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EDUCATION and CYBERNETICS

An interchange of Soviet and American ideas concerning education, programed learning, cybernetics, and the human mind

A Joint Report

by

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PREFACE

MY 1963 VISIT TO MOSCOW followed an invitation from the Ministry for Public Education of the R.S.F.S.R. in 1961 to revisit the Soviet Union. My first trip there was in 1958, when I assisted in plans for negotiating implementation of a portion of the Lacy-Zaroubin cultural agreement.

At the time of the invitation I was unable to go. When I suggested through channels that I could make the visit in the spring of 1963, it was indicated that I would be accompanied by a young American expert on Soviet affairs from an American university. Mr. Loren R. Graham, formerly an American exchange student at Moscow State University, now an Assistant Professor at Indiana University, agreed to accompany me. Mr. Graham speaks Russian well and was quite familiar with Moscow. He contributed much to whatever success we achieved.

Our visit, May 14-28, 1963, was sponsored by two Soviet agencies: The Ministry for Public Education of the R.S.F.S.R. and the Ministry of Higher and Specialized Secondary Education of the U.S.S.R.

Our basic purposes were to renew earlier contacts with Soviet educators and scientists; to explore the possibility of expanded exchange of educators under the U.S.-U.S.S.R. cultural agreement; and to exchange views concerning the role of cybernetics in education.

OLIVER J. CALDWELL

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Editor's note: This report is presented as a sequential factual account of the authors' visit in Moscow, May 14–28, 1963. The "Introduction" is by Mr. Caldwell, with comments by Mr. Graham. The main body of the report, "Activities in Moscow," is based entirely on the successive meetings of the American visitors with Soviet educators and scientists in the two sponsoring Soviet ministries of education, and on their visits to various institutions in Moscow. This section was dictated on tape by Mr. Graham in conversational style, and the text was reviewed and edited by both authors. Quotations in the text are from notes taken at the time of discussions.

INTRODUCTION

WE WERE FORTUNATE to be able to meet some of the top philosophers who are shaping Soviet policies involving cybernetics in education. I indicated that I was interested primarily in concepts, rather than "hardware." As it developed, we had opportunities to discuss concepts and also to see some interesting "hardware".

It is manifestly absurd to assume that one's impressions derived from a brief visit such as ours should represent vistas of truth. For whatever they may be worth, I offer the following comments, based on my limited contacts with Soviet education and educators, beginning in 1958 and culminating in the more current observations of my 1963 visit:

1. There seem to have been considerable changes in the Academy of Pedagogical Sciences of the R.S.F.S.R. in two directions—towards a more individualistic and liberal educational philosophy and, at the same time, towards ideas which dominated Soviet education under Stalin.

2. Two of the most dynamic educational societies of our generation are the United States of America and the U.S.S.R. Each is able to react effectively to new significant situations which affect education. It is my personal opinion that the U.S.S.R. will begin to collapse if inflexible dogma ever controls policies involved in the development of human resources; in my opinion expediency rather than principle is now a dominant factor in the evolution of Soviet education.

3. I received an impression that drastic changes have occurred in Soviet education since my first visit to Moscow in 1958; that many of these changes are contrary to the Communist dogmas of 1958; and that most or all of these changes are, in fact, evidences of the influence of pragmatism or expediency:

• The increasing use of intelligence tests is an example. All the Soviet officials with whom I had discussed intelligence testing in 1958 had insisted that they were "undemocratic."

• The acceptance of individual differences now, both in absolute ability and different kinds of ability, was surprising to me. The official view used to be that if some people find it hard to learn it is because they have been "exploited."

• The new, questioning attitude about "internats", or boarding schools, is another example. The influence of the cost factor of 72 rubles per month per child at the internat we visited in Moscow, if it is at all representative, is likely to have a serious effect on the expansion of the internat program.

• The waiving of the requirement in some schools that children wear a school uniform has many possible implications. It is too early to read anything definitive into this.

• The claim that some 30 percent of subjects in the last 3 years of the 11-year school are electives, if true, would certainly be a major change.

• Frank criticism of the polytechnical program in the 11-year schools was another surprise. Some Soviet educators are dubious of the value of factory and farm experience in school work. Apparently, they think the time is largely wasted because the pupils are seldom given significant work to do.

• Contrary to earlier assurances that only one intellectual standard prevails at the higher education level, I found that graduates of institutes of linguistics and energetics are *not* accepted freely as graduate students at Moscow State University. I was told frankly that this is a result of narrow specialization. If this trend towards specialization continues it may cause a serious weakness in Soviet society by forcing creative intelligence into separate and isolated channels.

• The increased emphasis on the "talent search" in Soviet schools is amusing to an American who, on an earlier visit, had listened to many lectures which affirmed that all children who have not been underprivileged are equally talented in every field.

4. "Cybernetics" is a magic word in the U.S.S.R., and seems to have much more importance there than in the United States. This may be so, in part, because the Soviets are hurrying to overcome the 2-year gap resulting from the initial Party attack on cybernetics as "bourgeois aberration." My personal limited observations in this field follow:

• I was tremendously impressed by the quality of the intellectual leaders with whom we discussed cybernetic theory and practice.

• I was equally impressed by what might be a policy conflict at the top Party level on the value and the role of cybernetics in a communist society. The apparent, and possibly temporary eclipse of Academician Berg, chairman of the Cybernetics Council of the Academy of Sciences of the U.S.S.R., is a case in point.

• Nevertheless, I believe there is a very important effort today in the U.S.S.R. to push back the frontiers of cybernetics. Specialists are undertaking some very sophisticated projects, under the direction of gifted people.

• Soviet research in the "defense mechanism" which prevents man from using all the neurons in his brain, and Soviet experiments designed to enable him to use more of his brain potential, seemed highly important.

• The research in extrasensory perception as a teaching device to enable a

teacher to surmount the biological defenses in the brain, as described by Landa, appeared potentially very important.

• Artemov's transistorized portable training machine, intended to serve as a "super-slide rule" to free creative minds from the drudgery of memorizing facts, could be a major breakthrough. This is a logical application of electronics and cybernetics to increasing the creative potential of the modern scholar in any field.

5. In another direction, there appear to have been major changes in the way people live in Moscow, in the 5 years since my first visit.

• People seem to have new freedoms. The uninhibited behavior in restaurants full of people, the new Soviet jazz, the popularity of the "twist," are examples.

• The general absence of queues of people at stores, multitudes of relatively well-dressed women, and the number of families picnicking by a stream with their cars parked nearby, seem to indicate substantial social and economic changes.

• There seems to be a new social stratification. More people are comparatively well off, and the gulf between the Party elite in their villas and the masses they claim to serve seems to be evidence of a broadening separation between the masses and the "new class."

6. Americans seem to be well liked by many Russian people. Crew cuts are popular among young men. American music and dances seem to flourish in spite of Party denunciations.

7. Very few Chinese were observed in Moscow, compared to 5 years ago. In the crowded dining room of the Peking Hotel I saw only four Chinese. The rest of those present, aside from ourselves, were Russians eating Chinese food.

The following personal comments by Mr. Graham also reflect marked changes and developments as he observed them in Moscow after his earlier stay there:

1. The general atmosphere in the U.S.S.R.

Although the material output and the overall living standards in the Soviet Union continue to rise, the current political situation seemed to be tense at the time of our visit. The intellectuals, particularly those in literature, fear that they may lose some of the freedom of activity gained in the last few years. We were told by several students that the intellectual scene was in turmoil, with the intellectuals all awaiting the results of the June 1963 plenary session of the Central Committee on Ideological Problems with a genuine sense of concern.* Students asked me if I was familiar with the

*[The Central Committee did not enact the harsh regulations which the intellectuals feared. Khrushchev evidently decided not to follow through with the punishments against the writers and artists as he threatened in his speech of March 8, 1963. The resolution of the June meeting was critical of liberal trends in the arts, but it did not impose the new discipline which was expected.]

disputes surrounding the Soviet writers Evtushenko, Ehrenburg, Tvardovsky, and Nekrasov. When I replied in the affirmative they questioned me closely, hoping, apparently, to discover more news about these issues which concern them so much. I believe that the fear of the return of old-line Stalinists in literature, and perhaps in all intellectual fields, including education, is a very genuine one in the Soviet Union. The fact that the living standard is rising makes the intellectuals all the more impatient with the vestiges of the Stalinist past.

2. Education

From my knowledge of both the Ministry of Public Education of the R.S.F.S.R. and the Ministry of Higher and Specialized Secondary Education of the U.S.S.R., it seemed clear that the latter, all-union ministry is now more influential. Our conversations there, at least, were more frank and open than those in the R.S.F.S.R. Ministry. We were told that the R.S.F.S.R. Ministry of Education was in the process of reorganization and may also become an all-union ministry.

My personal opinion is that the top leaders in the U.S.S.R. realize how valuable the cultural exchange program with the United States has been, and have every desire to continue and broaden it.

