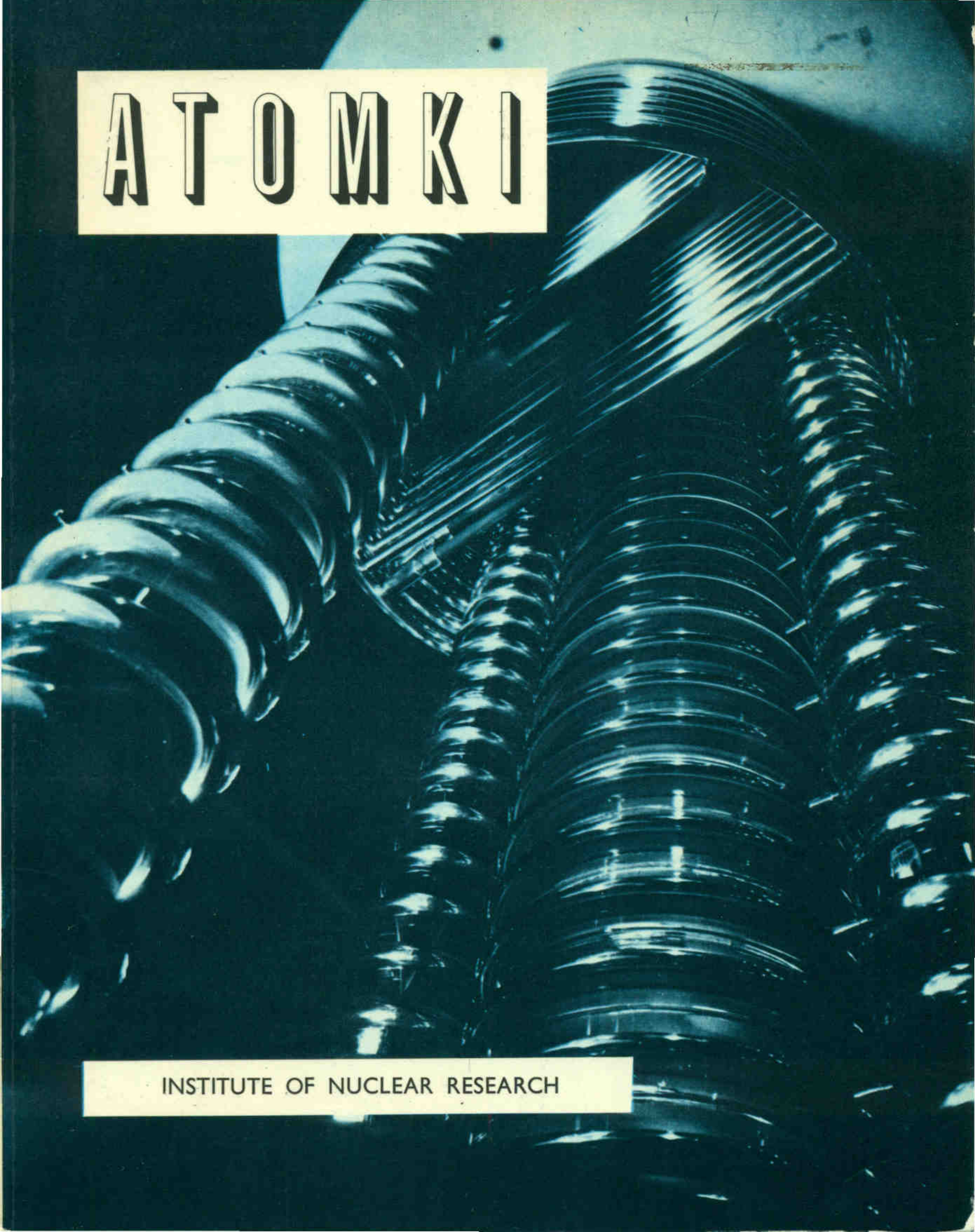
ATOMKI



INSTITUTE OF NUCLEAR RESEARCH

GENERAL INFORMATION

The Name and Address of the Institute: The Institute of Nuclear Research (ATOMKI) of the Hungarian Academy of Sciences, Debrecen II., Bem tér 18/c.

Year of Establishment: 1954.

Staff: In 1969 there were altogether 147 people on the staff. 52 out of this number are research workers and engineers with an university degree. In addition there are also university students in the institute doing their work for a science diploma, and a larger number of industrial apprentices.

Organization: Director of the Institute: Dr. Alexander Szalay, ordinary member of the Hungarian Academy of Sciences.

Deputy Director: Dr. László Medveczky, candidate in physical sciences.

The Division of Nuclear Reactions and their Scientific Applications
(Head: Dr. Alexander Szalay, director of the institute)

The Division of Nuclear Spectroscopy
(Head: Dr. Dénes Berényi, candidate in physical sciences)

The Division of Electrostatic Accelerators
(Head: Dr. Ede Koltay, candidate in physical sciences)

The Division of Nuclear Electronics
(Acting head: Dr. György Máthé, research collaborator)

ATOMKI Proceedings. The Institute issues a quarterly periodical, entitled ATOMKI Közlemények (ATOMKI).

Guest Rooms: The Institute has several guest rooms for visiting research workers from other institutes.

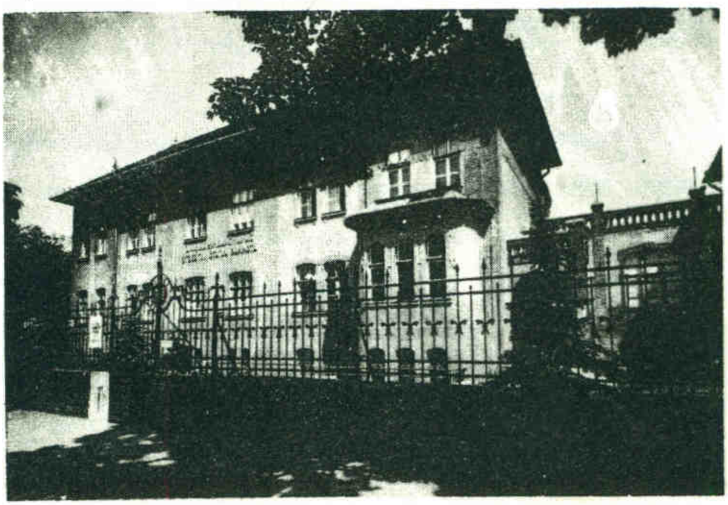
A HISTORICAL INTRODUCTION

The Institute of Nuclear Research (abbrev: ATOMKI) is an institution of the Hungarian Academy of Sciences developed from the Institute of Experimental Physics of the Kossuth L. University, Debrecen, Hungary.

