THE PATTERN OF SCIENTIFIC AND TECHNOLOGICAL TRAINING IN THE U.S.S.R.

The New Development in Novosibirsk

By DR. C. R. S. MANDERS, M.A., M.Sc., Ph.D., A.K.C., F.Inst.P.

A meeting of the Society was held at The Royal Society's Hall, Burlington House, Piccadilly, London, W.1, on Wednesday, April 6, 1960, at 1.30 p.m., when Dr. C. R. S. Manders, M.A., M.Sc., Ph.D., A.K.C., F.Inst.P., spoke on "The Pattern of Scientific and Technological Training in the U.S.S.R." Sir Philip Southwell, C.B.E., M.C. (Chairman of Council), was in the chair.

The CHAIRMAN: It is my privilege to introduce Dr. Manders and to say how pleased we are to welcome him here to talk to us on a subject which is very topical and interesting. I do not really know whether Dr. Manders is a physicist first and an educationist second, or an educationist first and physicist second. In any event, being a physicist is one of the most important things in modern development, and being an educationist is equally important, if not more so, for this country.

We have heard and read about the relative figures between America and the U.S.S.R. of the numbers of physicists and other technicians rather than scientists that have been produced in Russia and the worry that this has caused in the United States, as it does in this country, because we have not got the necessary trained people.

It will be most instructive and interesting to hear what Dr. Manders has to say on the developments in technical education in the U.S.S.R. and also about what is happening at Novosibirsk, in Russian Asia, which is a centre of development.

Dr. Manders is at present with the Scientific Civil Service and has been a lecturer in physics at the Royal Military College of Science and a Scientific Adviser to the Director of Military Intelligence at the War Office at the end of the war.

I. INTRODUCTION

LET me divide my talk into two parts. In the first, I will deal with conditions applying throughout the Soviet Union, in both Europe and Asia, and in the second I will try to give a picture of interesting new developments centred on the town of Novosibirsk, which is well and truly in Asia.

It is now just over forty years since the Soviet Union came into being. This happened, you will remember, under conditions of unusual difficulty. The South Russian harvest had been devastated by a locust plague so that food was scarce and morale low. In education and the social services, the country was backward, illiteracy was widespread and, even in the period since World War II, I have seen Soviet journals in which pleasure was expressed that this or the other area had achieved complete literacy. Forty years ago, the supply of trained personnel to lead the Soviet people out of their difficulties was apparently hopelessly inadequate, yet today the

U.S.S.R. challenges the U.S.A. for world supremacy. This achievement is one that bears comparison with any of modern times.

II. Some Factors contributing to rapid advances in the U.S.S.R.

Naturally, a whole host of factors has contributed to the Soviet advances of the past forty years. In quoting a few of these factors, I have it in mind to stress somewhat certain differences of practice as between the U.S.S.R. and the West in which the Soviet Union has been notably successful.

(i) *Leaders qualified in science and technology*

It has been clearly realized by the Soviet leaders from Lenin up to Khrushchev that science and technology are essential means for attaining Communist military and economic aims. With this emphasis over forty years, the scientific and technological disciplines are well represented in the background training of the present Soviet leaders. The President of the Academy of Sciences of the U.S.S.R. is an ex-officio member of the Communist Party Presidium, a body which might not unreasonably be compared with the Cabinet of a British Prime Minister. Until recently, some thirty-nine out of sixty-seven members of this body were scientifically or technically qualified. Further, the first Deputy-Chairman and nine out of the remaining thirteen Deputy-Chairmen of the Council of Ministers had similar qualifications. At top administrative level in the U.S.S.R., scientific and technological projects may be expected to have an easier passage, more understanding and sympathy than they would in the West.

(ii) *Central control and planning*

The U.S.S.R. has central control and planning. These offer obvious advantages for achieving maximum efficiency in a training, or, for that matter, practically any other, programme. Uniform standards can be set for the whole country, the system can be simplified and much of what is confusing in Western countries, where the training system has grown piecemeal, can be eliminated. If planning and production keep in step, there should be no unemployed, but people with the right qualifications should come available at the right time for all the jobs the State needs doing. With a centralized system, there exist the possibilities of being gloriously right or disastrously wrong. The essentials of the Soviet method are as follows. Ministries forecast their requirements in materials and manpower for a five (now seven) year plan in response to an overall directive from the Party executive. These stated requirements of Ministries modified slightly each year in the light of experience, are collated and plans drawn up by the State Planning Commission. The scientific and technological parts of the plan are vetted by the Academy of Sciences.

