

THE EDUCATIONAL SYSTEM OF THE MOSCOW PHYSICO-TECHNOLOGICAL INSTITUTION IN CONTEXT*

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RESUMEN

Utilizando materiales de archivo hasta ahora inéditos y entrevistas realizadas por el autor se examina la historia del Instituto Físico-Tecnológico de Moscú, establecido en los años de la postguerra para cubrir una gran demanda de especialistas en campos militarizados de la ciencia y la alta tecnología. El autor se concentra en el sistema educativo de esta institución y describe su contexto social y político. Señala la laguna existente entre el sistema educativo proclamado por los fundadores del Instituto y la práctica real.

ABSTRACT

By using hitherto unpublished archival material and interviews conducted by the author the history of the Moscow Physico-Technological Institution, established to cover a great demand for specialists in militarized fields of science and high technology in the immediate postwar years, is taken under examination. The author concentrates on the educational system of this institution and describes its social and political backgrounds. He points out the gap which arose between the system of education proclaimed by the Moscow Physico-Technological Institution's founders and real education at this Institution, when it was in full swing.

Palabras clave: Higher education, Russia, 20th Century.

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The celebration of 50th Anniversary of the Moscow Physico-Technological Institution (MPTI), which arose as a Faculty of the Lomonosov Moscow State University in November, 1946, inspired many jubilee publications¹. Almost all of them are filled with admiration for the *MPTI's educational system*, a system of advanced elite higher education in physico-mathematical sciences. This article is concerned with the historical examination of this *system*.

The idea of this *MPTI's system* was verbalized by two great figures in Soviet science, the Academicians P.L. Kapitza (1894-1984, Nobel Prize in 1978) and S.A. Christianovich (b. 1908) in their messages to I.V. Stalin and other authorities in 1945 and 1946, and in P.L. Kapitza's project which was enclosed with his 1945 letter to G.M. Malekov, then Chairman of the Council of Ministers. A group of outstanding Soviet physicists, mathematicians and industrial managers supported Kapitza and Christianovich and signed together with them some letters. To embody their idea the Physico-Technological Faculty at the Lomosov Moscow State University was established in November, 1946, with Academician Christianovich being appointed as Prorector on Special Matters of the Moscow State University to run the new Faculty.

The *MPTI system* was again proclaimed once the MPTI became a new separate educational institution in 1951. General Dr. I.F. Petrov and the Academician O.M. Belotzerkovsky, who held one after the other the position of MPTI Rector, and the acting Rector Corresponding Member of the Academy of Sciences N.V. Karlov regarded this *system* as the highest achievement of Soviet (and Russian) efforts in higher education (Belotzerkovsky likely introduced the term *the system of MPTI*). In fact, the acting MPTI authorities tend to present the *MPTI's system* as something for life.

"The MPTI's system has proved itself. MPTI is Russian national property [...] Created in the force-majeur situation of 1940-s, solved successfully problems which were put before it, MPTI must work for the good of new Russian under the new force-majeur circumstances" [*I am Phys-Tech*, 1996, p. 144].

The problem arises: what were historical backgrounds of the *MPTI system* and its embodiment and institutionalization? As a matter of fact we face two problems: what was the specific of the period in the history of the Soviet Union when the idea of the *MPTI's system* came? Under which circumstances the idea of the *MPTI's system* was embodied in actual persons, regulations, patterns and buildings?

The latter problem leads to another one. What was the historical trajectory of the *MPTI's system*? The political and economic situation in the Soviet Union changed in the flow of time. Correspondingly the situation in science changed. How did MPTI react to these changes? How did the *MPTI's system* adapt to the new circumstances?

It should be noted that we do not take under discussion the recent changes in MPTI conditioned by the general destruction of the Soviet science. The MPTI of Gorbachev's and Eltzin's time is a special problem to be tackled. Here we are interested in following changes that occurred in the *MPTI's system* under the rather quiet flow of the Soviet life as it was before the late 1980s. It should be noted that as yearly as those years the *MPTI's system* confronted with some problems which gained momentum at the *perestroika* and *democracy*.

Access to the MPTI Archives and Administrative Reports has made this study possible. Interviews with acting Rector of MPTI Professor N.V. Karlov (08.07.1996), former Prorector Professor D.A. Kuzmichev (14.03.1996), Dean of the Faculty of Problems of Physics and Energetics Professor S.A. Gardunin (16.04.1996), the MPTI Professors S.V. Illarionov and L.I. Borodkin (12.05.1996; 15.06.1996), who graduated from MPTI in 1961 and 1971 respectively, Dr. V.I. Arshinov (08.12.1996), who graduated from it in 1965, were of much importance as well.

In the first section a description of the *MPTI's system* is provided. The second section is a brief outline of the MPTI history. The third section is concerned with the social and political backgrounds of the rise and development of MPTI. The fourth section deals with the changes in MPTI and deviations from its original plan in the course of the MPTI's growth in 1960s-1980s.

1. The MPTI's educational system

As mentioned above the MPTI founders put forward the idea of a new advanced elite system of higher education in physico-mathematical sciences called later the *MPTI's system*. The principles of this system have been expressed, with one or another deviation, in the speeches and papers of some prominent figures in Soviet science and the MPTI authorities over the last 50 years. This section aims to summarize these principles authentically and carefully.