In the Institute of Experimental Physics nuclear research activity was initiated in 1936 by A. Szalay, the present director of ATOMKI, with the investigation of the excited states of elements of low atomic weight. It was in that year that Dr. Szalay returned from Cambridge, England, where he had been working for six months in Rutherford's institute.

World War II caused a serious set-back in the promising research activity. Owing to the unfavourable circumstances the elaboration of a lot of problems, well under way already in those years, was delayed considerably (the demostration of the recoil effect of the neutrino, the toroid-sector-type beta-ray spectrometer, the alpha-ray spectrometer, etc.). These problems, consequently, could be worked out only one or two decades later.

Though hindered by unusually modest means, it was due to the successful research work within the university institute as well as the teaching and training of students that the necessity for establishing a separate research institute in 1954 was created.



The main entrance of ATOMKI (building I.)

The buildings of ATOMKI from the yard

ORGANIZATION

The Institute is a research institution of the Hungarian Academy of Sciences.

The institute is headed by the director, who has an individual responsibility in the leadership. The institute's advisory organ is its Scientific Council.

The institute's staff includes 153 persons, of which there are 50 research workers (in August, 1970). Beside staff members the institute has several visitors and post-doctoral fellows as well as graduate students and a relatively large number of industrial apprentices in the workshops of the institute.
The staff works in four scientific, as well as a technical and an administrative division.

The four scientific divisions are as follows:

1.) The division of nuclear reactions and their scientific applications

2.) The division of nuclear spectroscopy

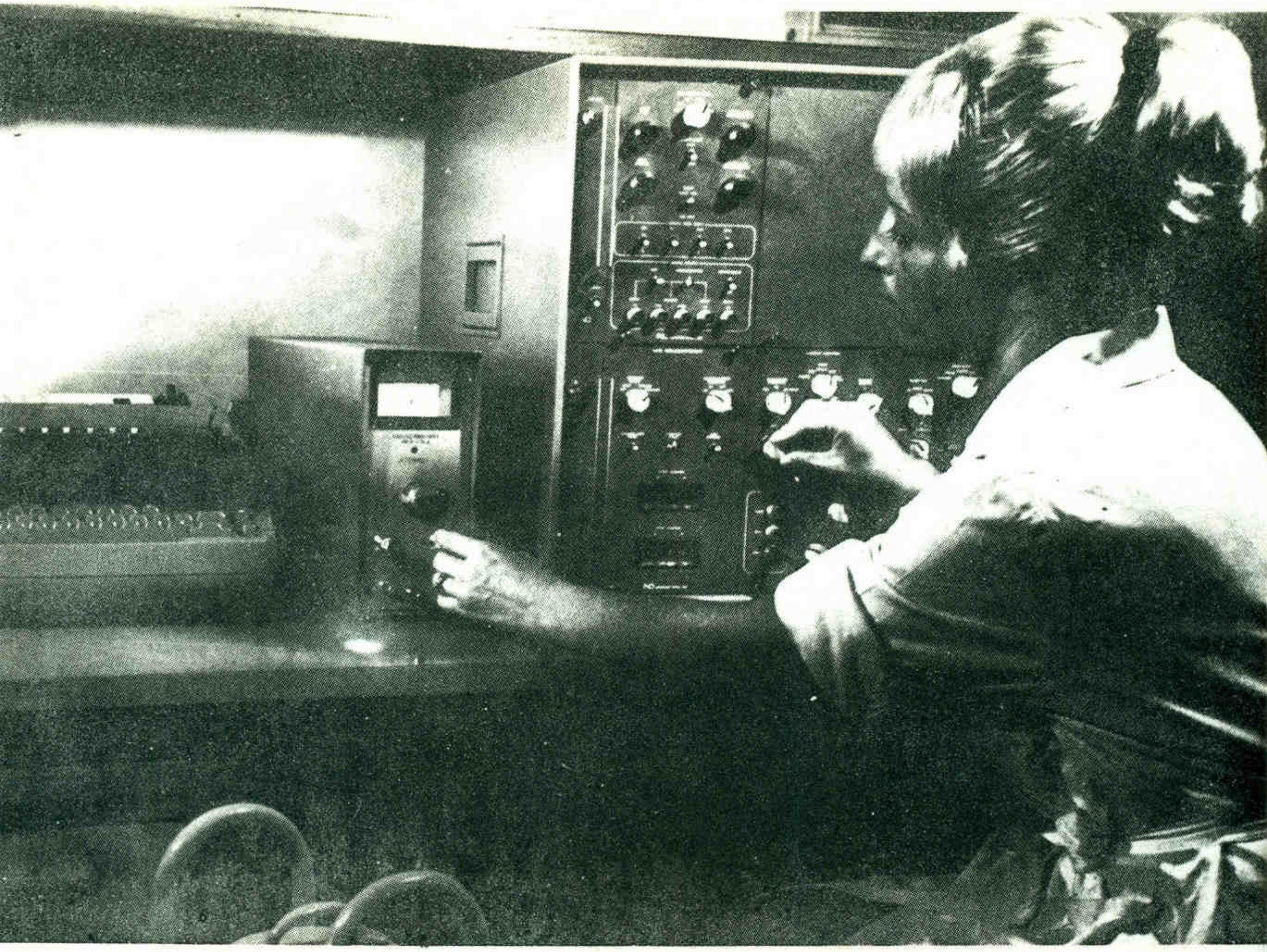
3.) The division of electrostatic accelerators

4.) The division of nuclear electronics

Recently a group within the division of nuclear spectroscopy has also conducted preliminary studies in connection with establishing a cyclotron.

The technical division of the institute is made up by a group of design engineers, the mechanical workshops, the cryogenic section (air and neon liquefying machines), and a maintenance group. From the point of view of organization, the electric and electronic workshops belong to the division of nuclear electronics.

The book stock of the institute's library numbers about 20.000 volumes (books, bound periodicals, institutional reports). Last year the number of the current periodicals was nearly 300, of which more then 200 were foreign.