3. Programed learning

The Soviet educators made no effort to conceal their intense interest in American developments in teaching machines, programed learning, and audiovisual aids. Although I am not an expert in these fields, I have the distinct feeling that the United States is ahead of the Soviet Union in these particular areas, and that the Soviet Union is now making a concentrated effort to catch up. Cybernetics, for instance, is finding application in dozens of fields—from law to education, economics to engineering.

Excellent examples of the diversity of cybernetics in the Soviet Union can be found in the book, *Cybernetics in the Service of Communism*, edited by Academician Berg. Although cybernetics continues to be defined more broadly in the Soviet Union than in the United States, I had the impression that Soviet scientists and scholars have lost a portion of their original enthusiasm for cybernetics as the key to all further progress. I base this conclusion partly on Berg's change from his earlier opinion that teaching machines would replace teachers; now, evidently, he says the machines can only supplement teachers. This attitude seems now to be the current Soviet line on cybernetics. In all our contacts, we were told that machines could only help man and not

replace him. Nevertheless, the Soviet Union is now placing tremendous emphasis on cybernetics, as illustrated by the fact that fully one-third of the activities of the Moscow Institute of Energetics are now concerned with cybernetics, as Soviet scholars define the field.

On the specific issue of teaching machines, I sensed a dispute between the technicians and the educators. The pedagogues often resist utilization of teaching machines, in fact, all new methods in the teaching field. As one of the engineers at the Institute of Energetics told us: "Our greatest problem is not in constructing teaching machines, but in reconstructing individuals so they are willing to use them."

Mr. Goncharov, vice president of the Academy of Pedagogical Sciences, seemed to be in the camp of the "stubborn" pedagogues. He felt that the teaching machines and other new methods, such as teaching algebraic concepts to young children, have only very limited applications. We were also told that the introduction of new teaching methods is much easier on the higher educational levels than the middle and lower levels.

ACTIVITIES IN MOSCOW

ON OUR FIRST MORNING in Moscow, we went to the Ministry of Higher and Specialized Secondary Education of the U.S.S.R. at 11 Zhdanov Street, where we met with Mr. V. G. Rastaturov, head of the Foreign Affairs section, who handled our programing, and with Mrs. Georgievna Markova, who was in charge of the details of our schedule at the Ministry. This meeting was spent primarily on preliminaries. Mr. Caldwell outlined broadly his interests in teaching machines, the Soviet public boarding schools (internats), and the foreign area study programs in institutions of the U.S.S.R. He emphasized his desire to discuss the philosophical problems of educational theory, especially as related to programed learning, and mentioned the names of several scholars with whom he would like to talk, such as professors Artemov, Landa, and Berg. He also expressed his interest in broader educational exchanges between the United States and the U.S.S.R. Mr. Rastaturov agreed to try to arrange meetings with some of the people mentioned, but noted that the question of any increase in cultural exchange would have to be considered within a general cultural exchange agreement and in conjunction with existing agreements, such as that with the Inter-University Committee on Travel Grants.

1 Cultural Concepts of Soviet Education

THE FIRST OFFICIALLY ARRANGED MEETING of our program took place on Friday, May 17, when we went to the Academy of Pedagogical Sciences of the R.S.F.S.R., at B. Polianka No. 58, Moscow.

Upon our arrival at the Academy, we were introduced to its vice president, N. K. Goncharov, who initiated a discussion in his office. Others present were Mr. Birilko, an interpreter with special interest in teaching machines, and Mrs. Kisleva, an official of the Ministry for Public Education of the R.S.F.S.R., who was our guide for visits to the institutions of the Ministry. The head of the foreign section of the Academy was also present.

Here, Mr. Caldwell restated the subjects of general interest to him, such as broader exchange by the Soviet Union and the United States of educational personnel and of information on various educational topics. He also enumerated other questions of particular significance:

1. The intensification of the educational process and the need to find new ways to facilitate this change.

2. The rapid expansion of the body of knowledge and the need quickly to introduce new knowledge into education at all levels, and to eliminate obsolescent knowledge.

3. The growth of the useful life span of man: The older citizens of the United States, for example, have become an explosive political force, and, with the increasing life span, it is necessary to find ways in which these older people may continue to enjoy productive and useful lives.

4. The introduction of cybernetic teaching machines in schools.

5. An exchange of philosophical concepts with Soviet specialists in the field of cybernetics in education—one of Mr. Caldwell's purposes in coming to the Soviet Union.

After this, Mr. Goncharov replied that the questions and points raised were not controversial, and it seemed to him, that on the whole, Mr. Caldwell's wishes could be granted. Again on the subject

of exchange of teachers between the Soviet Union and the United States, Mr. Goncharov pointed out that political questions could be important—indeed they might be decisive, and would have to be negotiated. He agreed that the United States and the U.S.S.R. are the two most dynamic societies in the world today, and that particularly in education they are not only dynamic, but parallel in some ways. For example, after mentioning certain Jeffersonian ideas, he commented, "You will see that they coincide very closely with some of the ideals of the Soviet revolution."

He then noted Mr. Caldwell's remark that a cultural revolution was occurring in the United States, and agreed that this was a specific coinciding point between the two educational systems.

"We have also here in the Soviet Union," he commented, "a cultural revolution, especially in public education."

Mr. Goncharov took some exception, however, to Mr. Caldwell's use of the word "utilitarian": The Soviets do not consider their educational system to be a particularly utilitarian one.

"We appreciate the full concept of education better than you do in the United States," he declared, and further expressed his belief that the cultural revolution in the Soviet Union has been much greater than in the United States.

Mr. Caldwell had said that his father, even though he is now in his eighties, continues to write, citing this as one example of older citizens in the United States fulfilling important tasks. Mr. Goncharov observed that if Mr. Caldwell's father still writes, it means that he was educated, whereas his own father was illiterate. Mr. Caldwell then said that his father had trapped muskrats and other fur-bearing animals to pay for his higher education; that it is part of the American tradition for people to educate themselves through their own labor.

"I am," Mr. Goncharov interjected, "a representative of the first generation of educated people, so perhaps that explains my pride in the Soviet system. Work must contribute to the overall development of man. A purely utilitarian education would be completely insufficient."

After Mr. Caldwell had expressed particular concern about the effect of science on education, Mr. Goncharov told us that in this field the Russian educators pay special attention to American writers. For example, the American scholar, William Heard Kilpatrick, in his book, *Education for a Changing Civilization*, reflected concern with the problem of how the changing rate of science influences the method of teaching. On this subject, some Soviet mathematicians say that classical courses in mathematics in the secondary school are obsolete and must be changed. Therefore, Mr. Goncharov explained, Soviet educators are experimenting with the introduction

of algebraic concepts at the primary level, and have established a demonstration school for this purpose. Mr. Goncharov said that personally, he was not sure of the value of this experiment and felt perhaps that childhood was a period with which one must be particularly careful. He continued:

"Whenever we are trying to introduce new methods in education, we must constantly compare the results of our new experiments with the old systems. There are limits to the use of technical devices."

Mr. Goncharov added he did not think that there are wide differences between the United States and the Soviet Union on understanding this question of the limits of the use of technical devices. There are extremists on both sides, he noted—extremists who say, for example, that machines will replace teachers. Academician Berg, who is chairman of the Cybernetics Council of the Academy of Sciences of the U.S.S.R., was saying this 2 years ago, but not any more, Mr. Goncharov stated.

Berg still believes, however, that the people of the Academy of Pedagogical Sciences and pedagogues in general do not like technology in education, and do not accept new methods willingly. Mr. Goncharov expressed his personal belief that the older the student, the easier it is to use teaching machines: A 6- or 7-year-old child needs the loving care of a person; a machine cannot fulfill this role. Later, when the child has been promoted to the upper grades, perhaps the machines can be used more properly.

"There is an old Russian proverb," Mr. Goncharov told us, "which goes like this: 'If you beat a rabbit hard enough it will run like a horse'. But children are not rabbits."

He then referred to Mr. Caldwell's hope for an increase in exchange of theoretical information in the field of education between the Soviet Union and the United States. He thought this should be easy to realize, since many Soviet journals, such as *Sovietskaia Pedagogika*, and others, publish articles on educational subjects. If Soviet information which has not yet been published in journals is desired, this sort of exchange also may be possible. "There are no secrets in teaching," Mr. Goncharov declared.

He mentioned that one subject then of special interest to Soviet educators was the discussion of the effectiveness or ineffectiveness of intelligence tests. Mr. Goncharov personally had witnessed the use of these tests when he had been in Western Europe. He commented that in his opinion such tests can be used for diagnosis, but not for determining actual intelligence. He admitted that there was some opposition in the Soviet Union to intelligence tests, part of which might be explained facetiously as opposition of people who had already occupied important positions, but who feared that if they were tested they might be judged unqualified.