(iii) *Newly-trained manpower at disposal of State*

Nearly all who train in the U.S.S.R. beyond the legal minimum stage receive aid from public funds in order to do so. The State requires that such people, professionals and semi-professionals alike, shall serve in posts

to which they are allotted for a period of three years after completing training. Some three-quarters of a million freshly-trained professionals and 1¼ million semi-professionals, in the main young folk without a load of other commitments, can be readily switched to the solution of the State's varying priority problems such as the great development schemes, teaching, etc. This group does not form a sweated labour force: individuals are paid the "rate for the job" and, moreover, military service is not required of them.

(iv) *"Small" subjects*

The U.S.S.R. is a large country. Thus it is able to produce a study group, and cater for it adequately, for small subjects, e.g., gyro engineering or boiler engineering, whereas many Western countries could only manage an occasional course, and that of an extremely compromise nature.

(v) *Combing of Western information*

Western publications are available in translation in the main Soviet establishments within about two months of original publication. The Academy's Institute of Scientific Information provides the finest and most complete abstracting service in the world. The combing of Western sources of information is carried out magnificently.

(vi) *Ploughing back*

Over the years, a generous proportion of the personnel trained has been ploughed back into teaching in order to train more specialists. Pay and prestige in teaching are good. The net annual increase in the body of trained personnel is currently 7 per cent. in U.S.S.R. (cf. 3½ per cent. in U.S.A. and 2½-3 per cent. in the United Kingdom).

(vii) *Strong basic subjects*

Soviet training is soundly based with undoubted insistence upon strong basic subjects. All 200 of the technology curricula followed in higher educational establishments of the Soviet Union devote approximately 10 per cent. of the time to advanced mathematics and a similar amount to physics.

(viii) *Teacher-training a first priority*

With each foreshadowed major scientific or technological advance there is initiated an appropriate teacher-training programme. Teachers of programming have been trained since 1955 in Moscow State University.

(ix) *Efficient propaganda*

The national targets are kept before the people and there is genuine pleasure and excitement among the population as the achievements tot up. Again, there are posts in the U.S.S.R. that people might not be keen

to fill, places where people may not be keen to work. Propaganda in the educational establishments presenting these posts and places as a challenge produces many young people eager to work for their country in the less favoured conditions.

III. The Soviet Educational Ladder

The diagram of Appendix 1 represents the conditions under the last (abandoned) five-year plan and, although changes have been taking place at primary and secondary stages during the last twelve months, the diagram represents the system that has produced the bulk of the present Soviet trained manpower.

Formal education in the Soviet Union begins at seven years of age and the primary stage until last year, lasted seven years. By 1960, the last five-year plan aimed to make the ten-year school available overall. Where ten-years school could be provided, such training was made compulsory by local regulation, in consequence of which the numbers graduating from ten-year school rose during the four completed years of the plan from 440,000 to 1,500,000! In the seven- and ten-year schools, boys and girls alike followed the same course. In the secondary stage—i.e., grades eight, nine and ten of the ten-year school—pupils spent 42 per cent. of their time on mathematics, physics and chemistry. Clearly, the ten-year school product was not so highly trained as the product from the Science VI of a British grammar school. A far higher average level in science was, however, attained by all completing ten-year school training in the U.S.S.R. and, of course, by vastly larger numbers of pupils than is the case in the West.

Other possibilities at the seven-year stage are illustrated in the diagram of Appendix 1. It has been possible to go out into paid employment at the seven-year stage, but the numbers doing so dropped sharply during the five-year plan. The labour reserve schools are run in association with industries and agriculture. The specialist secondary schools, mostly tekhnikums provided by appropriate Ministries, gave semi-professional training in some 2,000-plus specialities, the courses being of strongly practical character.

Of recent years, some 40 per cent. of the ten-year school output has been going on to some form of higher education together with a lesser percentage from the semi-professional schools and there has been talk of raising the figure to 70 per cent. Soviet universities provide only 10 per cent. of the country's trained manpower and instruction in them is given in basic subjects only. Medicine and engineering, applied subjects, are not university disciplines in the U.S.S.R. Pedagogical institute courses last four years, basic subjects in universities (physics excepted) take five years. Courses in the technologies take five or five and a half years (physics too). whilst medicine is a six-year course. For all courses but those in pedagogy, the student has to carry out a six-month diploma project, the account of the research being embodied in a dissertation that is defended in public. About one in six or seven people from higher educational establishments proceed to higher studies. Students, aspirants and doktorants are required to develop competence in one, two, three foreign languages, respectively.