A multi-channel analyser in nuclear reaction measurements

RESEARCH PROGRAM

Being an academic establishment the institute concentrates primarily on fundamental research. At present the major research subjects (projects) are these:

1.) the investigation of nuclear reactions

2.) nuclear spectroscopy

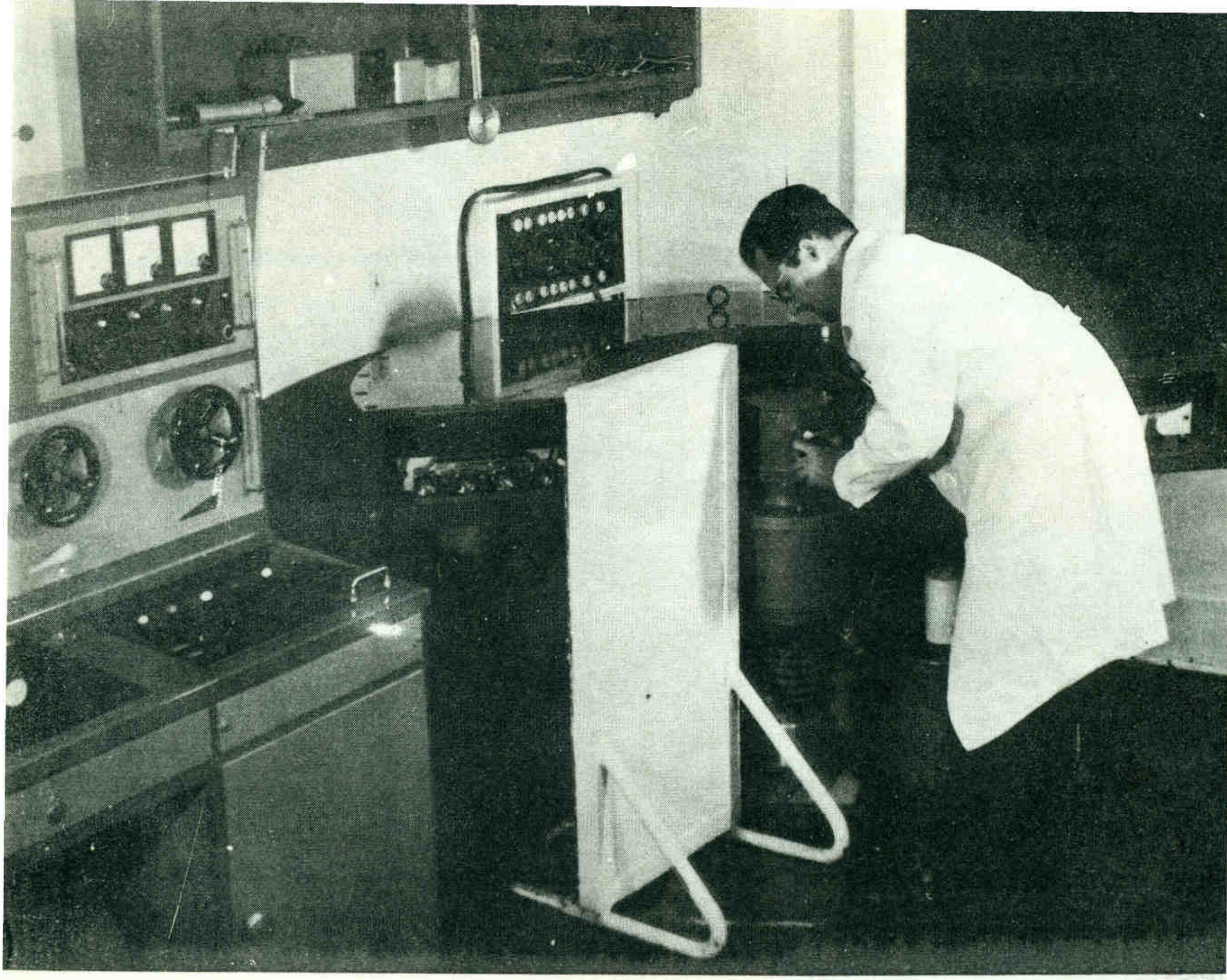
3.) the development of instruments and methods of nuclear physics

4.) the application of the methods of nuclear physics in other branches of science

1. THE INVESTIGATION OF NUCLEAR REACTIONS

When the institute was established, only the formerly elaborated, intensive polonium alpha source of very small area was at our disposal for these investigations. The application of the then modern detection techniques (scintillation gamma spectrometer, nuclear emulsion) made it possible to perform several valuable investigations with this preparation, such as the study of the energy spectrum of neutrons from the $^{9}Be(\alpha,n)^{12}C$ reaction, the determination of the until then unknown excited states of the ^{29}Si, ^{30}Si nuclei, the investigation of the $^{23}Na\ (\alpha;p,\gamma)^{26}$ reaction, etc. In the fifties, for the investigation of the reactions of charged particles, an up-to-date 800 kV Cockcroft-Walton generator was built in ATOMKI. Subsequently the generator was further developed for the purposes of high precision measurements in nuclear physics, and several valuable investigations were conducted thereby. They have been performed primarily at the (d, p), (d,α), (d,n)-type reaction, recently, for instance, the $^{23}Na(d,p)^{24}Na$, the $^{19}F(d,p)^{20}$, the $^{19}F(d,\alpha)^{17}O$ nuclear reactions have been studied, producing a lot of new, valuable information concerning the above reactions.