Mr. Goncharov then switched to the subject of the exchange of information by the United States and the U.S.S.R. on research in the nature of creativity. He said that among Soviet scientists there is a continuing quarrel over the definition of creativity, a quarrel which, in his opinion, is largely fruitless.

"Instead of quarreling over the definition of creativity," he suggested, "let us work on specific problems. For example, there is the problem of drawing. Here we can work out special relationships, involving perspective, motion, and so on.

"These relationships influence technological creativities," he continued. "Such creativity depends also on other factors, some of which perhaps cannot be explained in a technical way. There are human values which are more important than technical values. Each generation will have a different way of fostering creativity and will have different definitions of the nature of creativity. Each generation will make its own contribution toward reality."

Mr. Caldwell at this point commented that American scholars also cannot define creativity, but that they are nonetheless making effort to identify its characteristics, whatever creativity may be.

Mr. Goncharov replied that it is common knowledge that everyone is born with different characteristics, and that environment also plays an extremely important role in child development. Mr. Caldwell then spoke about some of the tests conducted at the universities of Chicago and Pittsburgh to identify the characteristics of children who have the ability to be creative, or who have done well in creative fields. Among the more interesting characteristics reported as the results of the tests were:

1. Some of the creative students had an average IQ about 20 points lower than their classmates.
2. They tended on the whole to be reserved.
3. They were often disliked by their teachers and fellow students.
4. They displayed a great deal of originality.

This information seemed to surprise both Mr. Goncharov and the head of the foreign section of the Academy of Pedagogical Sciences. They expressed curiosity concerning the report that markedly creative children scored lower on IQ tests than average pupils. Mr. Caldwell emphasized that he was no expert in this field, and was speaking from memory, having read certain reports concerning these tests.

Mr. Goncharov mentioned that another problem then of concern in the Soviet Union was the danger of intensive training; that in some cases the students had been trained so intensively they displayed a reaction against the object of their training. For example, one

student had been practicing the piano for many years. He began having recurring nightmares about a fire in his apartment. When asked if this were not a terrible experience, the student replied: "On the contrary—the only thing burning in the apartment was the piano!" Goncharov emphasized that this problem of over-training was currently a subject of considerable concern among Soviet theoreticians in education. After this meeting, Mr. Goncharov gave us several of his recent articles on education.

2 Teaching of English in Public Schools

THE NEXT DAY, Saturday, May 18, we visited School No. 5, at Kutuzovsky Prospect No. 12, which specializes in the teaching of English. It is a typical 11-year public day school, except that the teaching of English begins in the second, instead of the fifth year, when a foreign language normally starts in the 11-year school. There are 14 subjects in the curriculum of School No. 5.

One of the first classes which we visited was in home economics (*domovodstvo*), which we learned is a fairly recent addition in Soviet education. From the fifth to the eighth grade, the children receive 2 hours of home economics training a week. The classroom contained sewing machines and a number of kitchen appliances. By American standards, the home economics room was not particularly well equipped, but the quality of the classwork seemed to be high. The students were interested in their work, and our general impression was a positive one.

We next visited a class at the fourth-year level conducted entirely in the English language. The children had been assigned to read an English text, in this case a geography of Great Britain. The teacher asked questions on the assignment, the pupils answering in English surprisingly well, considering that this was only a fourth-grade class. Their speaking accent was mildly British; their answers tended to be rather stilted, and probably paralleled the text which they had been assigned to read. If innovation or originality had been called for, the answers might have been less smooth. Nevertheless, the class was obviously well trained, and we remember wishing American children were having an equal chance to learn Russian in the elementary grades.

We questioned the director about the homes of the students attending School No. 5. She replied that most of the students come from the particular complex of apartments in which the school is located, but that some of the older students are from outside this

area—those who had originally started in School No. 5, or perhaps in another school where the English language is emphasized, and then had moved to a district where no "English" school was available. On this street, there was only one such "English" school—No. 5. Another was being built nearby, scheduled to open in the autumn of 1963.

In Moscow, the director told us, there are about 35 schools which specialize in various languages, about 20 in the English language. Each makes an attempt to teach all subjects in the particular language of the school, with emphasis on achieving outstanding linguistic competence.

Mr. Caldwell asked the director if her school used the direct method of language teaching from the beginning, with the students in the lowest level attempting to follow the teacher in speaking the foreign words, and then later learning phonetics and grammar. She said that this was true, but that in the older-age classes the teachers supplement the direct method by utilizing technical aids, such as the radio, movies, and tape recorders. The director further commented that the teaching staff of the school definitely regards machines for language instruction as only supplements, not replacements for the teachers. Mr. Caldwell assured her that many American teachers hold the same opinion.

Asked about the average number of students in a class, the director replied that for classes in which the instructional language is English, the average is about 10 or 12 students, and in classes instructed in Russian, about 30.

The director informed us that in classes as low as the fourth level certain topics are taught entirely in the English language, but that these classes are primarily for those training in English. In the eighth grade a course in English literature is taught in the English language, and in the ninth grade instruction in contemporary history, physics and chemistry is also in English. Some courses in the machine shop of the school are taught entirely in English, as well as geography courses, usually at the upper levels.

This was an interesting conversation since we had been assured, prior to visiting this school, that above the lower grades all subjects except Russian are taught in English. We never did really pinpoint the extent to which English is used for instruction. Nevertheless, by our own American standards this was a unique institution.

We then went upstairs to the language laboratory of the school, where a seventh-year class of 14 students—5 boys and 9 girls—were discussing the geography of London. Again, the style seemed a bit mechanical and the students seemed to know the order of the events which they would take up, but they spoke English quite well.

We noted that not all of the students in School No. 5 were in the regulation school uniform, and when we asked about this, we were told that uniforms were instituted in schools of the U.S.S.R. about 12 or 14 years ago, but that in the near future they will not be required. Already students are permitted to wear ordinary clothes in the springtime when the weather is warm. This is potentially a very important development, since the wearing of a uniform tends to encourage uniformity at all levels.

At the end of the class we were permitted briefly to inspect the laboratory equipment, which seemed to be good, but somewhat on the massive side. Although every student had a microphone and earphones, the desks were not separated by acoustic partitions.

3 Boarding Schools— The Internat System

ON MONDAY, MAY 20, we visited Boarding School No. 12, an experimental school of the Academy of Pedagogical Sciences of the R.S.F.S.R. The Russian name of this school is *Bazovaia Shkola-Internat No. 12.*

When we arrived at the school, we were met by pupils who escorted us to the director's office, where we sat down for a discussion of the internat system and this internat in particular. The director began with the statement that boarding schools in the United States are of two types, those for the very rich and those for the very poor. From this point, she discussed the boarding schools in the Soviet Union. She said that this particular boarding school, No. 12, was founded in 1956. The student body is from all types of families, especially the poor, from families with many children, and from those whose parents must travel.

Moscow, the director said, is being reconstructed so rapidly that about 60 percent of the parents of the children in this school have moved into other districts where their children would normally attend school, but that they usually remain in the internat.

Twenty-five percent of the children in this school are educated at no expense to their parents. Seventy-five percent of the parents pay at least 10 percent of the cost of the education, the amount depending on their salary, meaning the combined salary of the father and the mother. Those parents who earn a combined salary of 300 rubles a month or higher pay the maximum fee for the education of their children, which is 54 rubles a month per child.

The actual cost of educating a child in this particular internat is 72 rubles a month; thus, the government must pay 72 rubles a month per child when the parents pay nothing at all.

The Academy of Pedagogical Sciences of the R.S.F.S.R., which is in charge of this particular school, thinks that this cost of 72 rubles a month per child is very high, and has pointed out that the school

has one adult to every 3 or 4 children. This ratio involves both the pedagogical staff and the sizeable service personnel required by a boarding school. The Academy wants to reduce the teaching staff of the internat by increasing the responsibility of the children for their own studies.

There are eight different grades in the school. Each has about 25 children and several teachers of various subjects, plus a general educator. The school has a total enrollment of 280 pupils and a pedagogical staff of 36 members. Mr. Caldwell asked if the ratio could be explained by the fact that School No. 12 is an experimental school. The director replied that this is not so, that the school's ratio is neither better nor worse than the ratio in other internats. Mr. Caldwell then inquired how this boarding school differs from others in the Soviet Union. The director said that it does not have any advantages over others, but that it is one of the four different experimental internats. She then gave us a brief description of each of these schools.

The first, School No. 12, which we were visiting, is an 8-year school, but will add a grade each year to become an 11-year school, emphasizing the teaching of the English language. The second experimental internat, No. 72, also in Moscow, is an 11-year school stressing mathematics and preparing students in particular for cybernetic programing. The third and fourth experimental internats are agricultural schools. One is located near Tolstoy's home at Iasnaia Poliana, and the other, in a town called Sasonova, near Smolensk, is a combined nursery-elementary internat, taking children from the earliest ages.

In all of these four experimental schools, special scientific workers of the Academy of Pedagogical Sciences of the R.S.F.S.R. observe the experiments being conducted. About 80 percent of these are teachers in the four schools, while others are observers. Most of them are former teachers who have finished *Aspirantura*, or graduate study.