1. Special severe mathematical and physical training of school-children to provide them with the necessary qualification for the admission to MPTI and

severe two-steps competitive entrance examinations; 2. Fundamental wide and severe training of students of the first-fourth years in physics, mathematics, mechanics (including special courses of theoretical physics, theoretical mechanics, and calculating mathematics) and two foreign languages (if studies in humanities and physical training are included, then it takes approx. half the duration of studies); 3. Special courses of instruction leading to the professionalism and delivered by the so-called base chairs (base departments), which were set up at the *base* institutions and laboratories (as a rule, the advanced laboratories and institutions of the Academy of Sciences of the USSR and *branch* research institutions that were under Ministries' commands), and wide participation of students of third-sixth years in the researches of those institutions and laboratories (also approx. half the duration); 4. Wide invitation of working scientists as lecturers and instructors (originally all the academic staff of the *base* chairs and the majority of the staff of the fundamental chairs were filled with invited working scientists); 5. Permanent competition between the MPTI students to continue their enrollment at MPTI, competition implied by a considerable amount of drop-outs and invitation of students of institutions close to MPTI to pass through appropriate examinations and join the MPTI students (usually with losing one or more years).

Comments: 1. The *MPTI's system* implies the democratic admission of young persons to the enrollment. In contrast to many elite educational institutions (for example, the Moscow State Institution of International Relations), the enrollment in MPTI has never been conditioned by any explicit or tacit social restrictions. The MPTI administration did much to increase the number of entrances and extend the range of the regions from which entrances could come (the special external physics-mathematical school that has been popular up till now, the evening physico-mathematical schools, mathematical *Olympic competitions*, etc.).

It should be noted, however, that the struggle against *cosmopolitanism* at the beginning of 1950s and the anti-Semitic wave of 1970s-1980s touched MPTI. The special problem is woman education at MPTI.

2. According to the MPTI founders, MPTI must provide training in abstract mathematics on the level of the celebrated Mechanico-Mathematical Faculty of the Moscow State University and training in applied mathematics better than at this Faculty.

3. Although the Institution is named physico-technological, there is no engineering course among the fundamental studies (originally there was a chair of strength of materials in MPTI, but this chair is not mentioned in the 1970 list of MPTI chairs). In such a way MPTI is escaping from a routine by

which engineering courses are usually more infected than physico-mathematical ones. The MPTI students can master all necessary engineering and technological knowledge within the framework of their studies at the *base* institutions and laboratories.

4. The *system of MPTI* provides (approx.) half and half ratio between subject-matter and problem training. Although a tendency to combine subject-matter and problem (survey) courses has long been characteristic for advanced higher educational institutions [BRUBACHER & RUDY, 1965, p. 275], the founders of MPTI, as if they took for granted J. Agassi's recommendation *to be concerned with problems but not with beliefs* [AGASSI, 1981, p. 118], transformed problem studies into an essential part of education. All the fundamental courses provide subject-matter training. The majority of courses of instructions offered at the *base* institutions and laboratories concentrate on problems that the institutions and laboratories tackle. These courses are guides to corresponding problems, and they develop as the problem-solving research brings results.

5. The *base* chairs are to provide very individual, tutorial training of students. The *MPTI's system* allows very small groups of students, which a *base* chair leads to professionalism, and presupposes a new type of university teacher who combines an instructor, scientific leader and tutor.

6. In contrast to the majority of educational institutions that aimed to a high graduates/newly enrolled students ratio, the *MPTI system* allows a considerable amount of drop-outs. In fact, the special interium State exam in physics after the third year should stimulate an increase in the number of drop-outs². Academician Kapitza, in his speech at the 1970 meeting of the Presidium of the Academy of Sciences, considered that the *Ecole Polytechnique*, with its 50% of drop-outs, provided a paradigm example for MPTI [KAPITZA, 1996, p. 13]. According to Kapitza's idea, the MPTI drop-outs could enrol at other technological institutions.

2. A brief outline of the MPTI history

Four periods of the MPTI history have been observed: 1. (1946-51) the Physico-Technological Faculty at the Moscow State University, super-elitism; 2. (1951-62) the formative years, the arise and development of MPTI as an elite educational institution under the Ministry of Higher Education (the period of Rector General Dr. I.F. Petrov); 3. (1962-87) the development and expansion of MPTI under Rector Academician O.M. Belotzerkovsky (acting Rector N.V. Karlov calls this period shaping of the MPTI's Empire); (1987-

present) the decline, loss of prestige and search for new ways of support under Rector Corresponding Member of the Academy of Sciences N.V. Karlov.

In the first period, it should be emphasized that the Physico-Technological Faculty at the Moscow State University embodied the *MPTI's system* perfectly. This was a rather small Faculty. 118 students of first year and 67 students of second year enrolled at it in 1946. First year students had been selected by the three steps competitions which started not only in Moscow but in Leningrad, Kiev, Tbilisi and Gorky. Second year students had been selected from the students of other educational institutions who submitted their applications (for example, the future Rector of MPTI Belotzerkovsky, who had been a student of the Bauman Moscow Higher Technical School, moved from fourth year to second year).

The fundamental courses were delivered by scientists such as L.D. Landau, P.L. Kapitza (both Nobel Prizes later), the great mathematicians S.L. Sobolev, M.A. Lavrent'ev, I.G. Petrovsky, the world class physicists E.M. Lifshitz (who was Landau's co-author, in the famous *Theoretical Physics* in 6 volumes), S.M. Rytov, *et al.* This Faculty was headed by a Scientific Council consisting of S.I. Vavilov (President of the Academy of Sciences), M.V. Keldysh, A.P. Alexandrov (they became one after the other Presidents of the Academy of Sciences), N.N. Semenov (Nobel Prize), I.V. Kurchatov (the Soviet Oppenheimer), and other great figures in Soviet science. As a matter of fact, all the Soviet intellectual power concentrated on the Physico-Technological Faculty. The very individual tutorial training had been launched at the *base* institutions and laboratories. Some former students of the Physico-Technological Faculty have reminiscently described how during the third or fourth years of their studies they were friendly helped to start their research by distinguished physicists and mathematicians and were led by those scholars on graduate and postgraduate levels.