In earlier years numerous remarkable investigations were conducted as regards nuclear reactions with neutrons (see chapter on outstanding results). Since 1967 these



The so-called band spectrograph for the investigation of internal conversion processes in higher electron shells. This piece of equipment was developed and constructed in the institute with the help of the industry and it is unique of its kind all over the world

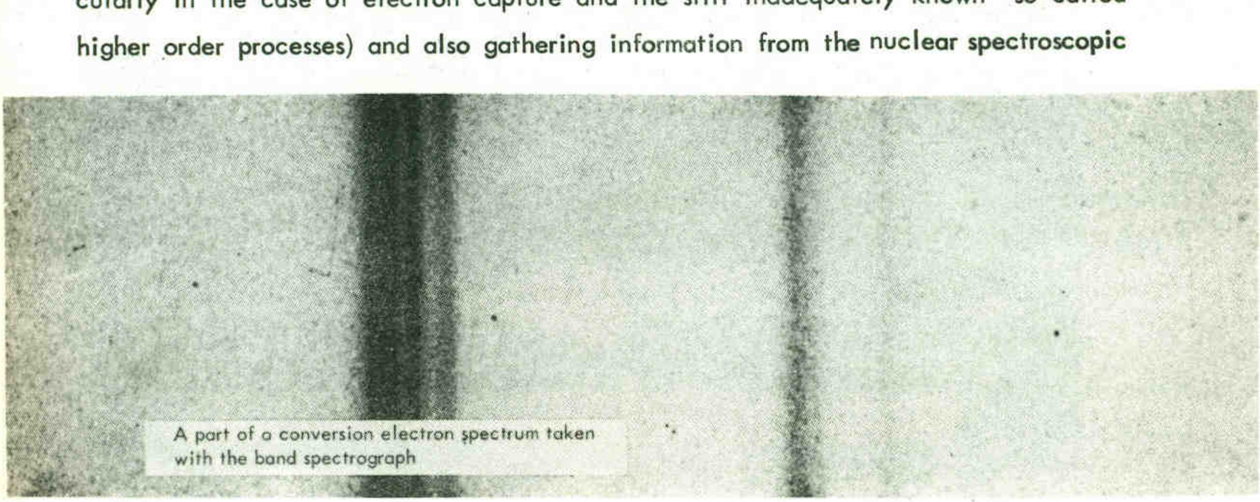
investigations have been going on in the Institute of Experimental Physics of the Kossuth L. University.

In our investigations of nuclear reactions we attempt to use the most up-to-date detection techniques. Our results until now have been carried out not only by means of scintillation and semiconductor detectors but also with the solid-state track or dielectric detectors (for measuring the energy and angular distribution of nuclear reaction particles). ATOMKI also helped the construction of the nominally 2 MV Van de Graaff generator of the Institute of Experimental Physics, which the research workers of the ATOMKI have also used in their investigations.

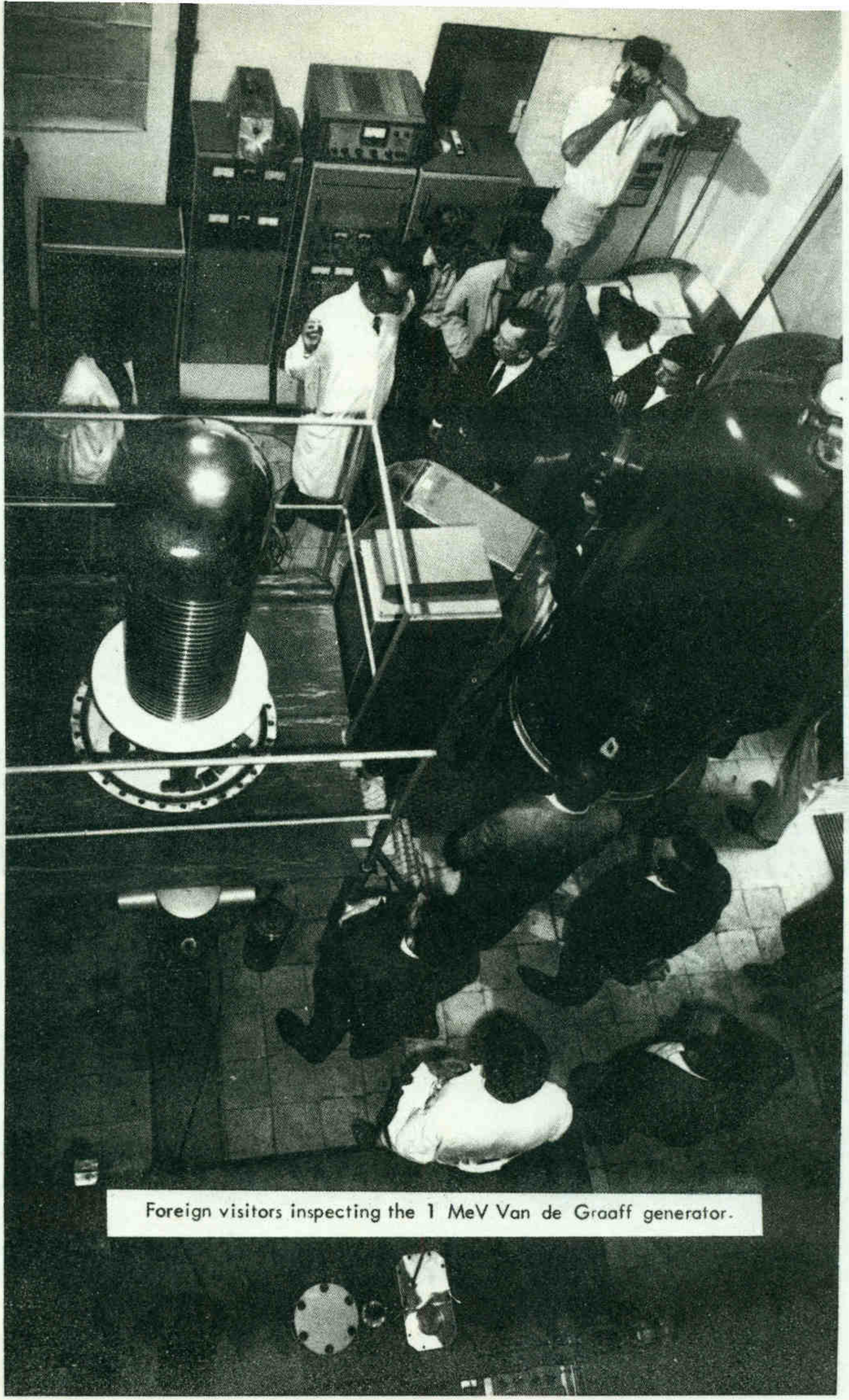
The institute endeavours to cooperate in this project with other institutions too (see later). Our collaborators investigating nuclear reactions have done research work in several foreign intitutions for shorter or longer periods and have produced joint publications with the collaborators of the host institutions. In this manner, for instance, we have established contacts with the Bohr Institute in Copenhagen, the Joint Institute for Nuclear Research in Duban, USSR, the International Centre for Theoretical Physics in Triest, the CISE Laboratory (Milan), the Radium Institute in Vienna, the AB Atomic Energy Institute (Studsvik, Sweden), the Research Institute for Physics in Stockholm (the former Nobel Institute); with the Department of Physics of F. Schiller University, Jena, we have established cooperation in joint project.

