibers in this industry is great. Additions of cotton or artificial fiber to the spinning and weaving processes tend to cheapen the product, but synthetic fiber in some cases increases the acceptability of high-quality wool fabric. It has been found in Western industry that even in the so-called 100-percent wool fabrics the addition of 2 to 5 percent of nylon facilitates spinning and weaving by reducing breakages. Experimental blending indicates that for acrilan, dynel, and orlon up to 30 percent of these fibers may be added to the wool with little change in properties of the material. Blends of wool with synthetic fibers in knitted products increases resistance to wear and prevents felting and shrinkage from laundering.

Even limited additions of synthetic fiber to the Soviet wool industry will make possible improved blends with new, reused, or

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reclaimed wool and with other traditional fibers. Thus will be opened development of entirely new and more varied yarns and fibers.

### 3. Other Consumer Industries.

In the use of synthetics in wearing apparel, a field where so much has been accomplished in the West in the period after World War II, the USSR hardly has made a start. Except for kapron stockings, few articles of apparel are produced from synthetic fibers. Nevertheless, Soviet planners are aware of the progress made abroad and of the advantages to be gained in the Soviet economy by rapid development of synthetic fiber. One of the major advantages to the USSR will be to ease somewhat the pressures on the Soviet agricultural system. Recently, however, the apparent willingness of the government to make concessions to the consumer has added new interest to synthetic fiber as a raw material for light industry. Some of the characteristics of synthetic fibers for apparel which are lacking in traditional fibers are (a) adaptability for blending, (b) qualities of "wash and wear," (c) wrinkle resistance, (d) greater tensile strength and resistance to abrasion, and (e) variety in texture and surface appearance.

To a lesser extent, other uses of synthetic fiber have been made in light industry in the USSR. Pile fabrics of kapron, which resemble various types of natural fur, and various other plush fabrics are produced in limited quantities. In the footwear industry, kapron net fabric is being used as a supplementary material in combination with leather and artificial leather.

#### B. Nonconsumer.

Aside from its uses in textiles and clothing, synthetic fiber is important in production of military items, especially parachutes, and in filling various industrial needs. In the US during World War II, military and industrial applications increased rapidly as new fibers were developed. The USSR presumably will develop a similar pattern of applications, and in a number of areas this pattern already has begun.

##### 1. Military.

As a parachute cloth, kapron rates high in providing the special qualities desired and surpasses silk, which was in general use before synthetic fiber became available. In the USSR kapron has been available for use in parachutes since about 1950. Important physical properties of kapron include (a) high tensile strength, permitting sheer but tough fabric which is light in weight; (b) high dimensional stability with excellent recovery from strains; (c) superior resistance to abrasion, which affords long wear; (d) low moisture

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absorption with high strength when wet; and (e) successful storage for indefinite periods without danger of mildew or decomposition.

In military clothing, synthetic fiber has proved valuable. Certain qualities in garments are improved by the use of synthetic fiber either in purely synthetic fabrics or blends with conventional fibers. For example, a wool fabric for uniforms may be improved by additions of synthetic fiber to provide better surface characteristics, a longer life for the garment, and the ability to retain a permanent crease. In the US, orlon types of synthetic fiber were approved in 1951 for blending with all-wool fabrics for uniforms, after scientific tests proved the blend to be superior to pure wool fabrics.

Blankets made of orlon and similar types of fiber used by the military services are in some ways superior to wool blankets, because these blankets do not shrink, are light in weight, and, being quick to dry, launder more easily than wool. The US military services also have approved synthetic fiber of the orlon type for use in drapery fabric, in aircraft upholstery, and under conditions where nonflammability especially is desired. 48/

## 2. Industrial.

Industrial applications of synthetic fibers are based primarily on their superlative strength and their resistance to heat, abrasion, and the action of chemicals. Not all of these characteristics are equally important in every application, nor does every type of fiber possess characteristics to the same degree of perfection.