Modifications

The Khrushchev Memorandum of September, 1958, envisaged replacement of the seven-year period of primary education by one of eight years. This was to be followed by a three- or four-year course of secondary education in one of five types of school, viz.:

(a) Academic type secondary school for perhaps 20 per cent. of pupils, differing from the old eighth, ninth and tenth grades in having four divisions.

(b) Technical type secondary school.

(c) Specialized schools for ballet, theatre, fine arts, military service, etc.

(d) Part-time secondary schools enabling people to work in factories and farms while studying.

(e) Evening class labour reserve schools.

Clearly, the changes in the system imply no relaxation of standards. The existing secondary school facilities can be readily adapted to serve the new purposes. The year 1959 saw the progressive introduction of the new arrangements.

IV. Manpower Reserves and Production Rates

Appendix 2 summarizes the position. Table I demonstrates the heavy bias in the U.S.S.R. in favour of science and technology. Prestige and rewards are high in these fields, particularly in teaching, and people tend, therefore, to remain in these fields more than they do in the West.

At higher degree level, the U.S.S.R. is not going to be starved of men qualified to direct the country's projects. At higher education and school level there is every indication that the outputs of trained personnel can not only be maintained without difficulty, but even stepped up.

Appendix 3 gives breakdown figures summarizing achievements in ten years after the war. The notable contribution of women to the trained manpower figures of the U.S.S.R. will be seen.

V. Defects/Difficulties

The Soviet training system with some 35 million people studying at its various levels is gigantic. One of its outstanding merits, stemming from central control and planning, is its relative simplicity. Let me, however, as a former co-opted member of an education committee and a university nominated school governor of some years' experience, note how the U.S.S.R. has fared in coping with problems that have dogged us in the West.

(i) *Accommodation*

At all levels in Soviet schools, a two-shift per day system is normal and less than a twelvemonth ago I picked up a broadcast where an area was rejoicing at seeing the end of a three-shift system. The provision of classroom, lecture-theatre and laboratory space is undoubtedly the most severe problem with which Soviet training has to cope. The short-fall in its building programme was one of the factors contributing to the abandon-

ment of the last five-year plan. Almost certainly it was a major factor precipitating the modification in the educational system at secondary level. Currently, candidates for higher education with two years of industrial experience are being accepted in preference to those with none, other things being equal. A two-year breathing space will enable the building programme to catch up somewhat.

(ii) *Equipment*

Western observers have, in general, been most envious of the quantity and quality of equipment in Soviet training establishments.

(iii) *Staff-student ratio*

With a planned economy, there can be no teacher problem. Prestige and pay make the happy position doubly satisfactory.

	U.S.S.R.	U.S.A.	U.K.
Higher educ. establishments	1 – 12·6	1 – 14·1	1 – 9 1 – 18·1 (gram)
Schools	1 – 17·6	1 – 21 (sec.) 1 – 30 (prim)	1 – 22·3 (S.M.) 1 – 30·5 (prim)

(iv) *Military Service*

Neither in education nor in any other sphere of scientific or technological endeavour is military service required of trained personnel. They have in any case to serve where the State requires for three years after completion of training.

VI. The Future: A Digression

In the West, there is a considerable tendency to adopt extreme views concerning the Soviet Union. Its people are neither supermen nor inferior material, but human beings with the same range of abilities and emotions as any other. With central control and efficient propaganda, the U.S.S.R. has got its trained personnel working with, to all reports, unusual intensity and to priorities well understood in appropriate Government Departments.

The Soviet Union is setting the pace in certain fields of scientific and technological endeavour and there is every indication that the process will go much further. If this country is to compete with the U.S.S.R., there are but two alternatives:

(a) to think up continuously methods superior to those of the Soviets;
(b) to adopt and adapt Soviet methods.

This latter could easily involve, among other things:

(i) abandonment of cherished, traditional ideas about women;
(ii) a demand for service to the State from those who have received aid from public funds for training beyond the legal minimum;

(iii) abolition of a "free market" in trained personnel and the acceptance of some, and probably increasing, measure of direction by the State.

One thing that is obvious is that any teacher supply problems must be solved as a first and urgent priority.