In School No. 12, there are 20 such scientific workers from the Academy of Pedagogical Sciences, who are particularly concerned with methodological and pedagogical problems. One subject under investigation is how to help the younger children to acquire a maximum amount of factual knowledge. This school, for one example, is trying to achieve intensification of instruction through many amateur activities. It has organized groups in ceramics, sculpture, mathematics, and other hobbies as a means of helping the students to absorb more information than they would in their classes alone. Since School No. 12 is a boarding school and the children are there throughout the day, this sort of instruction is perhaps more feasible than it would be in a regular school. In the other Soviet schools the

children stay only 6 hours a day, but in the internats they are actually in an educational environment all day long, the director told us.

One of the problems of School No. 12 is how to keep the parents from feeling that they have been deprived of their children, and the director indicated that in the past the problem with internats has been the parents rather than the children. She explained that she permits parents to visit their children at any time, except when they are actually in an instructional class. Pupils may also go home every weekend, returning on Monday morning. The director said that this permissive attitude on visiting seems to be helping to solve the internat's problem of parental relationships.

Mr. Caldwell asked if it is true that the U.S.S.R. is developing boarding schools in rural areas to bring enough children together in one location in order to provide a good school. He added that in some areas of the United States, where the population is extremely scattered, it is difficult to have a school large enough to justify the expense of good facilities and the employment of teachers trained in specialized subjects.

The director replied that Soviet authorities face the same problems, especially in rural central Russia, where ordinarily there is not sufficient population for establishing middle schools. In these areas it is very important to provide internats, she emphasized.

We then made a tour of the school, which occupies a 3-story building. The first floor consists of a dining room, machine shops, and the cultural club, the second floor of classrooms, and the third floor is a dormitory for the students.

The director commented that the school attempts to achieve a family environment for the children. Thus, each of the first graders has an older "friend" in one of the upper grades who helps him not only with his lessons, but with other problems he might have. We noticed, as we walked around the school, that older students often picked up the younger ones, played with them, talked with them, and helped them find their way around the school.

We next visited the industrial arts shops, which we found to be well equipped. In the fifth year, the students come to the industrial shops twice a week, receiving a total of 5 hours of instruction. The director and the men working in the shops emphasized that they actually produce goods which are used in Soviet factories, or elsewhere in the Soviet economy. One instructor called his particular shop a miniature factory in itself. He showed us boxes which the students and the instructors made for electrical equipment to be sent out for use in factories. There were seven men on the instructional staff of the shop, whose salaries come from what they make while working with the children in the classes, and after school

hours. This led us to question which came first with these workers—the welfare of the children or their own economic gains.

There are several departments in the industrial arts area, including woodshops, foundries, a sewing shop, machine shops, and other specialties. Other products which the teachers in the shops had made and were selling for their own earnings were rabbit cages, geologists' trunks, tables, and other small pieces of equipment. Even the sewing classes make clothes and other items which are sold to help support the school.

We then visited the dormitory on the third floor of the school. The rooms were clean and modest in equipment. It is planned that in 3 years a new dormitory will be built and the 8-year program of the school will be extended to include the full 11-year Soviet elementary and secondary curriculum. Mr. Caldwell was interested in the fact that the boys' and girls' dormitories are in different wings of the building; in another internat he had seen 5 years earlier the boys and girls had occupied rooms on opposite sides of the same hall.

4 Discussion of Exchange of Information

WE ARE INSERTING at this point our conversation of May 18 with Mrs. Kisleva, of the Ministry of Public Education of the R.S.F.S.R., and Mr. Birilko, a specialist in programed learning attached to the Academy of Pedagogical Sciences. The meeting began with a general discussion of the relationship of programed learning and teaching machines to education in the U.S.S.R.

Mr. Birilko expressed special interest in the collection of teaching machines which the U.S. Office of Education has assembled, especially the more complex machines. He also evidenced interest in exchanging information on programed learning with specialists in the United States, since he is writing his dissertation on this subject.

Mrs. Kisleva then took the initiative on the question of a possible exchange of Soviet and American teachers. She said it could easily be arranged under the auspicies of the Soviet Friendship Organization. Mr. Caldwell replied that this organization would not be acceptable to the United States. Mrs. Kisleva then said that because of financial considerations, any such program would be out of question for the present year. Mr. Caldwell replied that he had mentioned the possibility of exchanging teachers in good faith, but only for discussion purposes, inasmuch as any such exchanges would have to be made a part of the regular cultural exchange agreement.

Mr. Birilko added that it seemed to him that the two logical Soviet organs to negotiate the questions would be either the Cultural Committee of the Council of Ministers or the Ministry of Public Education of the R.S.F.S.R. Both Mrs. Kisleva and Mr. Birilko suggested that Mr. Caldwell bring up the question of possible teacher exchanges when we talked with the Assistant Minister, Mr. A. I. Markushevich.

When we met with Mr. Markushevich at the Ministry on Monday, May 20, Mr. Caldwell again expressed his desire to renew

contacts with some of the people he had met before in Moscow, and to revisit some of the schools he had seen to observe possible changes. He also wanted to discuss further the Soviet concepts of machine learning and programed learning in education. In the conversation, Mr. Caldwell mentioned that he might be able to recommend sending an exhibit of teaching machines to the Soviet Union, although he could not make a definite proposal since it would be necessary to negotiate this idea.

He also commented on the many changes currently occurring in education in the United States, particularly a new interest in methods for teaching about Communism. Evidence of this interest, Mr. Caldwell said, is seen in resolutions adopted by several national organizations in the United States recommending that students become better acquainted with the principles of Communism. He remarked that there is also a rapidly growing interest in the teaching of foreign languages and in broadening exchange programs with foreign countries.

Mr. Markushevich replied that he was very interested to hear of these changes occurring in school systems of the United States, and said: "I can see that some of my observations of 1958 are now out of date. Especially I see that the system of free electives without limits is being attacked and I feel that this is a necessary attack. As a mathematician myself, I believe that science and mathematics in the United States would profit very much from a decrease in the number of electives. I am interested in all this because this information which Mr. Caldwell has brought is new to me, even through I have talked with Americans, most recently in Geneva."

Mr. Markushevich then took up specifically the problems of programed learning.

"We are not going to hide our interest," he said, "in teaching machines and programed learning. We do not intend to create any sort of a superman through the use of such machines. We want real men, not supermen. We don't know exactly what a superman is. I can't consider myself a specialist in programed learning, although I am very interested in this field.

"Recently, I received from the United States some books on programed learning which contained very interesting ideas," Mr. Markushevich continued. "However, I would think that these books on the whole were rather elementary. But even in these books I found a rationale. This rationale is that through programed learning, a student can be stimulated at every level and a student may check his progress at every level."

Mr. Markushevich said that the Soviet Union is probably in the very beginning stages of the application of programed learning. Soviet institutions of higher education are most advanced in the

application of cybernetics to education. He added that it is regrettable that technology and cybernetics have so far not been applied more in the lower schools, inasmuch as the school is one of the most attractive and useful places for the application of all the achievements, technical and otherwise, of the human genius. Yet, looking at education critically, one will find that very few fields apply available technology less than education. So, Mr. Markushevich summed up, cybernetics and programed learning represent an open field in education.

"I would like very much," he said, "to exchange information in this field. Mr. Caldwell's suggestion concerning a possible exhibit of teaching machines would create very great interest among the educational workers in the U.S.S.R. Did I understand you correctly on this?"

Mr. Caldwell replied that there is an exhibit of this type already in existence, consisting of the latest machines brought together by the U.S. Office of Education. He suggested that the possibility of part of this exhibit being sent to the U.S.S.R. might be the subject of negotiation. At the same time he indicated that certain considerations might make it impossible to include some of the electronic teaching equipment in such an exhibit for the U.S.S.R.

Mr. Markushevich replied: "My personal reaction to this is entirely favorable; we would like very much to have the exhibit here, but this issue would, of course, have to be negotiated on an official level."

He added wryly that he fully understood that certain advanced equipment might be excluded from such an exhibit.

Mr. Markushevich then turned to the topic of the objective teaching in schools of the United States about the principles of Communism, and said: "We must be quite frank here. If the students in your country are learning about Communism and about Communists, then the aim must surely not be to make Communists of them.

"You want to educate students," he continued, "in the spirit of understanding of other people who live under different ideologies. It is quite clear to me that the aim is to explain the principles of Communism objectively, so that Americans will have a better understanding of Communism.

"And I think," Mr. Markushevich added, "that our textbook of social science, which is new, could be a source which the United States could use to teach about Communism, because the purpose of this book is to give the principles of Communism in a clear fashion."*

*The book to which Mr. Markushevich referred is *Social Sciences: Textbook for the Senior Classes of Secondary Schools and Secondary Specialized Institutions of Learning*, selected as a result of a competition among many Soviet scientists. The authors are G KH. Shekhnasarov, A. D. Boborykin, Yu. A. Krasin, A. M. Lushnikov, O. N. Pisarshevskiy, and V. V. Sukhodeyev.