For example, the nylon types, being exceedingly strong, are suitable for tire cord and are especially valuable for tires on heavy airplanes, where the tires are subject to sudden loads during landing. For casings of automobile tires, Soviet test results showed that "cord from polyamide fiber increases the life of tires [and that the] quality of tires, particularly heavy truck tires made from kapron cord is raised not less than 30 percent ... . By raising the life of tires from polyamide cord it is possible to obtain a saving of not less than 150 million rubles per million tires." 49/ A further saving of 20 percent of the rubber required for the tire industry is anticipated by the industrial planners. 50/

During the years immediately ahead the USSR hopes to raise the share of kapron cord used in its production of tires, although the present Soviet use of kapron cord in tires is small. According to published data, of tires currently produced in the USSR, 70 percent are of cotton cord and 30 percent are of viscose and kapron cord. 51/

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Strength again is the determining factor in the use of nylon types of synthetic fiber for towropes and many other types of rope and cord. Other properties give additional advantages such as lightness of weight and the characteristic of quick drying.

In some, but not all, filtering devices, types of nylon are superior to other types of synthetic fiber. Nylon filter cloths have high wet strength and are useful for alkaline or neutral liquids but not for acids. For dye bags and laundry nets these fibers are knit into fabrics which have a low moisture absorption and a long working life.

The dacron type is successful as an industrial fabric because of heat resistance and dimensional stability. These properties in turn provide economies in lengthening the life of the device in industry. Uses include filters for fertilizer plants and wool grease recovery plants, application in silica sand separation where abrasion is high, and the like. In the electrical field the potential of dacron is large and varied, with dacron's being used wherever there is need for a combination of strength, flexibility, and good insulating properties. High wet strength, low moisture absorption, and resistance to mildew are additional excellent properties.

Orlon and related types of fiber share certain features of nylon and are free of some of its shortcomings. In other properties such as strength and toughness, they are inferior to nylon. In qualities needed for industrial use these fibers offer superior chemical resistance, greater modulus of stretch, and increased dimensional stability. These fibers are used in dust fume bags, in nettings for dye houses and laundries, and as bonding fibers and fabrics. The property of chemical resistance permits many varied uses of these fibers as industrial fabrics in the chemical industry.

### VIII. Capabilities, Limitations, and Intentions.

#### A. Capabilities.

From a long-range point of view, the USSR is capable of expanding and developing its synthetic fiber industry in a manner comparable with development in the US. The potential for such an industry in the USSR appears great, but the low priority to which it has been relegated until recently has tended to retard laboratory research. In addition, low priority has retarded the initiation of new processes necessary to the expansion of the industry. For example, although the process for nitron has been mastered in the laboratory, the USSR intends to purchase a plant in West Germany

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to put the fiber into production. In the West, meanwhile, competition among the industrial companies developing synthetic fiber has stimulated great progress in both research and production.

Since the death of Stalin, and particularly during the period 1956-60, the USSR has shown an intense interest in synthetic materials, and plans for production of fiber have been accelerated. To the good fortune of the builders of the industry, raw materials basic to production are plentiful, and technological information from journals of Western industry is abundant.

B. Limitations.

At present, one limitation of the synthetic fiber industry in the USSR appears to be shortages of qualified specialists and skilled workers required to man the various phases of production. These shortages result in an inability to implement processes worked out by research. Another limitation is the failure of the machine building industry to design and produce equipment needed for the new processes. This failure forces the USSR to place considerable reliance on foreign-made machinery.

C. Intentions.

Developments in the synthetic fiber industry in the USSR at this time do not reflect present Soviet military intentions. The industry is needed badly from the point of view of the consumer although up to now both military and civilian needs have been served by the meager production of the industry. In the case of an emergency for war, however, the greatly expanded industry envisioned by the planners would be ready to meet the increased military demands and would require, in the process of conversion, a minimum of changes in operations of the plants.

The USSR intends to accelerate expansion of the synthetic fiber industry at a rate much greater than that for other branches of light industry in order (1) to introduce new types of fibers as another demonstration of scientific progress, (2) to relieve some of the pressures on the agricultural sector for raw materials to support production by light industry, (3) to improve the supply and quality of clothing and other types of consumer goods, and (4) to satisfy needs for special materials for industrial applications and for military uses.