THE NEW SCIENTIFIC TOWNSHIP OF NOVOSIBIRSK

I. Introduction

The U.S.S.R. is centrally organized with the seat of government in Moscow. Not unnaturally, therefore, there has been a tendency for scientific and technological teaching and research establishments to concentrate about the capital. At the present time, rather more than half of these establishments are in the Moscow area; somewhat less than a quarter of them centre on the former capital, Leningrad. More than nine-tenths of the scientific and technological activity of the U.S.S.R. takes place west of the Urals. Yet, to quote "Stroitel'naya Gazeta" (December 11, 1959), "Siberia contains three-quarters of the coal, four-fifths of the peat, three-fifths of the ore of the country, 100,000 km. of navigable rivers and there are obvious sites for hydro-electric power stations that would provide over seventy times as much power as the Lenin power station on the Volga."

Two things are obvious to the Soviet Government:

(a) there is a need for decentralizing;

(b) Siberia cries out for scientific and technological development.

II. Situation up to 1957

After World War I, A. F. Ioffe, now the grand old man of Soviet science, mindful of the desirability of developing other parts of the country than that around Moscow, was instrumental in setting up a number of physico-technical institutes. This venture, as might be expected, was a mixture of considerable, partial and modest success. The effort was on too small a scale. In the main, the major towns of Siberia possess only pedagogical institutes, an occasional medical institute and a few technical and forestry institutes.

The Academy of Sciences of the U.S.S.R. has set up filials at Novosibirsk (West Siberia), Irkutsk (East Siberia), Vladivostock (Far East Siberia) and Yakutsk, a base on Sakhalin and a physics institute at Krasnoyarsk.

In the post-war period, four significant factors may be noted.

(a) Since World War II, there have been many scientific expeditions into Siberia, probably well over a hundred. Thus, in the last decade there has been a much increased knowledge of the natural resources of the area.

(b) In the research institutes of the U.S.S.R. too, much successful work has been accomplished on breeding strains of food crops that can mature under the inhospitable conditions to be found in much of Siberia.

(c) The Soviet leaders are only too well aware that the world military situation makes dispersal imperative. An unusually determined effort to remedy the national as well as the Siberian situation presumably was behind the announcement of May 18, 1957.

(d) A commission which toured Siberia in 1957 reported that everywhere existed an acute shortage of scientists and a need for the strengthening of scientific knowledge.

III. The Plan

On the date referred to above in May, 1957, the Council of Ministers of the U.S.S.R. announced that a new scientific township was to be set up at Novosibirsk. This was to be associated with the creation of a Siberian Division of the All-Union Academy of Sciences.

The Academy of Sciences of the U.S.S.R. has a three-fold function. Its members and corresponding members form a learned society of size and status not unlike that of our own Royal Society. The Academy also functions rather like a Ministry of Science and Humanities. Thirdly, somewhat like the D.S.I.R., the Academy runs about a hundred research institutes with 14,000 qualified workers and 35,000 ancillary staff. The President of the Academy is an ex-officio member of the Presidium. The Academy is organized in eight Divisions (Physico-mathematical sciences, Chemical sciences, Technical sciences, etc.). Since 1957, there has been added a Siberian Department with the same horizontal structure but, naturally, smaller in size. The new department took over all the filials, bases and institutes of the All-Union Academy of Sciences to be found east of the Urals. Besides strengthening all of these—e.g., eight new institutes for Irkutsk—new institutions are under development at Kemerovo, Ulan Ude and Kamchatka.

The new scientific township is being built on a site 28 km. west from the centre of the Novosibirsk that figures on present-day maps, on either side of the Novosibirsk-Berdsk motor highway. The site is on "one of the most picturesque shores" of the Obsk Sea, a large artificial lake feeding a hydro-electric power station on the Ob river. The "area" of the township is 1,300 hectares, of which 750 are at present covered with forest. The township is administratively part of Novosibirsk since it falls within the boundary of a new "rayon" of the city—Sovetskiy.

IV. Under Construction

In the northern part of the township some fourteen institutes are currently going up. The emphasis in layout is on space and room for expansion. The other main features of the township are a university and an experimental factory employing 1,000 workers. The State Scientific Technical Library of several million volumes is to be transferred there from Moscow.

V. The University

This began to function in September, 1959. Besides undertaking the normal university basic scientific studies, it is also to give training in mechanical engineering. The avowed aim is to produce specialists capable of solving important scientific and practical problems and of introducing into practice the attainments of modern science and technology. To this end, it is being built and developed in close contact with the Siberian Department of the Academy of Sciences.