Mr. Markushevich then commented it was very interesting to him that schools in the United States are beginning to teach the Russian language more widely. Mr. Caldwell had mentioned the approximate ratio of the different languages to be taught in the state of California under the school law which requires all children in public school to begin the study of a foreign language in the sixth grade by July 1, 1965.

Mr. Markushevich said that the ratio the U.S.S.R. is trying to obtain in the teaching of foreign languages is: 50 percent English, 20 percent French, 20 percent German, and 10 percent in all other languages.

"It seems to me," he continued, "that those contacts we have had so far—textbooks, delegations, literature, materials—these exchanges between the United States and the U.S.S.R. are insufficient. I hope we can expand these contacts. I have noted that even our qualified specialists don't know exactly what is going on in other countries in the field of education, and particularly in such specialized fields as my own mathematics.

"We promise in this area of the teaching of the Russian language to give you all possible help in the form of materials and personal consultation. This is my personal feeling, not an official reaction." He said further:

"We could assemble a collective with a group of linguists from both the United States and the U.S.S.R. to discuss and prepare language books, records, and other materials for use in language instruction. We could prepare a series of records containing readings of excerpts from classical literature with emphasis on intonation and phonetics.

"I can see in this field of language teaching wide areas for cooperation. We would consider it very pleasant if more people in the United States knew Russian; also, it must not be unimportant to you that 50 percent of our secondary school students study the English language for 7 years, and a smaller percentage in special schools, for even 10 years."

Concluding our conversation, Mr. Markushevich referred to the subject of teacher exchange, stating: "A question of the actual exchange of teachers between our two countries would be a subject for negotiation in a new cultural agreement, and perhaps this very interesting project might be considered for the 1964–65 agreement."

5 Cybernetics and Programed Learning

ON WEDNESDAY, May 22, we attended a meeting at the Ministry of Higher and Secondary Specialized Education of the U.S.S.R. in the office of Professor Zinoviev, who is the head of the pedagogical section of the Ministry. Some 15 or 16 men and 1 woman were in attendance, among whom were Professor Lebedev, Chairman of the Scientific and Technical Council of the Ministry; Professor Artemov from the First Moscow Institute of Foreign Languages; Professor L. M. Landa, a biophysicist; Professor Arkhangelskii, and also Professor Bazilevskii and Professor Netushil from the Moscow Institute of Energetics. A notable absentee was Academician Berg.

This very interesting meeting commenced with a general discussion of the goals of education, including problems related to teaching, training, and learning, and other aspects of the educational process. The conversation then moved to the subject of cybernetics and teaching machines. Mr. Caldwell gave a rather detailed explanation of the status of programed learning in the United States, and also discussed the difference between linear and the branching devices in teaching machines. The participants seemed to be very much interested in Mr. Caldwell's information. We had the impression that machines available for programed instruction at this time in the U.S.S.R. work on the linear principle only.

One of the first questions raised by the Soviets was: "These complicated teaching machines which you are developing are very expensive to build, and yet we know that they accelerate the learning of the child. Have any kind of calculations or balances been made to determine more exactly the economic loss or gain involved in using such machines?" Mr. Caldwell replied that so far as he knew, research in the United States on this subject has come to no conclusions.

The Soviet scholars then asked what school levels are best suited for the application of cybernetics—the elementary level, the middle

level, or the higher educational establishment. Mr. Caldwell's reply was that he knew of no clear answer to this question; that American educators are using teaching machines at all levels experimentally, and that, to some, the middle and higher levels of education seem to be the most promising.

The next question from the Soviet scholars was: What particular subjects can best be taught by means of teaching machines—that is, language, physics, mathematics, or social sciences? Mr. Caldwell replied that those subjects which had logical progressions of knowledge, with one fact following another, seemed to be the best adapted for teaching machines. He enumerated mathematics, logic, engineering, language, and perhaps physics.

The Soviet representative from the Institute of Psychological Diseases commented that most of his work in neurology and cybernetics concerns problems of memory and the learning process. He said workers in the institute were making models for investigating the structure of the brain, and that they have identified the "defense mechanism." Another scientist added that the Soviets are trying to find ways to control, not to destroy this "screen" which prevents full utilization of the human brain.

Mr. Caldwell asked why the Soviet scientists do not "excise" the "defense mechanism," and thus enable an individual to use 100 percent of his brain. Dr. L. N. Landa leaned forward to answer this question: *If the "defense area" of the brain were removed, the individual would live very intensely for 24 hours, after which all his brain cells would be filled, and from that time forward he could neither forget anything nor learn anything new.*

The Soviet scholars then gave us an opportunity for questions. Mr. Caldwell asked: "Do you have a concept concerning the increase of man's ability to store knowledge through the use of cybernetics?" Professor Artemov said he had expected this question, and gave Mr. Caldwell Issue No. 8, 1962, of *Voprosi Filosofii*, a Soviet journal, which contained an article discussing this particular problem. Artemov then expressed the following views:

- We believe that cybernetics will help us to understand the processes of education, of learning, and teaching, more thoroughly. We believe that cybernetics and information theory follow regular physical laws and through the use of cybernetics we can discover these laws, or *zakonomernosti*.

- Soviet educators have noted that the effort to introduce cybernetic devices or teaching machine devices into the classroom forces educators to think along new lines. It often turns out that after the machines have been developed, or perhaps even before they have been developed, teachers have analyzed the teaching process in such a way that they are teaching in a better way than they originally did; this improvement often occurs even before the teaching machines are actually put into operation.

• Thinking along cybernetic lines helps the teacher to understand the teaching process as a process of information theory, of communication back and forth between the teachers and pupils. Therefore, Soviet educators often think of cybernetics as being primarily useful as a philosophical tool rather than as a technical methodology. In fact, Soviet pedagogues and people in education feel certain that the machines will only help man and not replace him.

Mr. Caldwell then repeated the question he had asked earlier: How can man make use of more of his brain cells?

One of the Soviet scholars replied that they have been conducting a number of experiments in the study of foreign languages, aimed at making more acute the students' sense of hearing and receptivity from the first, or during the first few lessons of instruction in a foreign language. The Soviet professor said that investigators have largely been following the methods of a French scientist, who has been working in a special language research program, dedicated to improving perceptivity and receptivity of language pupils.

This was an extraordinarily impressive meeting which lasted more than 3 hours. It is impossible here to impart the flavor of the exchange of ideas, or to report fully or accurately the ideas exchanged, and the many perceptive and sometimes pungent comments of the participants.

Someone commented that there are those who fear the application of cybernetic theory to learning. One group consists of mechanics, who fear they may become obsolete, and another of "creative" people, who also fear the possible consequences of automation.

Professor Artemov remarked that both fears were unjustified. As for the creative person, Artemov foresaw the day when drudgery would be eliminated by mental work machines. This would mean that a student in, say, physics, would carry in his pocket a small electronic computer that would include all of the necessary factual information he might need—all of the formulas, all of the physical constants, and other specific facts. The student would then be able to devote his own mind to the creative part of his study, drawing on his mental work machine for facts and formulas.

We discussed recent articles by Artemov, who was surprised to learn that some of them have been translated into English. He reaffirmed a statement in one of these articles asserting his belief that out of cybernetics would come a second revolution: The first revolution (the industrial) was one of the mechanics of production; the second revolution might be based on automation, which would both increase production and free the creative mind for creation.

Someone in the group then challenged Artemov to defend his concept of a "mental work machine." This he did vigorously. He said he foresaw a time in the not distant future when students at all levels would have transistorized training machines about the size of

today's transistorized radios. These machines would be programed to meet the specific needs of the individual. They would hasten the process of learning, reduce the time spent on studying, diminish the need for much rote memory work (the machine would do the remembering), and encourage the creativity of the individual. The machines would also help the individual to make full use of all his available brain cells and mental energy. Artemov said the machine would be used like a complicated slide rule.

Mr. Caldwell had the impression, from the reactions of some of the other Soviet scientists present, that there was a division of opinion among them concerning the best way in which potentialities of the human brain can best be developed. Again, Mr. Caldwell noted that these Soviet scientists, all of whom share in common problems, seemed to enjoy freedom in following different approaches to the desired solution.

Mr. Graham then asked Professor Artemov: "What success have the Soviet scientists had in the construction of the mental work machines? What machines have been devised and what are the prospects at the present time for further development along these lines?"

Professor Artemov replied that early models of these machines were very large, and would perhaps occupy all of Professor Zinoviev's desk top.

"Now," he asserted, "this is not the case. Our students sometimes go into the country or go home to study, and carry with them little machines which contain all of the needed information for particular courses. By combining machines of different types we can put into a single machine all that is necessary for the teaching of separate courses."