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## APPENDIX A

TYPES OF SYNTHETIC FIBERS AND THEIR COMPONENTS\*

<u>Group</u>	<u>US Name</u>	<u>Soviet Name</u>	<u>Intermediate Chemicals</u>	<u>Basic Materials</u>
Polyamide	Nylon 6	Kapron**	Caprolactum	Petroleum or coal tar
	Nylon 66	Anid	Polyhexamethylene-adipamide	Petroleum, coal tar, or agricultural wastes
	Nylon 7	Enant	Amino-enanthic acid	Coal tar
	Nylon 11	Rilsan	Sebacic acid	Castor oil
Polyester	Dacron	Lavsan***	Polyethylene terephthalate	Petroleum or coal tar
Vinyl and acrylic	Vinyon	Vinyon****	Vinylchloride and vinylacetate	Natural gas or coal
	Vinyon N	Vinyon N****	Vinylchloride and acrylonitrile	Acetylene, chlorine, and petroleum or coal tar
	Orlon	Nitron or nitrilon	Polyacrylonitrile	Petroleum
	Acrilan	Acrilan****	Acrylonitrile plus other polymers	Petroleum
	Geon	Khlorin	Polyvinyl chloride	Petroleum or coal and salt (NaCl)
	Saran	Soviden	Vinylidene chloride	Petroleum or coal and salt (NaCl)
	Fluorides	Teflon	Ftorlon	Tetrafluoroethylene

\* 52/\*\* In Germany this fiber is named perlon.\*\*\* In the UK this fiber is named terylene.\*\*\*\* The terms vinyon, vinyon N, and acrilan are US terms but are used also in the USSR, apparently having no Soviet counterpart. Vinyon N, in staple form, is named dynel.

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## APPENDIX B

GLOSSARY

A technical study of production of synthetic fibers and of fabrics made from synthetic fibers in the USSR requires the use of special terms. Further complicating the use of these terms, a number of them, especially names of fibers, have other names in the US, the UK, and Germany, and these other names must be used in conjunction with the country producing the fiber. Whenever feasible, the Soviet names are used in this report, and in this glossary the pertinent foreign equivalents of names of fibers are presented in each case. When a definition in this glossary contains a technical term, this term, in turn, is explained in a separate entry in the glossary. Definitions of terms are based primarily on Linton, George E., The Modern Textile Dictionary, Boston: Duell, Sloan and Pearce -- Little, Brown and Company, 1954; Webster's New International Dictionary of the English Language, second edition, unabridged, Springfield, Massachusetts: G. and C. Merriam Company, Publishers, 1934 (reprinted several times, with additions, through 1955); and The Van Nostrand Chemist's Dictionary, New York: D. Van Nostrand Company, Incorporated, 1953.

Acrilan. A product of Chemstrand Corporation of the US. It is an acrylic fiber which has many characteristics comparable to wool, such as warmth, softness, stability, recovery from wrinkling, and resistance to deterioration. Although acrilan is used mainly in blending with wool, it also is blended with viscose artificial fiber. Up to now in the Soviet press the term used in the USSR has been the same as in the US.

Anid. The Soviet term for nylon 66 which is derived from polyhexamethylenedipamide, a derivative of petroleum, coal tar, or agricultural wastes. (See Nylon 66.)

Artificial Fiber. A term synonymous with rayon fiber. Artificial fibers are cellulose based, not chemically based, fibers. The process is one of rearrangement of the cellulose molecules rather than chemical change. Basic materials are woodpulp and cotton linters.

Caprolactum. An intermediate product in the synthesis of kapron. Its source is phenol, which usually is derived from coal tar.

Casein Fiber. Synthetic protein fiber made from casein precipitated from skim milk. When cut to staple length, the fiber has many of the properties of wool. Lanital, an Italian product, was the first casein fiber to appear in the trade.

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Copolymer. The product of polymerization when 2 or more different monomeric substances are used instead of 1. Nylon is an example of a copolymer.

Cotton Linters. The short cotton fibers which cover the seeds of cotton after the fiber has been removed at the cotton gin. Among its uses is that of a raw material in the manufacture of artificial fibers.

Dacron. A polyester textile fiber produced by E.I. du Pont de Nemours and Company, Incorporated, of the US. Dacron was developed in England under the name of terylene, and US rights were granted in 1946. It is a condensation polymer obtained from ethylene glycol and terephthalic acid. The fiber in no way is related chemically to nylon or orlon. Staple fiber of dacron blends excellently with wool. Dacron filament yarn finds use in household and clothing fabrics and has numerous industrial uses. In the USSR this fiber is called lavsan. (See Lavsan and Terylene.)