2. NUCLEAR SPECTROSCOPY

Research activity in nuclear spectroscopy is carried on in two perspective fields. One is the investigation of the laws and features of the hitherto unknown or insufficiently known nuclear decay processes and radioactive phenomena (particularly in the case of electron capture and the still inadequately known so-called higher order processes) and also gathering information from the nuclear spectroscopic



A part of a conversion electron spectrum taken with the band spectrograph



Foreign visitors inspecting the 1 MeV Van de Graaff generator.

investigation of radioactive decays for the fundamental interactions. Investigations concerning a more thorough knowledge of the internal structure of the nucleus also are carried out here; they are directed to the determination of the so-called nuclear matrix elements in the respective nuclear transitions.

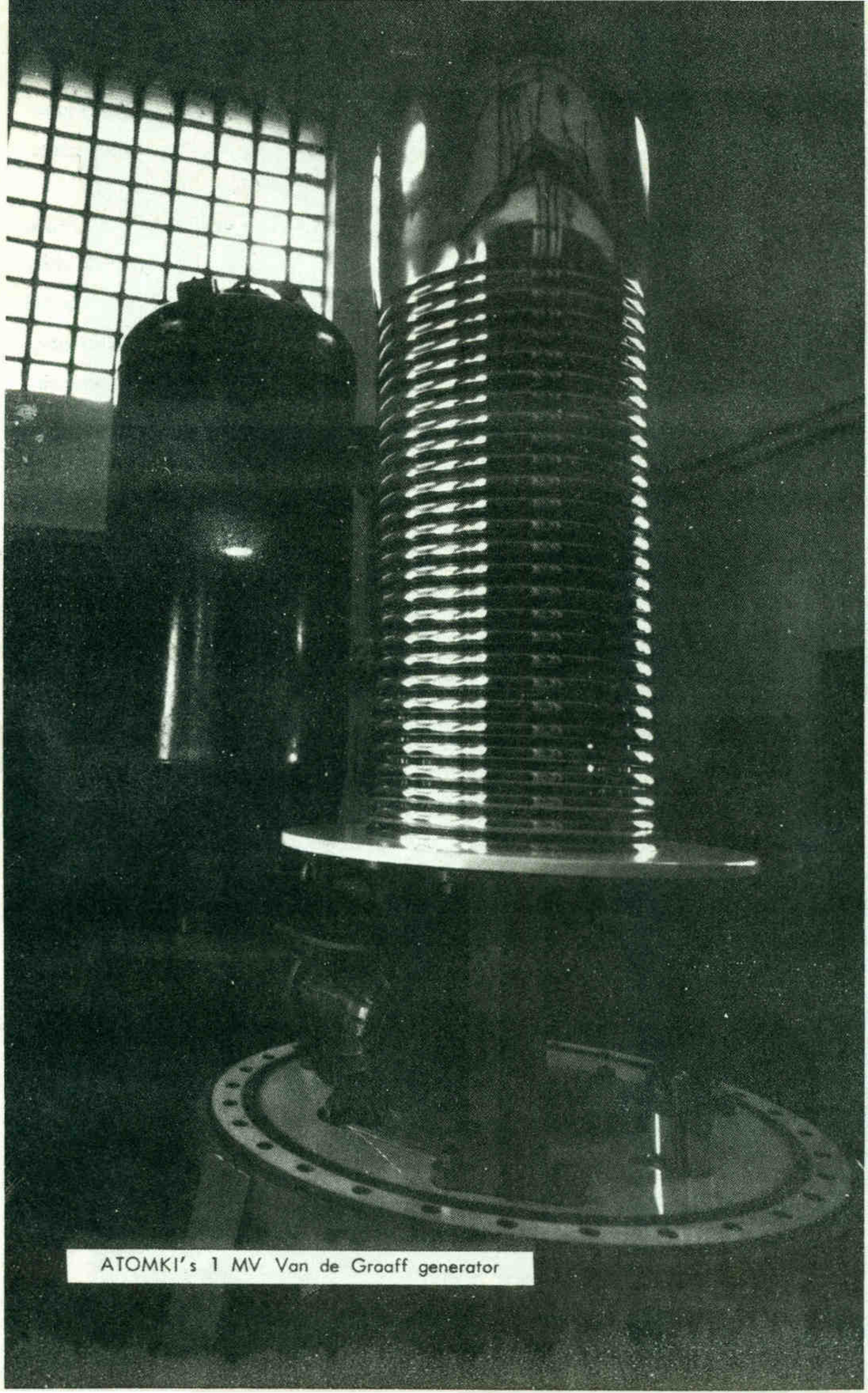
In the other research project experiments are conducted in the Joint Institute for Nuclear Research in Dubna. The preparatory work and the evaluation of the data is done in Debrecen. This project consists of the synthesis of new radioactive nuclei and the nuclear spectroscopic investigation of their radiations It was new alpha-radiating isotopes that have been primarily produced and studied so far; in the future, however, the investigation of isotopes with short half-lives (less than a few minutes) and the measurement of the radiations from their decay will be explored by means of the so-called "on line" method (i.e. with nuclear spectroscopic instruments attached directly to big accelerators).

3. THE DEVELOPMENT OF THE INSTRUMENTS AND METHODS OF NUCLEAR PHYSICS

Owing to the fact that the voltage of the accelerators in ATOMKI is relatively low, the sphere of nuclear investigations with charged particles is rather limited. To facilitate a comprehensive and more intensive study with higher bombarding energies, the building of an up-to-date Van de Graaff generator with a 5 MV nominal voltage and maximum energy stability was decided.

At present the development of the 5 MV generator is under way. Its development includes not only mechanical engineering and electric design but also the novel solution of the problems concerning the conceptual design of the accelerator (ion-optical investigations, etc.). The required buildings and the parts of the generator are practically ready.