The main university building is to house the faculties of pure and applied mathematics, geology-geography, biology and economics. A second building is for the physics and chemistry faculties. There is to be a whole complex of accommodation for students, research workers and staff.

Moscow University is known to have some autonomy in framing its courses—subject to approval of the Ministry of Higher Education—whereas other establishments have curricula imposed from above. Novosibirsk University is also to have some autonomy like Moscow. However, the absence of any stated faculties for the humanities and the 28 km. to Novosibirsk make one doubt whether the students will, in fact, find themselves in a scientific utopia—more likely, in a scientific wilderness. Whether there are, or are to be, 1,500 students is not for the moment quite clear.

VI. The Scientific Research Institutes

The Mathematics Institute of the Siberian Department of the Academy of Sciences of the U.S.S.R. will have four high-speed electronic computers, there is to be a Cybernetics Group and over all is Academician Sobolev.

Some sixty to eighty scientists are to be transferred from the Academy's Institute of Atomic Energy, Moscow, to the Institute of Physics already operating. The head is Corresponding Member of the Academy Budker. Much work is to be done on controlled thermonuclear reactions.

The Institute of Thermophysics under Novikov is to be concerned with the peaceful uses of atomic energy.

The Institute of Inorganic Chemistry—Corresponding Member Nikolayev—is to conduct research into the chemistry of the elements involved in nuclear energy and groups of chemists are to be transferred from Leningrad and other cities. A number of papers have appeared bearing the institute's address, but whether in fact it is in operation in premises in the new township is unknown.

The Institute of Automation, concerned with the automation of production processes, is to be directed by Karandeyev, a Corresponding Member of the Ukraine Academy of Sciences.

The Hydrodynamics Institute is to be run by Academician Lavrent'yev, who, besides being Chairman of the Siberian Department of the Academy of Sciences, U.S.S.R., is also Vice-President of that body and a world-renowned mathematician.

The Institute of Theoretical and Applied Mechanics is to be directed by Academician Khristiyanovich, one of the world's highest authorities on aero-hydro-gas dynamics.

Academician Trofimuk, former Minister of the Oil Industry and discoverer of some oil deposits, is head of the Geology-Geophysics Institute.

Academician Nemchinov, replaced later by Corresponding Member Prudenskiy, have inaugurated the Institute of Economics and the Organization of Industrial Production.

At the Institute of Cytology and Genetics, Corresponding Member Dubinin has now been replaced by D. K. Belyayev.

Institute of Experimental Biology and Medicine—Meshalkin; Institute of Organic Chemistry—Corresponding Member Vorozhtsov; Institute of

Catalysis—Corresponding Member Boreskov; Institute of Chemical Kinetics—Corresponding Member Kovalskiy.

Whether the projected High-Voltage Institute has materialized, I do not know. There is to be an independent Laboratory of Measuring and Computing Electronics headed by Corresponding Member Ardeyev.

The Siberian Department has been allotted special tasks for joint research with the Academy of Sciences of the Chinese People's Republic.

VII. Will it Succeed?

An eventual population for the new township is estimated at 60,000. So far, 2,000 research scientists and 3,000 additional scientific and technical workers are reported to be working there. Modern research is a complex structure and for first-class work the services of numerous disciplines are required. In addition, library and publishing facilities, computation services, provision for pilot production are all essential. A modern science/technology complex has of necessity to be large.

Lavrent'yev and Khristiyanovich are outstanding scientists and there are others there too, who are first-class. At the first election of the Siberian Department, five academicians and eleven corresponding members were created. Whether first-class facilities for work, first-class (but not necessarily the top class throughout) scientific leadership and high prestige will suffice to make a successful project, is a matter of opinion. What is happening in distant Siberia is, however, a large-scale experiment that will give the world much food for sober thought.

Documentary material was also provided for those present at the lecture, illustrating:

(i) Types of Soviet higher educational establishments.
(ii) Distribution by subject of the output of professional and semi-professional manpower, 1955.
(iii) Curriculum of seven- and ten-year schools.
(iv) Physics curriculum, Moscow State University.
(v) Chemistry curriculum, Moscow State University.
(vi) Curriculum in Radio Equipment Design and Production Technology.
(vii) Curriculum for Teacher of (Pure) Mathematics, Rostov-on-Don Pedagogical Institute.
(viii) Curriculum for Teacher of (Pure) Mathematics in Secondary Schools, Moscow State University.
(ix) Curriculum in Applied Mathematics, Moscow State University.
(x) Data relating to research work in U.S.S.R., Establishments/Personnel/Subjects.