Denier. A unit expressing the fineness of silk, artificial fiber, or nylon yarns in terms of weights in grams per 9,000 meters of length. Thus 100-denier yarn is finer than 150-denier yarn.

Dynel. A staple fiber spun from a copolymer of acrylonitrile and vinyl chloride. The name distinguishes it from the older vinyon yarns developed by Union Carbide and Carbon Corporation of the US. Features of this fiber include strength, warmth, quick-drying properties, and good dimensional stability. It is acid and alkali resistant and is not flammable. (See Vinyon.)

Enant. The Soviet name for nylon 7 when derived from amino-anthic acid, which is, in turn, a derivative of furfural. (See Nylon 7.)

Ester. A compound formed by replacement of the hydrogen of an acid by a hydrocarbon radical.

Geon. Polyvinylchloride fiber produced by the B.F. Goodrich Company of the US. Geon is a monofilament, and fabric woven of geon fiber is used largely in upholstery material. In the USSR this type of fiber is known as khlorin. (See Polyvinyl Fiber and Khlorin.)

Glass Fiber. Textile fibers and yarns produced from glass which, when drawn fine enough, can be woven into strong, flexible fabrics. Glass fiber is produced in both monofilament and staple form.

Intermediates. Materials formed by the chemical processing of basic raw materials which must be subjected to further chemical reactions to yield the final product.

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Kapron. The synthetic fiber in greatest production in the USSR. In the US this fiber is named nylon 6 and in East Germany perlon. The intermediate chemical is caprolactum, which is derived from petroleum or coal tar. (See Nylon 6 and Perlon.)

Khlorin. The Soviet term for the polyvinylchloride fiber geon. (See Polyvinyl Fibers and Geon.)

Lavsan. The Soviet name for the US polyester fiber, dacron, and the British fiber, terylene. (See Dacron and Terylene.)

Manmade Fiber. A composite term which includes fibers synthesized either from cellulose or from chemical bases. Manmade fibers are neither of plant nor of animal origin in the traditional sense. Thus the term manmade fibers includes artificial and synthetic fibers.

Monofilament. A continuous filament or strand from artificial or synthetic material -- that is, the filament is uncut as is staple fiber.

Monomer. A single molecule, or a substance consisting of single molecules, having a relatively low molecular weight. In relation to synthetic fiber, a monomer is the simple unpolymerized form of a compound and thus is differentiated from a polymer.

Nitron. The Soviet name for the acrylic fiber, orlon. (See Orlon.)

Nylon 6. A type of nylon produced in countries of the Soviet Bloc. In the USSR this fiber is named kapron and in East Germany perlon. Nylon 6 is much less significant than nylon 66 in commercial production in the US. Its chemical intermediate is caprolactum. (See Kapron and Perlon.)

Nylon 7. A type of nylon of little use in Western countries. In the USSR it is derived from amino-enanthic acid from furfural and is named enant. It is an industrial fiber rather than a fiber of light industry. (See Enant.)

Nylon 11. A synthetic fiber made from castor beans. It is named rilsan in France, where it was developed. (See Rilsan.)

Nylon 66. The most common nylon fiber produced in the US. The intermediate chemical is polyhexamethylene-adipamide from coal, petroleum, or agricultural wastes. Textile uses of this fiber are for items of apparel such as hosiery, lingerie, dress goods, and shirting; industrial uses, for tire fabrics, filter fabrics, laundry netting, pressing fabrics, belting, and fuel cells. (See Anid.)

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Orlon. A continuous filament or staple fiber produced by E.I. du Pont de Nemours and Company, Incorporated, of the US. The product is based on a polymer of acrylonitrile and therefore is classed as an acrylic fiber. Features of orlon include resistance to sunlight, stability, little or no shrinkage, a soft warm feel, and good draping characteristics. In the USSR this fiber is named nitron. (See Nitron.)

Perlon. The type of nylon fiber produced in East Germany. (See Nylon 6 and Kapron.)

Pile. The raised loops or tufts that form all or a portion of the surface of a fabric. The pile can be cut, uncut, looped, or curled.

Plush. A pile fabric having a pile which measures 1/8 inch or more. Artificial and synthetic fibers, as well as silk, cotton, and wool, can be used to manufacture plush.