As a result of the intensive struggle against this innovatory enterprise the Physico-Technological Faculty was closed in 1951. A small fraction of students was allowed to graduate from this Faculty. The others were moved to the Physical Faculty of the Moscow State University and the Moscow Engineering Physical Institution. However, after a visit of General Petrov to Stalin (Petrov was asked to do this by Kapitza and some other academicians) in Dolgoprudnaya (a small town in the Moscow region) on the base of Physico-Technological Faculty MPTI was established. This was in the same 1951. General Petrov (1897-1994) was appointed Director of this Institution (later this position was called Rector). Petrov did his best to embody the *MPTI system* under the new circumstances. MPTI was guided by the Scientific Council which was rooted in that of the Faculty. Under General Petrov MPTI was developed to the standard of a working institution.

In 1962 the MPTI's graduate Dr. (later Academician) O.M. Belotzerkovsky (b. 1925) became Rector of MPTI. The interviewed persons relate the rapid growth of MPTI under O.M. Belotzerkovsky's direction. However, as it is presented in Table 1 and Figure 1, this growth had started during *the second period*. Under Belotzerkovsky (*third period*) this growth had been shaped into the administrative innovations.

Originally MPTI consisted of four Faculties: Radiophysics, Radioengineering, Aeromechanics, and Physico-Chemical. Within 1955 and 1956 the Faculty of Radioengineering was renamed as the Faculty of Radioengineering and Cybernetics and the Faculty of Radiophysics was renamed as the Faculty of General and Applied physics. These new names are explained by the growths in the diversity of studies at the Faculties. The new Faculty of Physical and Quantum Electronics was established in 1964³. In 1965 the Faculty of Aeromechanics and Flight Technology was established on the base of the Faculty of Aeromechanics, which had already been renamed as the Faculty of Aerophysics and Mechanics of Flight. At the same time the Faculty of Aerophysics and Mechanics of Flight took a new name: it was called the Faculty of Aerophysics and Applied Mathematics. In 1969 this Faculty was divided into two Faculties: the Faculty of Aerophysics and Space Research and the Faculty of Control and Applied Mathematics. The modern name of the Physico-Chemical Faculty is the Faculty of Molecular and Chemical Physics. In 1976 the Faculty of the Problems of Physics and Energetics concentrated on the studies in the control thermonuclear synthesis and in 1982 the Faculty of Physico-Chemical Biology arose.

The development of the MPTI's Faculties is presented in Table 2 and Figures 2 and 3 as variations in the number of graduates of the MPTI's Faculties. Figures 2 and 3 show variations in the number of Faculty graduates as sinus-like curves with the general tendency to a stable increase. The first rapid growth (1963-65) is partially explained by the 1957 State campaign for admission of young workers to higher education. This campaign had led to the increase in the number of educational institution's students. The drop, which the curves for Faculty of General and Applied Physics and Faculty of Radiotechnology and Cybernetics show in 1970s, was a response to the establishment of new Faculties in 1964, 1965, and 1969.

In 1952 MPTI had 5 *base* chairs to train students for professionalism, in 1958 the number of *base chairs* was 15, in 1965 was 28, in 1970 was 45, in 1980 was about 100. In 1984 worked really about 80 *base* chairs.

The *MPTI's Empire* was shaped by expanding into new geographical regions too. In 1972 the MPTI education at the Far East Scientific Center of

the Academy of Sciences was launched, in 1981 the South Urals *base chair* (in town Miass), in 1982 the Kiev branch were opened.

From the above reasoning we do not take *the fourth contemporary period of the development of MPTI* under any special consideration. In the next section we make this study wider and turn to the social context in which MPTI arose and developed. In other words we turn to the questions which were put above. What was the specific of the period in the history of the Soviet Union when idea of the *MPTI's system* came? Under which circumstances the idea of the *MPTI's system* was embodied in actual persons, regulations, patterns and buildings?

3. The social context of the rise and development of MPTI

The rise and development of MPTI seems to be connected with the *special scholarship programme*, traces of which are observed in some recollections and collections that are kept at the Center of the Contemporary Documentation (the former Archives of the Central Committee of the Communist Party of the USSR)⁴. This *programme* was launched in the immediate Post-War II period to cover a demand for highly qualified specialists in military fields of science. The Physico-Chemical Faculty of the Moscow Mendeleev Chemic-Technological Institution and the Faculty of Rare and Radioactive Metals of the Institution of Steel arose as special Faculties. The Moscow Physico-Engineering Institution arose as a Faculty within the framework of the special Moscow Mechanical Institution belonging to Narkomat (Ministry) of Ammunition in 1945. There is no Institution with this name now but its Physico-Engineering Faculty together with the Faculty of Physical Instrument Engineering (arose in 1949), the Physico-Mechanical Faculty, (arose in 1951), the Faculty of Computer Set-Ups (arose in 1954) had formed the core of the present Moscow Physico-Engineering Institution.