Discussion

The Chairman: I thank Dr. Manders very much for his talk and for the documentation, which has enabled us to give a lot more thought to the subject. He is ready to answer any questions that anyone may wish to put to him.

Mr. Egerton Sykes: I should like to ask two questions. Of the new

institutions to which Dr. Manders referred at Irkutsk, would it not be correct to say that they are mainly concerned with aerodynamics, space flight, rocketry and things of that kind? That seems to be the centre from which a large number of the satellites are supposed to have been put into orbit recently.

Dr. MANDERS: I have heard the same story. I cannot, offhand, quote the list of institutes going up in Irkutsk. Given a few minutes' warning, no doubt I could have done.

Mr. ECERTON SYKES: Do you not consider that one of the main reasons why the Soviet technological system of education tends to score over ours is to be found in the course papers and the diploma projects which each student has to do, when he has not only to put up a project, but has to defend it himself in front of a concourse of teachers and experts to show that his stuff is really good? That is a type of examination which is practically unknown in the West.

Dr. MANDERS: You are not quite right in saying that it is practically unknown in the West. There are quite a number of places in this country where work of this kind is done. I agree that it is not done on quite the same scale as in the Soviet Union.

There is something else which always impresses me about these diploma projects. From something like 290,000 graduates per annum, subtract, say, 100,000 for those going to the teaching side who do not do a project. That means that something like 190,000-200,000 projects per annum have to be thought out. That is a fantastic number of problems to set, and it is a fantastic number of people tackling them.

I have enquired into this particular problem and I am informed by British experts that the level of achievement in these projects varies from the genuine contribution to knowledge to the downright poor. That must be inevitable with the numbers involved. I quite agree with you, however, that even if a student produces a rather poor effort, it has been good training for him and it will stand him in good stead in his subsequent career.

Colonel G. WHEELER: Will Dr. Manders say whether the institute in Novosibirsk is particularly concerned with Asian peoples or whether it is exclusively concerned with the R.S.F.S.R.? I do not know about this. The Central Asian Republics have their own training establishments and Academy of Science, and so on, but is it possible that this establishment in Novosibirsk is used in any special way for the training of Asian peoples as distinct from, or with, the Russians and Ukrainians who mostly inhabit Siberia?

Dr. MANDERS: I do not think it is possible to give the exact answer to that question. The Soviet intention, as far as I can read their thoughts, is to get a marked decentralization. If they can build up this set-up in Novosibirsk, no doubt the intention is that it should be built up in the same sort of way as Moscow and attract people from all over the Union to it, although inevitably, being stuck where it is, it will draw most heavily on the peoples who are closest—in other words, the R.S.F.S.R. more particularly in the first instance.

Colonel WHEELER: This is an interesting question. The Asian peoples

of the Central Asian Republics do aspire to higher education in the R.S.F.S.R. The great ambition of students in these Republics is to go to Moscow or Leningrad. I wonder whether this isolated place would have less attraction for them than Moscow. Are they likely to be compelled to go to Novosibirsk.

You mentioned particularly decentralization, which I thoroughly understand, but it is more decentralization than a plan to create a special Asian establishment. It is not really territorial. It is simply in order to have something which is far away from possible attacks.

Dr. MANDERS: Yes.. Undoubtedly, at the present time, the majority of people, certainly in the western side of the Soviet Union, are not too conscious of any desire to move over to Novosibirsk. I have met a number of Soviet scientists in the last year and the question has been put to them very tactfully, whether they would accept a higher appointment if offered one in Novosibirsk, and most of them simply shudder. But undoubtedly both the stick and the carrot will be methods adopted for building up this new township.

To a lesser extent, no doubt, the student population will be recruited in the same sort of way. Undoubtedly, too, a man trained in physics in, say, Novosibirsk is most likely to find a job in Siberia. Unless he has exceptional qualities which make it desirable for him to go to Moscow, my guess is that he will not get to Moscow except on a visit.

Lady BONHAM-CARTER: Do I gather that the humanities are not to be taught at all at the new university of Novosibirsk, and that there is to be no art, history or language?

Dr. MANDERS: The present programme of the university makes no provision whatever for humanities. Physics, biology, chemistry, mathematics and mechanics—that is the lot.

Colonel GASTRELL: May I ask the location of this place on the map?

Dr. MANDERS indicated the position on the map of Novosibirsk and Irkutsk and added: I mentioned that there was to be development of an establishment out here, at Kamchatka. It does not need much imagination to guess what might be happening there.