Simultaneously, our physicists already work on the technically finished 1 MV generator, which serves as the model of the future 5 MV generator. It is also here that the behaviour of the various units to be used in the 5 MV generator is studi-



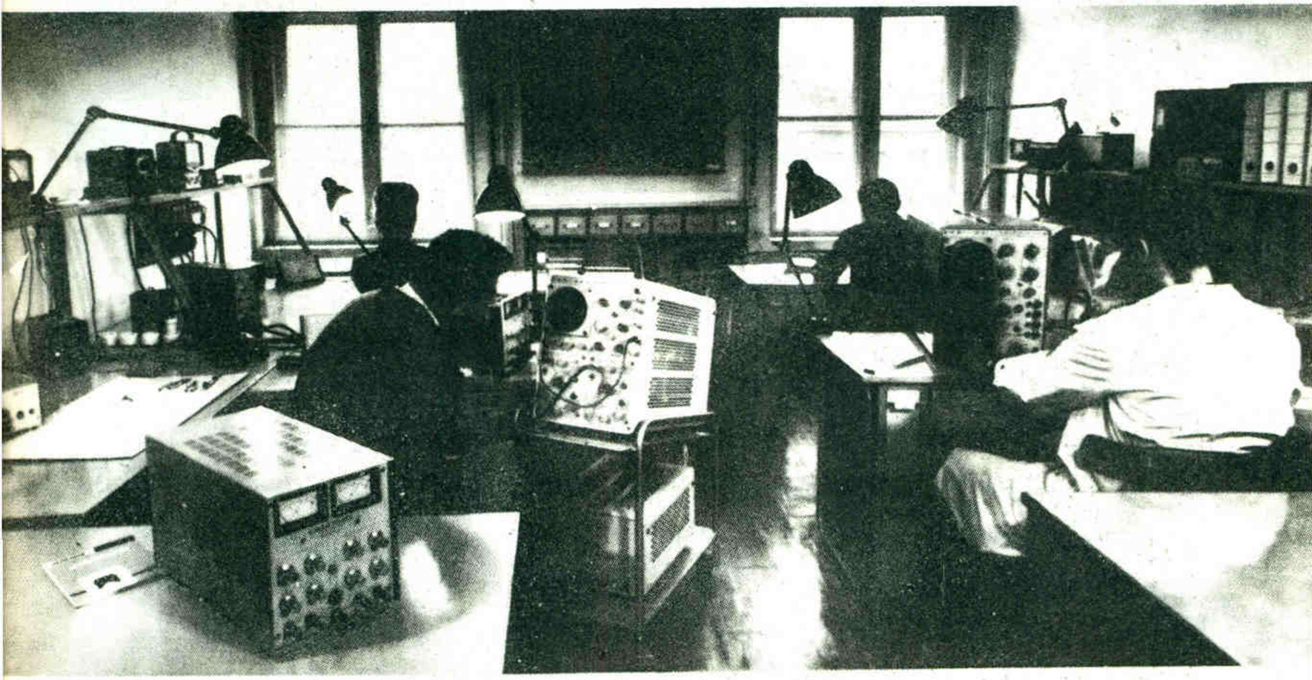
ATOMKI's 1 MV Van de Graaff generator

ed under operating conditions. Likewise, efforts are being made concerning the nuclear measurements to be carried on by means of the model generator.

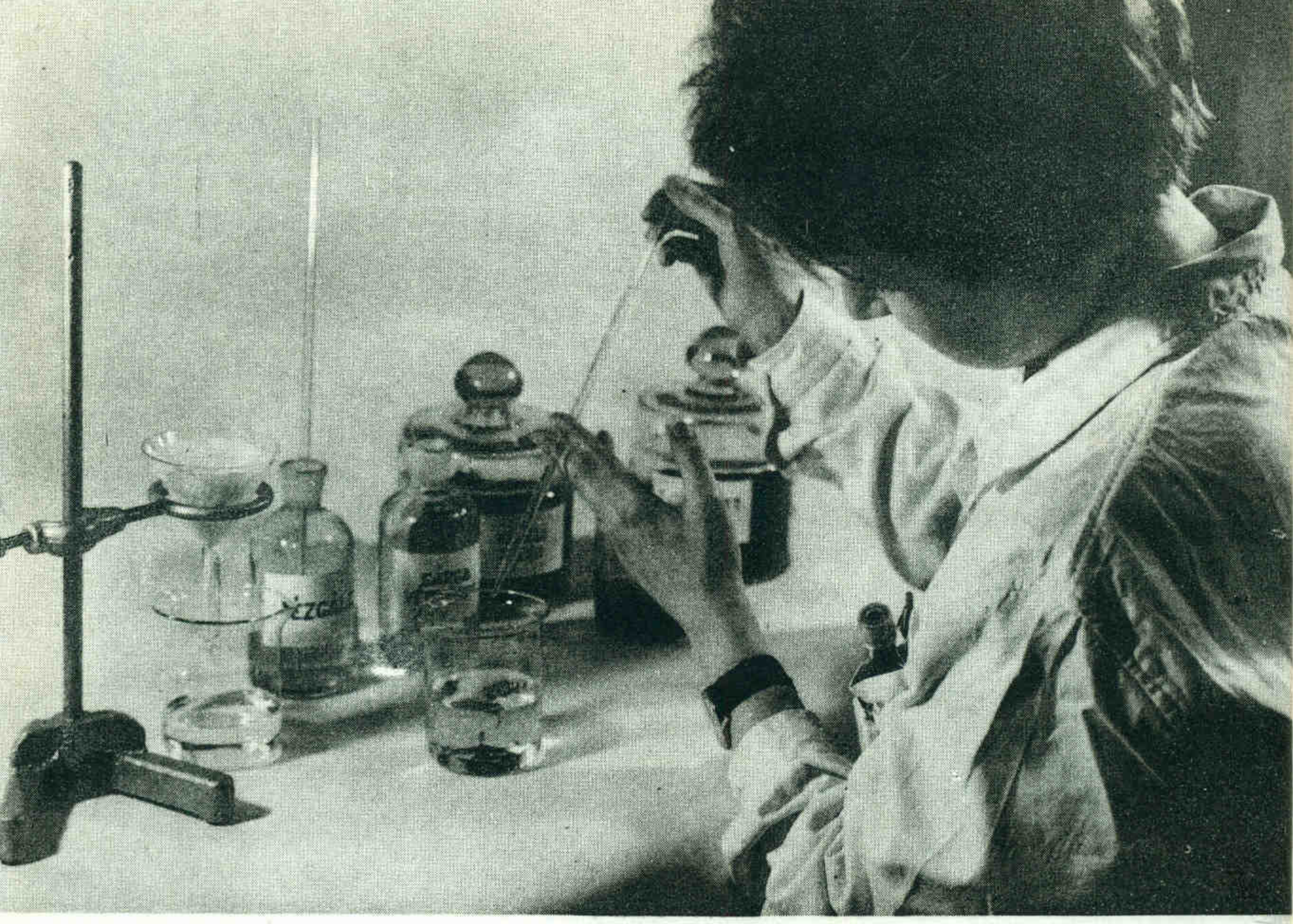
Since the foundation of the institute the procurement of electronic instruments necessary for nuclear research had been quite problematic. To satisfy the need, a few years ago an electronic group was formed, in our institute which, in January 1968, was organized into a division.