The Physico-Technological Faculty of the Moscow Lomonosov State University was also considered to be a *special* Faculty, and Academician Christianovich, who took charge of the Faculty, was given a tittle of Prorektor on Special Matters. However, the significance of this Faculty and subsequent MPTI can not be judged by the standard of militarization of higher education alone. In this case another standard would also be applied. The Physico-Technological Faculty and MPTI arose from endeavors of some academicians supported by the authorities of the military engineering to establish their own system of higher education within the framework of the Academy of Sciences. This was a reaction on the tense relations between the physicists of the Academy of Sciences and the leading members of the

Physical Faculty of the Moscow University. For a number of reasons, after the mid 1930s the best Soviet physicists concentrated in the staff of the Institute at the Academy of Sciences. Although some Academicians delivered lectures at the Physical Faculty as their second job, they did not hold strong positions there. The Faculty's members intended to develop studies and scholarship in their own way and under their own authorities. In turn, the physicists of the Academy of Sciences were not satisfied with the educational standards of the Physical Faculty.

Judging by some reminiscences, during the immediate postwar period the organization of Soviet science was affected by two movements. First of all, the State's and Communist Party's authorities intended to integrate the best applied science into the military-industrial complex. A net of secret Scientific Research Institutions, Research Design Bureaus and laboratories in the field of technology and engineering of nuclear weapons, explosion, rockets, materials, propellant, radio-location, etc. had been established over the last war and first postwar years. Many talented scientists and engineers worked in secrecy at those establishments called numbered Institutions or letter boxes.

However, there was a responsive movement⁵. In the search for financial support and prestige some leading scientists aimed to awake military-industrial authorities' interest in their enterprises and connect those enterprises with the programs of militarized science and technology. In such a way a good portion of basic, pure science turned out to be integrated into the military-industrial complex.

The *programme of special scholarship* presupposed advanced training in physics and mathematics. At the *special* faculties and colleges prominent figures in physics and mathematics provided students with training which went very far from the applied military problems. I.E. Tamm excellent teaching at the Physico-Engineering Faculty, where he held the chair of theoretical physics (1945-50), provides an expressive example [KAGAN, 1990].

From its very beginning the Physico-Technological Faculty and subsequently MPTI was formed under the authorities of the Academy of Sciences and great scientists. This resulted in the program of wide and severe training in physical theory and mathematics at MPTI. As the 1946 resolution of the Council of Ministries, signed by Stalin, claimed that this Institution's objective was *to give adequate backgrounds in the important fields of contemporary physics*. Although MPTI was oriented toward professionalism in the technology of aircraft of rapid speed, physics of explosion and other military fields of science, it produced also specialists whose destination was to develop the best possible theoretical and experimental physics in the USSR.

It is not surprising that the leading Research Institutes of the Academy of Sciences tended to expand their academic staffs by inviting MPTI's graduates. For example, the Institute of Physical Problems headed by Kapitza (now is named the Kapitza Institute) included into its staff only those who graduated from MPTI [RUBININ, 1996, p. 186].

The history of the genesis of the L.D. Landau Institute of Theoretical Physics provides a piece of evidence too. According to the scientometrics report published in *The Scientists*⁶, this Institute was evaluated as the best Soviet high-impact one. This Institution was established in 1964 on the base of the theoretical department, which was under the great Soviet theoretical department, which was under the great Soviet theoretician Nobel prize winner L.D. Landau, at the Institute of Physical Problems. Some prominent Soviet theoreticians entered the academic staff of the Institute when it was being organized. However *further we expanded our academic staff by inviting MPTI graduates and succeeded to establish the special chair of the problems of theoretical physics at MPTI* [HALATNIKOV, 1995, p. 77].

It is interesting that education at MPTI is authoritative among mathematicians too. Professor L.D. Kudrjavitzev, an outstanding mathematician, who was head of the MPTI chair of mathematical analysis (1954-89), says that there are 9 MPTI graduates among 130 mathematicians enrolled at the Steklov Institute of Mathematics of the Academy of Sciences. It should be noted that there is no mathematical professionalization at MPTI.

It should be emphasized that, in contrast to other *special* Faculties and colleges, MPTI had a rather flexible structure for the pursuit of frontier research. The *MPTI's system* combining profound training in basic, pure science and problem studies in narrow fields of research is open to the challenges of the rapid restructuring of contemporary science. This system permitted to organize rapidly training in a new profession: in the not written by the MPTI officials for the Presidium of the Academy of Sciences (1971, December) the time it took for organizing a new speciality within the framework of the *system of MPTI* was estimated as 1.5-2 years.

In the long run, however, this flexibility of MPTI was in the service of the militarized state. In 1950s-1980s MPTI was constantly waiting for a new *State Order* to organize the production of specialists in a new field or subfield of science and technology and a corresponding financial infusion.

As other institutions of *special* education, MPTI was supplied by the State authorities with some privileges. Here some of them are listed: 1. As it is well-known, in the Soviet Union students were regularly on a kind of salary (scholarship). A student of MPTI was given considerably more money

than a student of any other educational institution; 2. In endeavoring to involve more working scientists into teaching the profitable student to academic staff ratio was stated for MPTI (in 1960s-1970s this ratio was 5:1, the average student to academic staff ratio in soviet educational institutions was 8:1 then); 3. In fact, scientists employed in the Institutions of the Academy of Sciences could have their second job at MPTI (usually scientists were allowed to do their second job after regular hours of work, in the case of MPTI that limitation was eliminated); 4. According to some recollections (not confirmed by an archive evidence) MPTI's professors and instructors received an additional payment in 1950s-1960s; 5. MPTI students had a kind of academic freedom, for example, they could move after any semester from one Faculty to another, decide themselves to attend any lectures or not.