The CHAIRMAN: I would like to express, on behalf of the Society, our thanks to Dr. Manders for coming and giving us this talk. (*Applause.*). Whether we can get any satisfaction from the fact that the electronic computers of which Dr. Manders spoke for Novosibirsk and for other places in Russia are likely to come from this country, with our system of education, I do not know.

The agreement with the Soviet on the exchange of technical studies with this country has brought visitors here, and I believe that the Russians who came over were extremely impressed with the advances that this country has made in electronic computers and are quite likely to establish these in some of their university establishments.

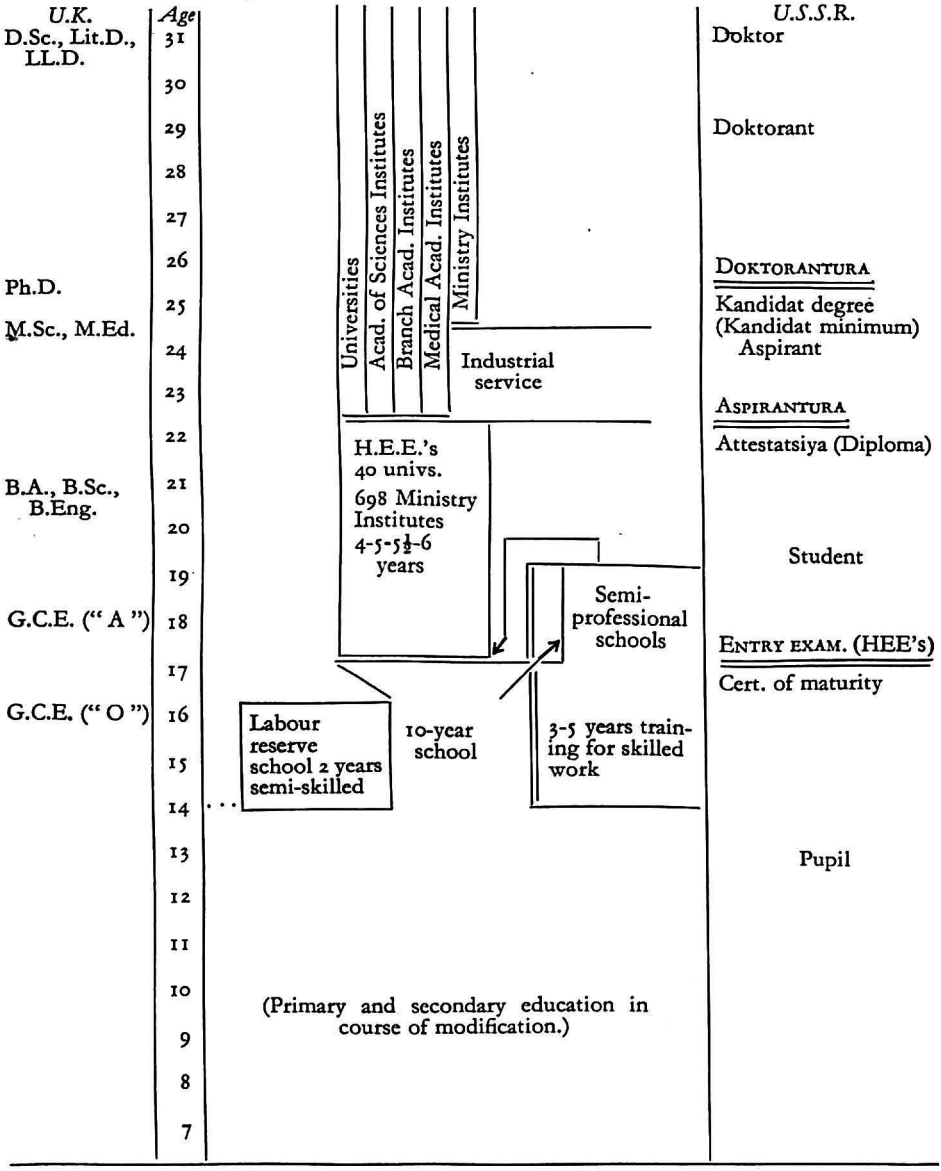
It is obvious that for the development of a new country—and the Americans are finding Alaska rather similar—there has to be some kind of order in the plan or nobody will go to live there.

I thank you very much, sir, on behalf of the Society.

The vote of thanks was accorded by acclamation.