In the field of nuclear electronics it was the development of transistorized fundamental units (stabilized power supplies, counting units, amplifiers, differential discriminators, etc.) that was primarily important, with special regard to the application of semiconductor detectors.

Both presently and in the years to come the department's activity will be focused mainly on the implementation of electronic projects concerning the construction of the Van de Graaff accelerators (particularly the 5 MV one).



A glance at the electronic lab



Investigations are conducted to discover the reasons for the shortage of microelements in the vegetation of boggy areas

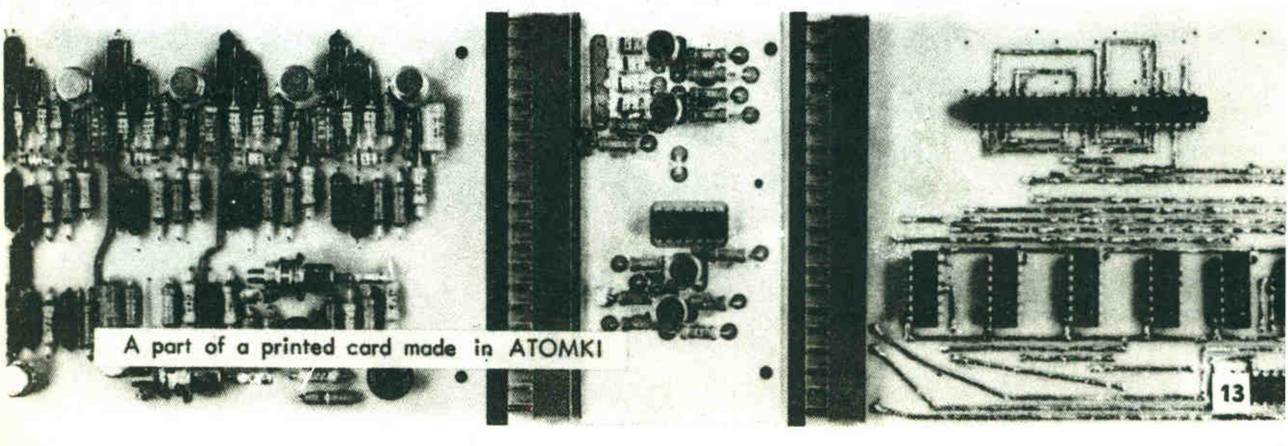
4. THE APPLICATION OF THE METHODS OF NUCLEAR PHYSICS IN OTHER BRANCHES OF SCIENCE

Since the time it was established, ATOMKI has continuously striven to explore, on the one hand, the applicability of the results achieved in fundamental research (equipments and methods developed and elaborated here, as well as professional experience) that may be valuable also from the point of view of national economy and on the other hand, to advance the solution of the related problems of other branches of science through their application. In addition to the exploration of the laws governing uranium enrichment and the retention of fission products in peat, investigations have been also carried out relating to several natural factors that influence the results of hydrogeologic uranium research.

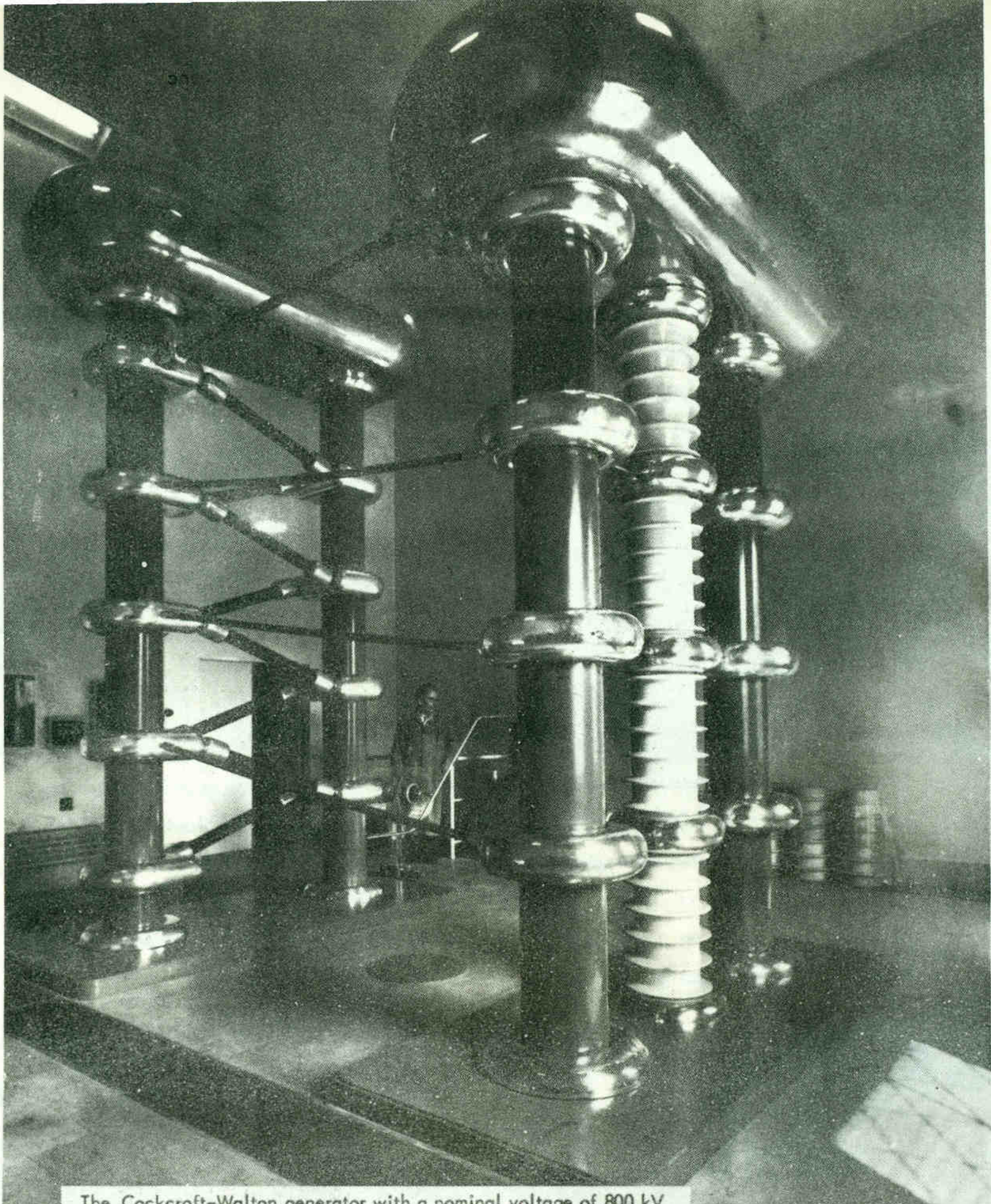
The discovery of the sorption of microelements in peat humic acids is considered to be a significant result also from the point of view of national economy. Laboratory experiments seem to prove that the reason for the deprivation diseases of the cultivated plants grown in boggy areas is the sorption of the nutritive microelements in the humic acid content of the soil, before even the plants could utilize them. Following the quantitative laboratory determination of the sorption of nutritive trace elements, joint experiments with the Department of Plant Cultivation of the College for Agricultural Sciences, Keszthely, were started in 1967, to explore the ways of practical application. Since the area of barren reclaimed boggy land in this country amounts to 100.000 hectares, the importance of such projects seems to be very high from the point of view of national economy.