"We believe," Professor Artemov continued, "that these machines can separate the mechanical from the creative, especially in foreign languages and in engineering. These machines are not learning machines but training machines. We have succeeded especially well in language instruction. If we have a student who is trying to learn a language which is very different from his native language, as for example, a Chinese student learning Russian, he often doesn't understand his deficiency in pronunciation. We have machines called 'testers' in which the sound goes through a microphone and then to a 'trembler', which the student feels with his fingers. He can correct his pronunciation by feeling first the trembling produced by the correct pronunciation of the word, and then the trembling produced by his own pronunciation."

Professor Artemov, a specialist in foreign languages, said that Soviet educators make wider use of audiovisual aids than of cybernetics or programed learning in language training, since cybernetics

in foreign language teaching is more a philosophy than a method of the present time. [We thought there was a certain inconsistency in these remarks.]

He added that in many cities of the Soviet Union there are enormous laboratories with whole floors equipped with electronic machines used for the teaching of foreign languages. Three main types of machines are used. The first are "hearing" machines, which are mostly tape recorders.

"In my laboratory, in the First Moscow Foreign Language Institute, we have hundreds of such tape recorders," he said.

The second type of machine in primary use is the motion picture machine, and the third is the television set.

"In addition," Professor Artemov explained, "we are currently applying more sophisticated and complex combinations of these machines and others for the teaching of foreign languages. New devices include the use of oscillographs and pictograms."

He added this interesting comment: "I am not a mathematician, unfortunately, because mathematics becomes increasingly important in my work. We are actually introducing technical devices in the teaching of foreign languages more and more. We find that this is a very good way to investigate the structure of the methodology of language teaching. We sometimes find that we can make a short cut in teaching, even without the machines. However, the machines are distinct advantages."

Mr. Caldwell then commented that the object of education, according to Confucius, is the creation of superior men, and that both the United States and the U.S.S.R. seem to be trying to create such men. He added that if humanity should succeed in creating a superior man, such an individual would obviously possess superior powers, which it might become difficult to control.

Mr. Caldwell asked: "Will the 'superior man' be safe to have in the house?"

The Soviet scientists looked to Professor Zinoviev. After a pause he said: "This is a very difficult question to answer. We hadn't really thought about it before, but we believe that control over individuals will be the task of society. Since society will become self-regulating, there will be no danger in the production of such superior individuals, because the laws of the development of society are already well known. We believe that the 'superior man' will be hailed by this society and will not be feared at all."

Mr. Caldwell then remarked that the great fear is that "a Hitler" will arise somewhere in the world, perhaps with five times the power of the old Hitler, since he may be a superior being, developed by the methods being discussed.

Professor Zinoviev insisted that Soviet scientists do not fear this

problem because the Soviet society and personality is known to be shaped by environment; therefore such a person could not arise in the Soviet Union.

"But I must add," he emphasized, "that this is my personal opinion. We will help the superior man to develop; we welcome him, and we do not fear the appearance of this man. All societies will eventually develop along the socialist line and this will solve the problem of control. Our Ministry is already trying to locate talented youngsters who are capable of leaping ahead. That shows we do not fear the appearance of superior men."

Professor Zinoviev added that the scientists in the Soviet Union are particularly interested in the problem of the selection of talented individuals, and that perhaps the United States and the U.S.S.R. might exchange information in this area.

Mr. Caldwell replied: "Our research shows that we have somewhat misunderstood the development of children. It now appears that there is an age between 3 and 5 when the child can learn most readily, because his perceptions and receptivity are most keen. We want to use this period without hurting the child."

He then asked: "Could you tell us if you are also trying to use this period intensively? We are trying to introduce scientific concepts to the child during this period—even concepts which are fairly advanced."

Professor Zinoviev replied: "I have not studied this problem but I will give my opinion. If a 2½- or 3-year-old child studies a foreign language, algebra, and so on, it seems to me that this would be a very dangerous business. Children can be overloaded at this age."

Here Professor Landa interrupted: "We agree that concepts can be taught at the nursery school level. We also introduce concepts at this young age, but won't this process age the person too early? This is one of our worries. We are also studying the possibility of introducing the concepts of algebra at earlier ages. It seems to me that in the first grade, that is, at 7 years of age in the Soviet Union, the concepts of algebra and geometry can be taught. But we stress the structure of the subject matter. When I visited a first grade class, I witnessed the way in which young children can absorb these concepts and ideas."

Mr. Caldwell then said: "It is amazing how we under capitalism and you under dialectical materialism come to very similar conclusions and are investigating similar problems. For example, we are both now interested in how to make the best educational use of this most receptive period of the child."

He added that American researchers have also made experiments with drugs which enlarge the sphere of human mental activity.

Among such drugs are mescalene and lysergic acid. Mr. Graham then described some of the experiments being conducted in universities in the United States in this field of increasing perceptivity through the use of drugs.

Professor Artemov indicated that the Soviets are not carrying out as much research involving drugs as in other fields, but said that as a student he had taken a certain drug, belonging to the phosphorous family, to help him in an examination. He had also investigated the use of drugs to increase perceptivity.

Artemov added: "We are experimenting also with the use of drugs for the treatment of mental patients. We also do many experiments on animals."

However, Artemov did not indicate that either mescalene, lysergic acid, or similar drugs which have recently been discussed widely in the United States are being used.

At this point, the representative of the Institute of Psychological Disease commented: "We are interested in the defensive mechanism which prevents the brain from absorbing more information."

He went on to say that, as Mr. Caldwell had noted, the human brain is underutilized; that many more brain cells could be used than are being used; and that for some reason, the brain seems to resist additional information. Obviously, if man can learn to control the defense mechanism, man will be able to make much more efficient use of his brain. He said this problem of the defensive mechanism of the brain is being studied in many institutes in the Soviet Union.

One of the most interesting parts of our discussion started with a question by the Soviets concerning what research is being done in the United States in extrasensory perception.

Mr. Caldwell answered that he knew little about this, but mentioned some American institutions which he thought were active in this field, including Duke University and the University of California at Berkeley. He added that parapsychology is not held in high regard by many American scientists.

The Soviet scientist replied that he and his colleagues are much interested in this subject. He said it is demonstrable that the thinking process produces electrical microwaves, and that Soviet scientists are trying to control these waves, and to use them to achieve specific objectives. One of these objectives is to use controlled mental radio waves in the mind of a teacher to surmount the defense mechanism in the pupil's mind. If this can be achieved, he declared, there will be a major revolution in the processes of education, and doubtless, in the whole of human society.

Mr. Caldwell then expressed the hope that the United States and the U.S.S.R. can exchange more information in this field—the use

of drugs to increase perceptivity, the study of the defensive mechanism of the brain, and so on. Professor Zinoviev replied that the Soviets agree unanimously that such exchanges should take place.

Next, Mr. Caldwell asked what he called his "political question": Is it true that Marxist philosophers think that as a result of the concept of dialectical materialism regarding the law of the transformation of quantity into quality, that computers or machines may some day be capable of independent thinking? He also asked whether the Marxist concept of the withering away of the State can be explained as a cybernetic process: That is, when the State withers, society will become self-regulating, and therefore, the army, the police, and the apparatus of the State become unnecessary.

The members of the group again turned to Professor Zinoviev for his answer. He said: "I am not a specialist in these questions; I am not so bold as to try to answer on such short notice such questions. Maybe my colleagues will try to answer. The problem is far too serious."

Several in the group suggested that we read the article that Berg had written, "Cybernetics and Communism," which had appeared in *Pravda*, treating this particular problem.

Professor Zinoviev then said in conclusion: "The conversation which we have just had has taught something new to every person present at this meeting. I hope you can meet with Academician Berg, who will be eager to discuss further problems of cybernetics and philosophy with you, and will no doubt be able to handle those questions which I have not answered. Thank you again for your frank discussion."

6 Moscow Institute of Foreign Languages

ON THE AFTERNOON of Wednesday, May 22, we visited the First Moscow Pedagogical Institute of Foreign Languages, on Metrostroevskaia Street No. 38. We were received by pro-rector Barkhudarov; the rector, whom we did not meet, is Kolshanskii.

The pro-rector told us that more than 6,000 students are enrolled in the Institute of Foreign Languages. The languages which are taught there are primarily English, French, and German; some Spanish and Italian, and other languages.

The institute consists of the pedagogical department and the translators' department. The first is engaged primarily in training teachers, and provides instruction chiefly in French, English, and German. The translators' department offers instruction in Italian, Spanish, Swedish, Danish, and Portuguese, along with the three principal languages. In addition to the two main departments mentioned, the institute provides a number of auxiliary courses: For example, a 2-year teacher-refresher course, correspondence courses, and courses for engineers and other specialists who are not mainly interested in language itself.

Barkhudarov informed us that the institute has many students from abroad who study Russian as a foreign language.

"Most of our foreign students," he said, "are either Mongolian, Germans, Hungarians, or Vietnamese. We also have some Africans from the Congo and Somaliland. There are also several exchange professors from Germany and France."