APPENDIX I

SIMPLIFIED SOVIET EDUCATIONAL LADDER



TYPES OF SOVIET HIGHER EDUCATIONAL ESTABLISHMENT
(1959)

		No. of estabs.
1.	Universities	40
2.	Polytechnics and industrial higher educational establishments	32
3.	Power engineering, electrotechnical, radiotechnical and physico-technical higher educational establishments	8
4.	Mechanical engineering, shipbuilding, aviation, printing and cine-engineering higher educational establishments	30
5.	Geological, mining, petroleum, peat and metallurgical higher educational establishments	27
6.	Chemico-technological higher educational establishments	10
7.	Higher educational establishments of the Food and Fish industry	13
8.	Higher educational establishments of light industry	8
9.	Civil engineering, surveying and motor-highway higher educational establishments	30
10.	Hydro-meteorological institutes	2
11.	Higher educational establishments of transport and communications	30
12.	Agricultural and Forestry higher educational establishments	109
13.	Economics higher educational establishments	23
14.	Juridical higher educational establishments	4
15.	Higher educational establishments of the Arts	47
16.	Medical higher educational establishments	80
17.	Higher educational establishments of physical culture	15
18.	Pedageogical, historical-archive and librarianship higher educational establishments	209
19.	Correspondence institutes	21
	TOTAL	738

Appendix 2

Table 1.—Trained Reserves

(1959—*estimated*)	*U.S.S.R.*	*U.S.A.*	*U.K.*
" Graduates " working in all fields	3,230,000	4,598,000	530,000
Net annual rate of increase (approx.) ..	7%	3½%	3%
" Graduates " working in sci./technol. fields	1,748,000	1,438,000	160,000
Populations	210 M	162 M	52 M

Table 2.—Higher Degrees

(1959—*estimated*)	*U.S.S.R.*	*U.S.A.*	*U.K.*
Numbers working in sci./technol. fields ..	79,000	67,000	12,000
Annual increase in sci./technol. fields ..	6,000	4,300	600

Table 3.—Higher Education

(1958)	*U.S.S.R.*	*U.S.A.*	*U.K.*
Total enrolment	2,250,000	3,259,000	99,536
Number of " graduations "	290,000	440,304	24,000
includes—engineering	90,000	37,040	} 11,100
—science	70,000	65,000	

Table 4.—Ten-Year School

Completing 10-year school in 000's	1950	1952	1953	1954	1956	1958
	220	315	440	750	1,300	1,500

Table 5.—Semi-Professional Education

	U.S.S.R.	*U.S.A.*	*U.K.*
Semi-professional reserve (1956) ..	3,680,000	Wide variety of sources, no figures available.	Wide variety of sources, no figures available.
Total enrolment (1957)	1,961,000		

Table 6.—Labour Reserve Schools

	U.S.S.R.	*U.S.A.*	*U.K.*
Annual output (1956)	650,000	See above	See above

Appendix 3

Field	Higher Educational Establishments					Semi-professional Training Establishments				
	Enrolment 1955-6		*New entrants* 1955-6	*Output* 1955-6	*Output* 1946-55	*Enrolment* 1955-6		*New entrants* 1955-6	*Output* 1955-6	*Output* 1946-55
		Women					*Women*			
		%					%			
Industries and constructions	550,600	35	144,812	56,446	331,900	843,100	42	245,527	140,799	826,800
Transport and communications	99,000	35	29,775	9,465	60,900	150,300	42	48,498	23,920	165,900
Agriculture	195,900	39	51,065	24,136	136,800	337,800	43	98,208	57,769	408,400
Economics and law	106,700	67	28,537	15,645	109,000	134,600	82	51,711	30,479	238,700
Educational (Univs., Pedagog. and Librarianship Inst.)	741,600	72	172,056	120,836	915,500	247,200	85	51,682	73,541	655,500
(Univs.)	(166,256)		(36,690)	(22,866)						
Arts and cinema	14,400	42	2,901	2,493	21,400	31,500	51	10,682	4,951	38,200
Public health, physical culture, sport	158,800	69	32,298	16,825	196,900	215,900	89	81,246	56,311	501,400
Total	1,867,000	52	461,444	245,846	1,773,000	1,960,400	55	587,554	387,770	2,837,900
(Number of correspondence students)	(639,100)			(62,014)		(286,500)				
Number of establishments	765 (1955-6)					3,753 (1955-6)				
Number of correspondence establishments	22 (1955-6)					41 (1955-6)				