The MPTI's social prestige

1. The competition between MPTI's entrants was higher (a number of entrants per vacancy) than at the Physical Faculty of the Moscow State University and other prestige physical and technological educational institutions (in 1950s this competition reached sometimes 15 persons per vacancy, in 1970s the competition to enrol at MPTI was not so high, however, according to the Report of the Ministry of Higher Education, it was higher than that to enrol at any other physical and technological institution⁷); 2. There was a competition between the Research Institutions to take a graduate from MPTI, every world-class physical institution held the *base chair/chairs* at MPTI and expanded its academic staff by recruiting the graduates of MPTI; 3. MPTI had world-class physicists and mathematicians as lecturers and instructors, many of the MPTI's professors had their courses of lectures published as authoritative text-books⁸.

4. The MPTI's system and the actual MPTI

To what extent idea of the *MPTI's system*, verbalized by Kapitza, Christianovich and other founders of MPTI, had been embodied in actual regulations and structures of MPTI? As noted above, this idea had perfectly been embodied in the Physico-Technological Faculty of the Moscow State University. However, in the period of big MPTI or *MPTI's Empire*, as Professor Karlov calls it, the *MPTI's system* was affected by some implicit and explicit deformations.

1. The orientation toward working scientists could not persist the flow of time. Originally, all the members of *base chairs* and lecturers and instructors in *basic, pure science* were mostly working scientists. Over 1960s-1970s the

number of professional teachers, whose main occupation was to teach students, had increased and the ratio *working scientists/professional teachers* had changed in favor of them⁹. Moreover, the own MPTI's *base* chairs located in Dolgoprudnaya had been established.

As early as in 1963 P.L. Kapitza diagnosed the problem in his address to the MPTI's graduates:

"We have the most hard problem with teaching in basic academic disciplines. In the past great scientists delivered lectures in general physics, chemistry, mathematics, mechanics and other basic disciplines. Such work was regarded as very prominent and important. Over the last years the things have changed" [KAPITZA, 1974, p. 134].

It is interesting that Rector Belotzerkovsky tried to change the key ideology of MPTI. Kapitza considered that high-quality of MPTI education hanged on the absence of own scientific research at MPTI. From the Soviet experience he knew that scientific researches at higher schools turned out usually to be below the world level and scientists engaged in such researches would become teachers of sorts. Kapitza regarded as an achievement of the Coordinative Council chaired by him¹⁰ a moratorium on the establishment of research laboratories at MPTI. This moratorium would hold MPTI from converting into a common ordinary educational institution [KAPITZA, 1996, p. 14].

On the other hand, Belotzerkovsky claimed that it is necessary to integrate science at MPTI and he is credited with establishing the Scientific Research Department at MPTI [BELOTZERKOVSKY, 1996, pp. 85-86].

2. According to the *MPTI's system*, *base* chairs should provide very individual tutorial training of students. As P.L. Kapitza wrote in his paper for the MPTI's home weekly *Za nauku (For Science)*, *the student must work at the 'base' institute or laboratory as a future scientists but not as a technician* [KAPITZA, 1996, p. 17].

As yearly as at the end of 1950 some indications appeared that students were used for routine work at the *base* Institutes and laboratories. For example, a former student of MPTI recalls how on arriving to the Institute of Radio-Electronics he felt that nobody needed him. He saw his scientific leader in passing by only, and he was charged with the adjustment of the tape-recorder belonging to a research worker of the laboratory [FOMENKO, 1996, pp. 387-388].

The things did not become better in 1960s. Another former MPTI's student reminisces about his 1964-65 studies at the *base* laboratory located at the Institute called *Letter Box No.: 89*¹¹. This laboratory belonged to the Department of Solid Microschemes. He was charged with the adaptation and adjustment of electronic probing microanalyzer bought from Toshiba. As the laboratory was secret, a representative of Toshiba might not be invited to do this work in a regular way:

"In the course of my work [this former student says], I found out that analyzer can not tackle problems which were put before it. However Head of laboratory did not expect evidently that real research would be carried out by the analyzer. He wanted to show that the apparatus worked and money had not wasted".

This decline in education at *base* chairs was probably conditioned by the cumulative character of the growth of MPTI. As noted above, within 1958 and 1980 the number of *base* chairs had increased from 28 to 100. New *base* chairs opened and opened but no *base* chair was ever closed. As a result, some *base* chairs gave up advanced research and excellent teaching. In fact, the *base* institution and laboratories are motivated to teach and train students if they are interested in incorporating the students into their academic staff. Therefore, this motivation is conditioned by what lies in the institution's and laboratories' perspective.

3. The *MPTI's system* presupposes permanent competition between students to continue their enrollment at MPTI. 1960s brought the decline of this competition. Under General Petrov's command (1951-62) the percent of drop-outs in relation to the amount of newly enrolled students was about 25. For example, in 1955, 240 persons entered MPTI, only 180 persons among them became graduates in 1961. In total 200 persons graduated from MPTI in 1961 (20 had come from other educational institutions). Rector Belotzerkovsky begun to take into account the struggle of the Ministry of Higher Education against large amounts of drop-outs. As yearly as in 1963 he estimated a desirable percent of drop-outs as 10.

Fig. 4 shows the decrease in percentage of drop-outs (in relation to the number of graduates) at the Faculty of Molecular and Chemical Physics.

Certainly, the percentage of drop-outs is not a quite reliable indication of the severity of the competition to continue the struggle with science. Increase in the number of drop-outs can be resulted from changes in an outdoor situation: the drop in the life level, for example. However, in relatively quiet periods of life the institution's failure to retain its earlier standard of severity of education can be traced in part to decreases in the percent of drop-outs.