Polyamide. A complex hydrocarbon, the molecule of which contains nitrogen. The various types of nylon, including kapron, belong to the polyamide group. Basic materials include petroleum, coal tar, and agricultural wastes. Literally thousands of condensates, or polymers, can be obtained by the various processes, and properties of the polymers in each case depend upon the chemical structure of the intermediates.

Polyester. Long-chain high-molecular-weight esters produced by esterification of two or more molecules of hydroxy fatty acids. The process is basic to production of lavsan. Coal and petroleum are the raw materials used.

Polymer. A comparatively large molecule produced by linking together many molecules of a monomeric substance. Such a reaction is known as polymerization.

Polymerization. The chemical reaction in which molecules of a monomeric substance are linked together, thus yielding a compound having a higher molecular weight and different physical properties.

Polyvinyl Fiber. High-tenacity filament obtained by polymerizing vinylformate or vinylacetate. (See Geon and Khlorin.)

Rayon. A term synonymous with artificial fiber. (See Artificial Fiber.)

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Rilsan. A synthetic fiber made from castor beans. It is the type of nylon 11 which was developed by the French and is produced on a large scale only in that country. (See Nylon 11.)

Saran. A chemical fiber of polyvinylidene chloride, which is derived from ethylene, a petroleum product, and from brine. It is produced by Dow Chemical Company of the US and is used for screen cloth, luggage, upholstery, draperies, and footwear. The Soviet type is named soviden. (See Soviden.)

Soviden. The Soviet name for the polyvinylidene chloride fiber, saran. (See Saran.)

Staple Fiber. Filaments of manmade fiber which have been cut to the length of natural fibers such as wool or cotton.

Synthetic Fiber. Chemically based fiber such as nylon, orlon, and dacron as differentiated from cellulose-based fibers which are types of artificial fiber. The basic monomers are synthesized from such raw materials as coal, petroleum, and agricultural wastes by a linking reaction known as polymerization.

Tensile Strength. The number of pounds of resistance that a fiber or fabric will give before it breaks.

Terylene. The UK counterpart of the US fiber dacron. In the USSR this fiber is named lavsan. The terylene process was discovered by the UK although the USSR also claims development of the process. (See Dacron and Lavsan.)

Vinyon. A copolymer of vinylchloride and vinylacetate produced by Union Carbide and Carbon Corporation of the US. The textile fiber is produced by American Viscose Corporation of the US. The fabric is warm to the touch and compares favorably with silk or wool. In its staple form, named dynel, it may be blended with cotton or wool to yield fabric which permanently retains creases and pleats. Dynel is also a superior material for production of blankets and warm clothing. Vinyon is suitable for dress goods, bathing suits, rainwear, and a number of industrial uses. (See Dynel.)

Vinyon N. A copolymer of vinyl chloride and acrylonitrile which differs basically from vinyon. The resin is dissolved in acetone and is spun on equipment similar to that used to make acetate. Properties of vinyon N include warmth and resistance to perspiration and mildew, and vinyon N does not cause allergic reactions. Fabrics of vinyon N are suitable for dress goods, bathing suits, foundation garments, rainwear, and industrial filter devices.



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## APPENDIX C

PLANTS IDENTIFIED WITH PRODUCTION OF SYNTHETIC FIBERS IN THE USSR

<u>Location and Name</u>	<u>Coordinates</u>	<u>Type of Plant</u>	<u>Product</u>	
Dzerzhinsk, Plant <input type="text"/>	56°15' N - 43°29' E	Chemical	Caprolactum (for kapron)	50X1
Dzerzhinsk, Rulon Plant	56°15' N - 43°29' E	Chemical	Adipic acid and hexamethylene diamine (for anid)	
Klin, Plant <input type="text"/>	56°21' N - 36°45' E	Textile	Kapron fiber and thread	50X1
Kiev, Artificial Fiber Combine	50°27' N - 30°32' E	Textile	Kapron fiber and thread	
Moscow, Kuskovskiy Chemical Plant	55°45' N - 37°35' E	Chemical	Vinyl mono- filament	
Kalinin, Artificial Fiber Combine	56°50' N - 35°55' E	Textile	Nitron fibers	
Kishinev, Chemical Plant	47°01' N - 28°50' E	Chemical	Khlorin fibers	