The length of study at the institute is 5 years in the pedagogical department and 6 in the translators'. The students also take general courses, especially those centered on the local culture of the country whose language is being studied. During the fourth year, the students have 36 class hours, but in the last or fifth year the number of instruction hours is less. The students are free on Sunday and on one other day during each week for independent study.

"The institute's students," Barkhudarov said, "usually become teachers or translators. While an attempt is also made here to teach national cultures, the institute is not a center of area studies. To tell the truth, our purpose here is completely practical. If one wants a general education, he would not come to the Institute of Foreign Languages; indeed, it would be necessary for him to go to the university. Students who have graduated from this institute usually do not go on to universities; in fact, they can enter graduate school (*aspirantura*) only through correspondence courses."

Students in foreign languages at the institute break down according to the following percentages: 50 percent study English, 15 percent German, 25 percent French, and 10 percent study Italian, Spanish, or other languages. For example, the pro-rector said that since the Soviet Union is establishing relations with Brazil, the institute has begun to teach Portuguese. At the time of our visit, the institute had two exchange teachers in Great Britain, teaching in universities, and one graduate student in the United States.

Barkhudarov noted that there were no English or American teachers in the institute. Mr. Caldwell then suggested that perhaps an exchange program could be worked out so that American professors and teachers could study or teach in the institute in Moscow. Barkhudarov said that this would be very useful and that he would like to see such an exchange achieved.

We then went to hear a lecture by Professor Artemov on the specific characteristics of phonemes, at a congress of linguists then in session at the institute, and a second lecture by another speaker on the same subject. These lectures were obviously pointing toward the possibility of machine translation, the hope of finding common characteristics in the sounds of spoken languages which could be sorted out and translated by the use of computers and simultaneous translators. Professor Artemov told us that he is a friend of Roman Jakobson, the well-known linguist at Harvard University. Jakobson studied with Artemov in Russia before the revolution.

Professor Artemov then took us on a tour of his language laboratory. He explained that the two main items of equipment in the laboratory are intonographs and spectrographs. The spectrographs in use have 32 filters, but the institute is building a new laboratory which will have a spectrograph with 54 filters. He said further that with the use of oscillographs and intonographs, pictures can be made of any spoken language for use in picking out phonemes and common tonal characteristics.

The Moscow Pedagogical Institute of Foreign Languages is the home base for 24 branch institutes in other cities of the U.S.S.R. where similar work is being done. Prominently displayed on a wall of the laboratory was a map of the Soviet Union showing the loca-

tion of all these branch institutes in other cities. Also labeled on the map were institutes in other European countries which have ties with the Moscow institute.

Artemov took us into a computer room in the laboratory where research is being conducted to identify common phonetic elements of many languages, to facilitate the comparison of phonemes in order to locate common elements and to discard those unimportant. We believe this would be a valuable installation for an American specialist in this field to visit.

We thought Artemov to be a first class scientist who was glad to share his work and ideas with congenial foreign visitors. He showed us a new computer under construction in his laboratory which appeared to be a sophisticated machine. Artemov gave no indication of how the machine would handle grammar and word order, but translation from English to Russian might be done in this way:

1. The ideas would be fed to the computer as Russian words and phrases.

2. A single voice would program the computer in English equivalents of Russian word-ideas.

3. The link between English and Russian would be pictures of phonemes on the oscillograph.

4. To translate from English to Russian, the original voice which programed the computer would read English into the machine.

5. The attached oscillograph would picture each phoneme.

6. The computer would match individual or group-phonemes to ideas.

7. The computer would then print a Russian version of the text read by the voice in English.

7 Moscow Institute of Energetics

WE VISITED on Thursday, May 23, the Moscow Institute of Energetics, the full name of which is the Moscow Order of Lenin Energetics Institute, located at Krasnokazarmennaia Street, No. 14. It is also known as the Moscow Power Institute.

We were met at the institute by the pro-rector, D. V. Rosewig, and Professor Anatolii Vladimirovich Netushil, who is head of the Department of Automatic Machinery. He said that he was glad to speak with us and would welcome other visitors from the U.S. Office of Education who might come to Moscow.

Our conference began in the pro-rector's office with Professor Netushil, Professor Rosewig, and Professor Arkhangelskii, who had studied at the University of California in Berkeley. The group also included an unidentified participant, the head of a "student construction bureau" in the institute, who seemed exceptionally intelligent and asked many questions.

The Institute of Energetics is the source of many of the teaching machines and cybernetic devices used in the Soviet Union. Professor Netushil, in particular, is connected with both research and the construction of cybernetic devices. After a few preliminaries, the conversation quickly moved to the subject of programed learning.

The institute people were particularly interested in examples of textbooks which had been written according to linear principles, and asked Mr. Caldwell to send the institute examples of such textbooks, if possible. They said they would also be interested in seeing some of the material on the programed teaching of physics compiled by Jerrold Zacharias of the Massachusetts Institute of Technology.

The pro-rector commented that he was personally not so interested in the methods of teaching, which are improved by programed learning, as in the problem of what today should be the content of physics and mathematics courses. He asked this question: Can the problem of the rapidly growing body of knowledge in physics and

mathematics be solved or helped through the use of programed learning?

Mr. Caldwell replied that he was no specialist in this field, but that he had heard the problem discussed by better informed American educators. He conveyed his impression that in the United States this problem is being treated from several different approaches. One, which he sketched in some detail, is the system of collective authorship in the writing of books, a method which has developed in the United States in recent years.

Second, he discussed experiments in introducing mathematical and physical concepts to children at a very early age, thereby intensifying and accelerating the entire educational process.

Finally, Mr. Caldwell spoke of the encouragement of scientific research outside of the school. He described in some detail science fairs and various talent contests in the United States, adding that he knew the Soviet Union was also interested in such activities: The Young Pioneers, school hobby clubs, and other groups in Soviet schools pursue similar research projects.

The representatives of the Moscow Institute of Energetics were also greatly interested in the use of teaching films. They seemed to be surprised that instructional films are so widely used for teaching in the United States. Our hosts said that they would like to see some samples of American technical teaching films, and to have more information on American electronic teaching machines built on branching principles. We therefore came to the conclusion, after the meeting, that the Soviet Union must be lagging behind the United States in the use of teaching films.

Mr. Caldwell's first question to the pro-rector concerned the nature of an "institute of energetics." Professor Rosewig gave us the following information:

- The Moscow Institute of Energetics has an enrollment of about 12,000 day students and 6,000 evening students, a total of 18,000. The institute has three different departments:
- The first, the energetics department, is concerned with power equipment and generating equipment, both hydro- and thermoelectric. [In an American university, this might be called the department of power engineering.]
- The second is the electro-technical department, which deals with problems of power transmission lines, electrical generators, and motors and related equipment.
- The third is the electronics and cybernetics department. Its students and faculty are concerned with cybernetic devices of all types—electronic computing machines, teaching machines, and other types of automated equipment, some of which in the institute appeared to be of the most modern and sophisticated nature.

In all, in the Institute of Energetics, there are 30 different *uchebnye*

plany, or courses of study, and within these courses 300 specialties are taught. We were told that the institute receives many requests from other institutes in the U.S.S.R. for teaching machines. The Moscow institute also has an All-Institute Instructors' Group Bureau, which brings together specialists in different areas who cooperate to solve the problems of programed learning and teaching machines.

After this general discussion we went to lunch in a room off the students' cafeteria. We noted the poor quality of food being served to the students, compared to the excellent meal we enjoyed. Mr. Caldwell viewed this as one of many signs of a growing stratification in Soviet society.

The unidentified man in our party, previously referred to, who heads a student construction group, commented at length before and during lunch concerning the organization of competing groups of instructors and students within the institute. He described these as being similar to medieval guilds. After lunch he took us to one of the student construction groups, where we were shown one of the cybernetic teaching devices. This was actually a testing device, and Mr. Caldwell was given a photograph of it.

This device answers only "yes" or "no" to 15 different questions which had been programed into it through a film, which, in turn, is threaded in a complicated way so that it forms a Mobius Strip. We were told that the device possesses 5,000 memory units, which seemed to us a much greater potentiality than needed for the 15 questions which it was currently programed to answer. Mr. Caldwell operated the machine. For each question the student was given a choice of six answers. He then pushed a button corresponding to the number which he thought was correct. The machine flashed a "yes" or "no" light and the student then proceeded to the next question. At the end of the test period the machine flashed the student's total score, plus the number of correct and incorrect answers. This machine seemed rather primitive, having no feedback involved, except giving the student's total score.

The machine did not change the next question on the basis of the success of the student in answering the preceding question. However, the machine would not duplicate the sequence of questions within a substantial period of use. Mr. Caldwell assumed this had something to do with the Mobius Strip threading of the film.