5. Conclusion

The historical backgrounds of the *MPTI's system* run as follows: 1. The militarized *big* Soviet science in its formative years supplemented MPTI with social privileges and prestige; 2. MPTI, which aimed at the expanded reproduction of the scientific elite, was guided itself by the elite.

As a matter of fact, the former contradicts to the latter; big MPTI could not be guided by scientific elite. The *MPTI's system* in its authentic form did not work at actual MPTI for a long time. This system arose together with the Physico-Technological Faculty of the Moscow State University in 1946, it was passed to MPTI in 1951. However, when MPTI was in full swing the *system* began to decline.

Table 1. *Increase in the number of MPTI graduates*

<i>Year</i>	<i>The number of graduates</i>	<i>Year</i>	<i>The number of graduates</i>
1952	34	1973	x
1953	37	1974	x
1954	42	1975	618
1955	50	1976	595
1956	34	1977	607
1957	163	1978	617
1958	181	1980	660
1959	181	1981	691
1960	222	1982	717
1961	207	1983	x
1962	229	1984	785
1963	302	1985	x
1964	331	1986	783
1965	342	1987	707
1966	343	1988	757
1967	340	1989	757
1968	418	1990	759
1969	470	1991	760
1970	x	1992	780
1971	x	1993	800
1972	x		

SOURCE: MPTI Archives and Reports of the Department of Teaching (x means a lack of information)

Fig. 1. Trend in the number of MPTI graduates

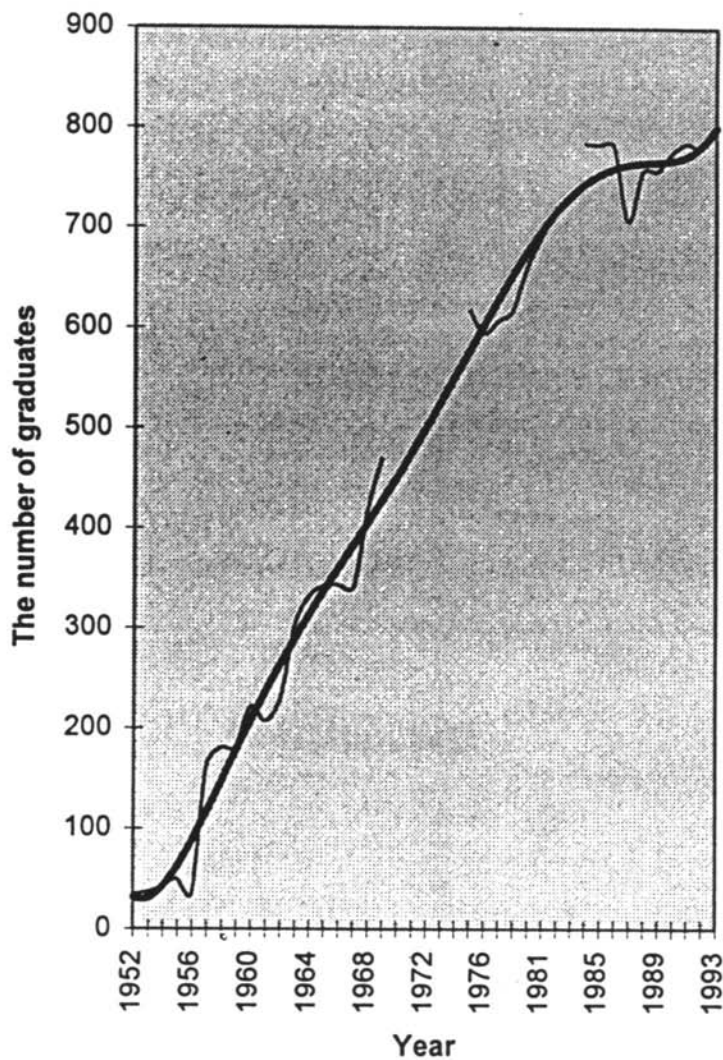


Table 2. Increase in the number of MPTI Faculties graduates

Year	Faculty										
	APh & AM	APh & MF	Ph B	Ph & E	C & AM	AM & FT	Ph & QE	M & ChPh	APh & SR	G & APh	Rt & Cy
1952		27									
1953		31									
1954		42									
1955		48									
1956		34									
1957		50									
1958		x						21		34	58
1959		x						x		x	x
1960		x						x		x	x
1961		x						x		x	x
1962		75						37/40		44	71
1963		99						39/41		68	90
1964		124						27/36		60/59	101
1965	100							54/51		71	101
1966	105						22	50/57		79/76	73
1967	114						28	48		92/90	78/73
1968	116						32	67		97/93	98
1969	140						44	70/82		91/87	6/113
1970							49	77		107	108
1971					65		x	86	122	126	18/130
1972					92		x	86	82	127	
1973					84		x	79	98	117	107
1974					79		x	75	94	102	83
1975					95/93	73	66	98/97	93/90	4/101	98
1976					86	84	70	79	91	95	79/81
1977					101	78	53	91/90	92	00/98	95
1978				33	103	88	70	80/78	79	98/96	93/97
1979				33	104	81	67	82/80	75/76	87/88	82
1980				34/35	92	108	75	92/91	74	84/83	91/92
1981				44	103	99	81	91	84	94/92	91
1982				55/56	106	88	82	9/107	90	95/96	0/102
1983				59	98	x	x	95	x	96	109
1984				78	95	x	x	108	x	104	114
1985				80	97	x	x	108	x	89	84
1986				85	101/98	102	88/86	3/115	118	88	2/103
1987				69	84	x	x	116	x		88
1988			50	77/76	93	90	69	73	96	90	96
1989			61	75	80/81	86	85	72/73	108	91	83/98
1990			79	80	98	86/85	67	85/84	105	81/79	81
1991			52	x	x	x	x	x	x	x	x
1992			45	x	x	x	x	x	x	x	x
1993			56/57	80	100	76	87	90	111	99	100
1994			43/46	103	118	119	103	104	107	130	105

SOURCE: MPTI Archives and Reports of the Department of Teaching (x means a lack of information, / means that estimates given in documents differ)

Abbreviations:***APh & AM (Aerophysics and Applied Mathematics)***

This Faculty was founded on the base of the Faculty of Aerophysics and Mechanics of Flight and issued the two faculties in 1969.