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## APPENDIX D

METHODOLOGY

Data on production of synthetic fibers and of fabrics made from synthetic fibers in the USSR is generally not available, because Soviet statistical reports group synthetic fiber with artificial and natural silk to present a total, always referred to as silk. That such information is not separated out is hardly surprising in consideration of the rudimentary stages of development of the Soviet synthetic fiber industry and the meagerness of its production of natural silk. Numerous descriptive references have appeared in the Soviet press and industrial publications on various types of synthetic fibers since 1950. Only recently has any reference been made to production in absolute terms. Production in the USSR in 1955 and goals for 1960 were given, but for total synthetic fiber only. No data have been published to permit a breakdown of types of to show quantities of production of fabric or of knit goods. In this report, estimates of production of individual types of fiber were made by using the official total of production and applying data on individual plant capacities.

Data have been published to show what part of the total manmade fiber that synthetic fiber represents. It is known from Soviet publications what percentage of knitwear, for example, and what percentage of hosiery are of manmade fiber, thus making possible rough judgments of the importance of synthetic fiber in light industry.

To study the synthetic fiber industry in the USSR, it was necessary to relate it to the synthetic fiber industry in Western countries. The US has the best of the Western industries for comparison because new technology has developed most rapidly in the US. Many types of fibers are under research in the US, and new fibers continue to enter mass production yearly. The USSR, however, draws on technological information from the US and other Western countries. There are innumerable possibilities in the types of synthetic fibers which can be developed and manufactured, but types of fiber that are produced in the USSR or which are included in the research programs in the USSR are invariably the types developed elsewhere in the world, especially in the US.

A view of the technological progress of the USSR was provided by a report of the 1957 meeting of CEMA in which specialists in synthetic fiber planned the future progress of the industry. This report was a study in detail of the capability and intentions of the synthetic fiber industry in the USSR.

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To place synthetic fiber in perspective as a material for light industry, the fiber was shown, in this report, in relation to production of other silk and "silklake" fibers and fabrics. Such a relationship shows, again, the extent of the upward trend in Soviet production of synthetic fiber for the future. Speeches of Soviet leaders provided additional evidence of increased emphasis on development of the industry.

Discussion of the uses of synthetic fiber in industry (contrasted with consumer uses) was based on US experience. The study of military uses, except for information on production of parachutes, also was based on analogy with the US.

Total production of artificial and synthetic fiber in the USSR in 1955 amounted to 110,500 tons.\* 53/ Production of synthetic fiber was 8,800 tons, 54/ leaving a balance of 101,700 tons as the amount of artificial fiber produced.

Soviet production of synthetic fiber for 1956 and 1957 has not been announced in detail but has been derived from estimates based on official figures and other data. Production of artificial and synthetic fiber together totaled 128,900 tons in 1956 according to official Soviet data, 55/ and production for 1957 was reported to be 149,000 tons. 56/

Production of synthetic fiber in 1956 was reported  to be 8 percent of total manmade fiber. The figures for production in 1957 represent an estimate based on an interpolation between figures for 1955 and 1960 (using the plan goal for 1960), which gave an annual average rate of increase of 38 percent. Production of artificial fiber is derived by difference.

Although information about the capacity of plants for synthetic fiber is incomplete, certain descriptive information tends to confirm data on production which have been reported officially. Production of kapron comprises about 90 percent of total production of synthetic fiber in the USSR. Plant  at Dzerzhinsk, sole producing plant for caprolactum, has an estimated productive capacity of 7,000-12,000 tons per year. 58/  estimated  production of caprolactum began in May 1949.

in 1951 the entire output of caprolactum at Plant  at Dzerzhinsk, was transferred to Plant  at Klin, for polymerization and spinning. 59/ By 1954, Plant

\* P. 13, above.

50X1

50X1

50X1  
50X1

50X1

50X1

50X1

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was reported officially to be producing 5,000 tons of kapron fiber.\* 60/  
The Artificial Fiber Combine, a plant for spinning synthetic fiber,  
at Kiev, produces kapron and now is believed to be receiving  
caprolactum from Plant [redacted] at Dzerzhinsk. Production of this  
plant is not known but is probably about 3,000 tons.

50X1

\* The conversion rate of caprolactum to kapron is probably about  
90 percent -- for example, for every 10 tons of caprolactum, 9 tons  
of kapron may be obtained.

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