The student construction group which we visited was also doing work on foundry control for the Likhachev auto factory in Moscow. The head of this group proudly told us that it had perfected an electronic device which regulates the cooling of liquid steel. This device, he said, was highly successful and had been bought by an American steel corporation. The student group had also con-

structed, for purposes of student demonstration, a "turtle" for library work, which follows white lines painted on the library floor and distributes books automatically. This "turtle" is a little cart with a drive mechanism connected to a photo-electric cell which prevents it from leaving the white lines. If a person stands in front of the cart and obstructs the way, it automatically stops until the obstruction is removed. Such a system for distribution of books in libraries has certain advantages over pneumatic tubes or other systems, in that it can be easily changed, since the "turtle" will follow wherever a white line is painted on the floor.

The workers in this group emphasized that all the products which they were developing were intended for genuine uses somewhere in Soviet industry, and, consequently, all the work was planned with practical applications in mind. One interesting device then being built was a computer for medical diagnosis with 20,000 memory cells. When it is completed, a sick person could punch the buttons corresponding to his symptoms and receive an immediate diagnosis.

We both believed this construction group which we visited was far from being the most sophisticated one in the institute. We were told that the all-institute construction bureau was the one performing the most important work in cybernetics.

Our visit to the office of Professor Netushil, which followed, was almost purely personal. We did not see the laboratories in his department of automatic machinery, but did have a further interesting discussion with him on possible future application of cybernetics in teaching and other fields. We also suggested that an exchange of specialists in cybernetics and in programed learning might be considered for the next U.S.-U.S.S.R. cultural agreement.

We had two distinct impressions from our visit to the Moscow Institute of Energetics: (1) The work in cybernetics at this institute is large in volume and uneven in quality, but in part seems very sophisticated; (2) Professor Netushil and the head of the student construction bureau, whose name we did not obtain, are important figures in the Soviet cybernetic complex.

8 Moscow State University

ON THE NEXT DAY, Friday, May 24, we visited Moscow State University, our last formal engagement in Moscow. We thought for various reasons that Academician Berg might be present at lunch, but when we finally did meet pro-rector Ivanov in his office, Berg was absent. Ivanov and the head of the foreign department of the university were with us at lunch. The table was set for one other person who did not appear.

During lunch in Ivanov's office (a very good meal, by the way), Mr. Caldwell again referred to his interest in a possible teacher exchange program. Ivanov said a number of teachers from the United States were coming to Moscow State University that summer for language training, and he expressed an opinion that perhaps the suggested exchange program might be based upon this smaller program. He further suggested that a large and continuing summer school program for American teachers might be negotiated in the U.S.-U.S.S.R. cultural agreement. The pro-rector said he would supervise such a program personally to insure its success. He also added with a smile that it might be well for the American side to send its own professors with the American teachers in order to avoid "misunderstanding" at home.

By Mr. Caldwell: This meeting at the university was in general a courtesy call. Nevertheless, the pro-rector seemed genuinely interested in the establishment of a substantial summer training center for American teachers at Moscow State University. This appears quite feasible from a physical standpoint because Russian universities have no regular summer schools. If American schools are to implement effectively the recommendations of the American Legion, the American Bar Association, and other groups regarding better teaching about Communism, such a summer school for American teachers might be found valuable.

9 Informal Discussion on Placement of Graduates

BECAUSE WE HAD no evening programs arranged by our hosts, we were able to dine in a different restaurant almost every night. We thus met many interesting people; restaurants in Moscow often are crowded, and it is the custom to sit at any table where there are empty chairs.

Among the discussions over the dinner table was one which involved a very able and articulate student who had just graduated from Moscow State University. The subject of discussion concerned particularly the method by which Soviet students graduating from universities are placed in jobs. The academic commission which awards degrees and defines questions of academic standing in the Soviet Union is the higher attestation commission, called VAK. It is often thought that VAK not only awards degrees and determines examination questions, but also has something to do with the allocation of strategic manpower.

However, we were told by this student (who was currently coping with the problem of securing a suitable and acceptable job), that the placement of young graduates in the Soviet Union is handled by a committee called the State Committee on the Distribution of Young Specialists (*Gosudarstvennyi Komitet Po Raspredeleniiu Molodykh Spetsialistov*).

The actual work of allotment, according to our informant, is done by local committees at each university operating under this State Committee. These local committees consist of the heads of each department in the universities, or *kafedra*, plus the dean and the assistant dean, or *dekan*, of each faculty. The latter two, that is, the dean and the assistant dean, apparently decide the question of allocation for most students, the other members of the committee merely agreeing with their decision.

Our informant told us that the VAK committee was then meeting in the philological faculty of Moscow State University. Each grad-

uating student in that faculty would appear before the committee to defend his particular interest, to state where he would like to be placed, and why he might be given special treatment. A very few students are given the right to what is called a free diploma (*svobodnyi diplom*) and may pick jobs freely. The other students are all assigned to jobs, although their particular desires may be considered, and they must work at their assignment for 2 or 3 years.

We were told, however, by some recent graduates that discipline in such job assignments is rather lax, and often, after a year of work at the assigned place, the young specialist may simply take off and go to another. In such cases the student is not usually punished. In fact, students sometimes refuse to serve even 1 year at their original assignments. Punishment seems to depend, in some cases, on whether the student accepts a government grant of money to help him in his new assignment. If the student accepts the money and does not go to the assigned place, then he is usually caught and punished. But if he does not accept the grant, and simply ignores the order to go to the original assignment, he often gets away with it. The whole system of the assignment of young university graduates seems to have many exceptions.

This situation seems to indicate that the law of supply and demand may be stronger than Communist planning principles. We learned that the shortage of skilled personnel in a rapidly growing economy made it relatively easy to find jobs outside the established system.

In the case of those who have received advanced degrees—that is, the *kandidat* (candidate) or *doktor* (doctor) degrees—the higher attestation commission, VAK, is said to have no influence at all. Various universities and industrial establishments simply advertise their vacancies, and professionals holding degrees compete for these positions. If there is only one applicant for a particular vacancy, then that man fills it. Among graduates of the philological faculty at Moscow State University in the spring of 1963, the least wanted positions were those of school teachers. The reason is partly financial, since beginning school teachers in the Soviet Union receive only 70 rubles a month salary.

Mr. Caldwell had the feeling that supply and demand is undermining the so-called preferred status of teachers in the Soviet Union. During the past 5 years, since his first visit in 1958, the comparative economic status of the teachers appears to have worsened. Of course, officials in the education ministries deny this.

All beginning school teachers receive the same pay except in the Arctic regions, where they are sometimes paid more as an allowance for winter clothing. The more desired positions for graduates from the philological faculty of Moscow State University are with the

publishing houses, where employes may receive as much as 120 to 130 rubles a month.

In the Soviet process of allocating students to jobs, there appears to be an effort to send them back to their home regions, if there are vacancies. Thus, a student born and raised in Moscow is likely to be appointed to a position in that city. As a matter of fact, all of the students who graduated from the philological faculty of the university in May 1963 and are "Moscovites" were given positions in Moscow.

The assignment of graduates to jobs by the State in the U.S.S.R. is often pictured in the United States as automatic and heartless. After talking to students under little or no restraint, and hearing their own case histories, one is likely to assume either that the system has changed or now has a heart.

Perhaps the most coveted assignment upon graduation from the university is *aspirantura*, or graduate study, which is very difficult to obtain. Of over 40 students who graduated from the Moscow State University philological faculty in 1963, only one received an assignment to *aspirantura*, and this was a correspondence course, not full-time graduate study.

We asked one student: How do students in the university avoid military service? What are the provisions of the military draft with respect to students? He replied that the university permits students to enter at the age of 17 or 18, but that the army does not call men until they are 19. This means that all male students have a chance to begin their studies at a university or institute before they are eligible for army draft. University students are then exempted from the call. Previously, the university had a military faculty which taught military science, and students who had taken these courses became officers after going through officer's school shortly after graduation. We were told these military faculties have been eliminated in the universities. A few students are still called into the army after graduation. This may be considered by some as a catastrophe, since these students will be required to serve for 25 years.

CONCLUSION

By Mr. Caldwell

SINCE MY VISIT TO MOSCOW, I have discussed with a number of American scholars and scientists the work being done in the United States, in the U.S.S.R., and elsewhere, designed to expand the capacity of the human brain and thus to create a "superior man." It is clear that considerable research is being done in this area. However, as a nonprofessional observer, I have the impression that research in the U.S.S.R. may be more advanced than similar research in the non-Communist world. If this is true, and if the Soviet scientists achieve even a small portion of their stated goals during the next generation, the results could bring about a serious effect on the balance of power.

We were impressed by the Soviet scientists we met on our visit to Moscow and by their generally warm welcome to us. Is it perhaps not time for responsible American leadership to take a new look at the problems involved today in developing human resources? Furthermore, it seems imperative that the United States should devote a larger proportion of its energies and resources to the development of a new generation of Americans, who will have the skills and wisdom necessary for carrying out their responsibilities for leadership and cooperation in a new world of tomorrow.

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