APh & MF (Aerophysics and Mechanics of Flight)

This faculty was originally called the Faculty of Aeromechanics and was transformed into the Faculty of Aerophysics and Applied Mathematics and Faculty of Aeromechanics and Flying Technology in 1965.

Ph B (Physicochemical Biology)

Founded in 1982.

Ph & E (Problems of Physics and Energetics)

Founded in 1976.

C & AM (Control and Applied Mathematics)

As the Faculty of Aerophysics and Space Research this Faculty was formed in 1969 by dividing the Faculty of Aerophysics and Applied Mathematics.

AM & FT (Aeromechanics and Flying Technology)

Founded in 1965 on the base of the Faculty of Aerophysics and Mechanics of Flight.

Ph & QE (Physical and Quantum Electronics)

Founded in 1994.

M & ChPh (Molecular and Chemical Physics)

Originally this faculty was called the Faculty of Physicochemistry.

APh & SR (Aerophysics and Space Research)

Till 1965 there was the Faculty of Aeromechanics, then Aerophysics and Mechanics of Flight, the present Faculty was formed in 1969 by dividing the Faculty of Aerophysics and Applied Mathematics (see below).

G & APh (General and Applied Physics)

Till 1956 it was called the Faculty of Radiophysics.

Rt & Cy (Radiotechnology and Cybernetics)

Till 1955 it was called the Faculty of Radiotechnology.

Fig. 2. Trends in the graduates of the MPTI Faculties

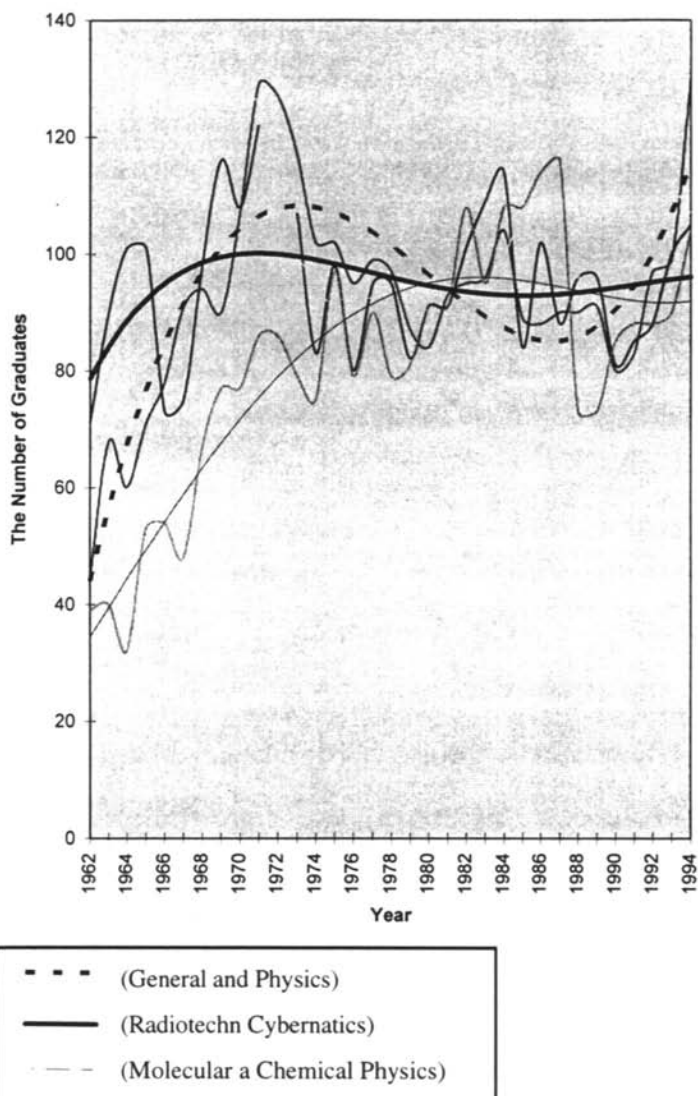


Fig. 3. Trends in the graduates of the MPTI Faculties

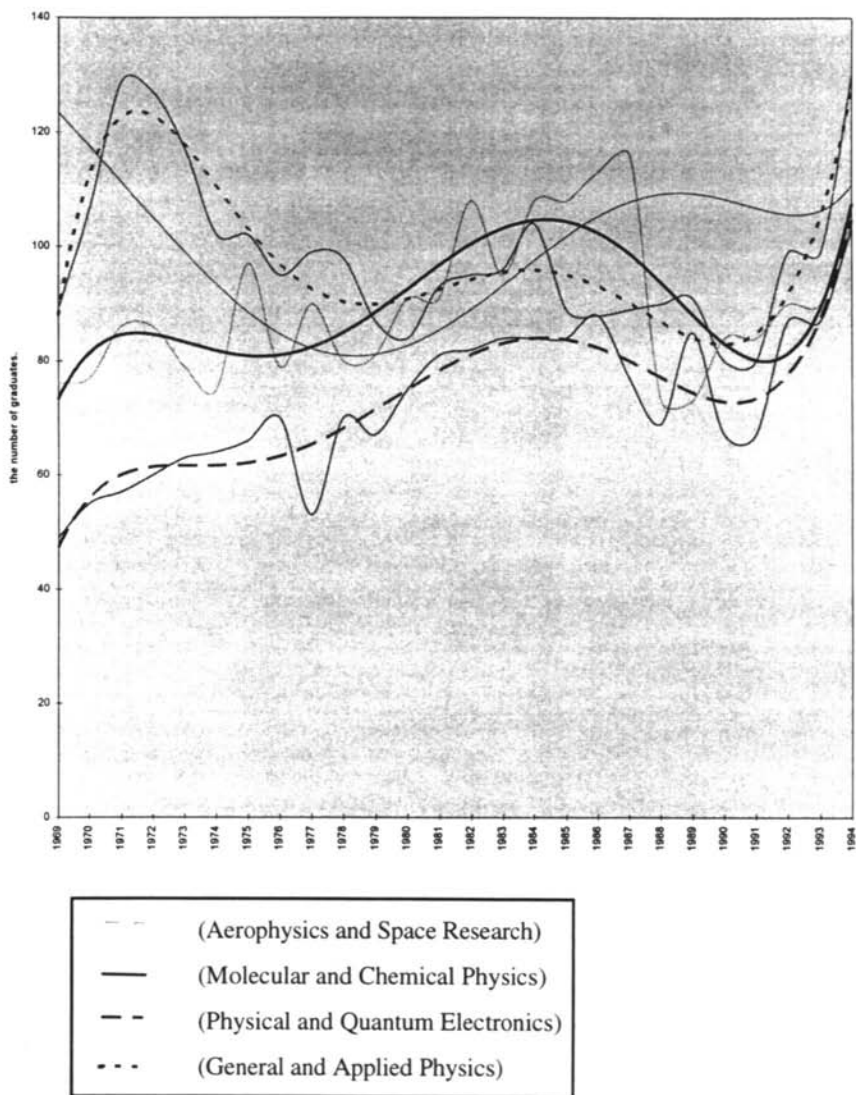
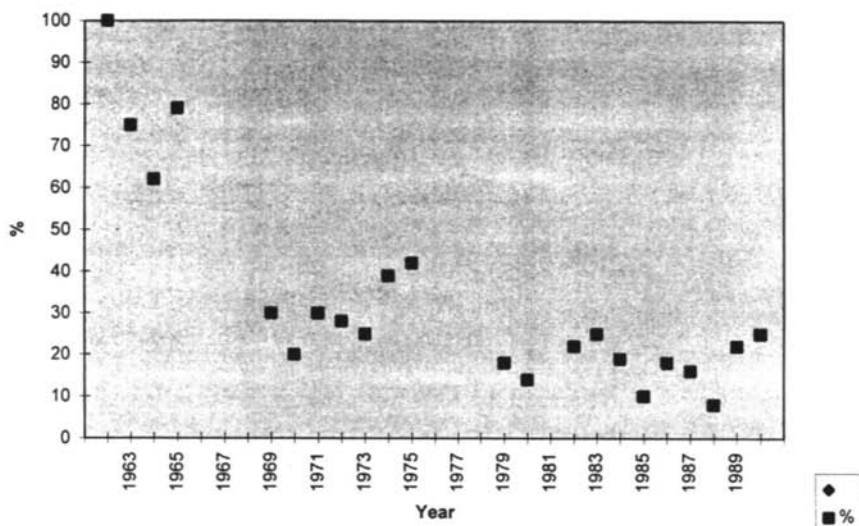


Fig. 4. Percent of drop-outs in relation to the number of graduates: the Faculty of Molecular and Physical Chemistry



NOTES

- 1 For instance, *I am Phys-Tech*.
- 2 Besides the regular State (or National) exams after all the course of studies to obtain a higher school diploma, a student of MPTI should pass through a State exam in physics at the end of third year.
- 3 Physical and industrial electronics are usually distinguished.
- 4 *The Center...*, Stock 5, list 17, item 529; list 37, item 101.
- 5 In his reminiscences, the leading constructor of rockets, Corresponding Member of the Academy of Science, B.E. Chertock points to the fact that in 1947 the Minister D.N. Ustinov was requested by the President of the Academy of Sciences S.I. Vavilov to allow his visit to NII-88, the main Research Institution of technology of rockets. Chertok seems to regard this fact as a symbol of the move of Soviet scientists to military secret research [CHERTOK, 1995, p. 251].
- 6 *The Scientist*, 1990, February, 19.
- 7 *The Center...*, Stock 5, list 61, item 66.
- 8 At the beginning of 1970s, in reply to the request of the administration the Chair of Radiophysics presented a list of 27 books that lecturers and instructors had published.

9 As S.A. Gordynin recalls, P.L. Kapitza, one of the founders of MPTI, demanded that working scientists rather than professional teachers filled 80% of the academic staff of the Chair of General Physics. Now here working sciences/professional teachers ratio is aprox. 2:3.

10 Into the Coordinative Council the Scientific Council, which guided the Physico-Technological Faculty and MPTI, had been transformed by Rector O.M. Belotzerkovsky.

11 Interview with Dr. V.I. Arshinov.

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