In the course of mass spectrometric investigations we did pioner work in the field of the absolute geological dating of Hungarian lead ores. These investigations are part of the long-range national scientific research project.

The introduction into medical biology of the application of radioactive isotopes was facilitated considerably by our institute through the production of the required instruments and radioactive preparations as well as through providing training opportunities for the scientists of other institutions. Such investigations were carried out by a group, which started its work at the end of the forties still in the University Institute, chiefly in collaboration with medical institutions. Having succesfully completed our plans in that field we concluded the project in 1962 promoting at the same time, however, further investigations of this kind at the medical university.



A part of a printed card made in ATOMKI



The Cockcroft-Walton generator with a nominal voltage of 800 kV

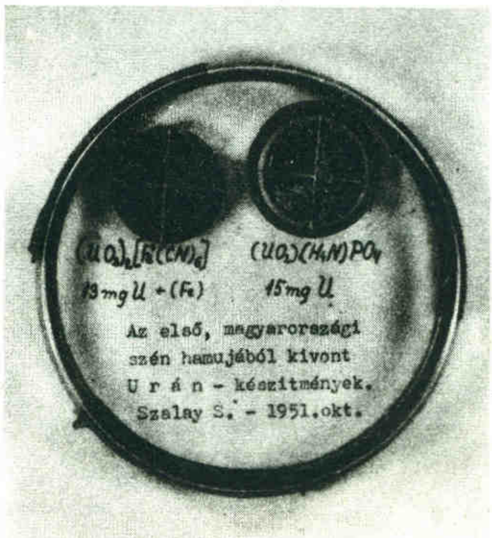
SOME IMPORTANT SCIENTIFIC RESULTS OF ATOMKI

I. THE DISCOVERY OF URANIUM ENRICHMENT IN COALS AND THE CLARIFICATION OF THE MECHANISM OF THE ENRICHMENT

The discovery of uranium enrichment in coals (1949) and the clarification of the laws governing the geochemical mechanism of the process of enrichment (since 1951), furthermore the extension of this concept to other polyvalent cations with high atomic weight is due to the research of A. Szalay, the head of the institute, and his collaborators. This law, in the last analysis, comes to this: humic acids from the decomposition of plants, in the geochemical circulation of natural waters will absorb uranium and other cations with a high atomic weight, in the course of ion exchange.

The pioneering nature and the results of these investigations are internationally acknowledged and quoted in the pertinent literature.

Professor Szalay has lectured on these investigations at a number of inter-



The first uranium preparations (obtained from the ashes of Hungarian brown coal, October 1951) national forums, where the results have been discussed in detail (Royal Institute of Technology, Stockholm, 1956; Vernadsky Geochemical Institute, Moscow, 1957; The 2nd International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1958; Vernadsky Geochemical Commemorative Congress, Moscow, 1963; The 22nd IUPAC Conference, London, 1963; The 3rd International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1964; Liverpool University, Liverpool, 1965; Institute for Atomic Energy, Harwell, 1965; The Department of Physics, Rostock University, 1966; Leipzig University, 1967; The 4th International Organic Geochemical Conference, Amsterdam, 1968; The Royal Swedish Academy of Sciences, Stockholm, 1968; Institute of Technology, Gothenburg, 1968.)

Some pertinent publications from ATOMKI:

A. Szalay, Acta Geològica Hung., 2 (1954) 299.

A. Szalay, Acta Physica Hung., 8 (1957) 25.

A. Szalay, Proceedings of the II. International Conference on the Peaceful Uses of Atomic Energy. Vol. 2. United Nations, Geneva, 1958. p. 182.

А. Салаи, Труды Геохимической конференции посвященной столетию со дня рождения академика Е. И. Вернадского. Том 2. стр. 428. Изд. "Наука" Москва, 1964.

A. Szalay and M. Szilágyi, Proceedings of the III. International Conference on the Peaceful Uses of Atomic Energy, Vol. 14., United Nations, Geneva, 1965. p. 361.

2. PHOTOGRAPHING THE NEUTRINO RECOIL EFFECT IN THE WILSON CHAMBER

Our experiments directed to photographing the neutrino recoil effect in the decay of ^{6}He were met with wide recognition already at the international conference of nuclear physics (Mesons and Recently Discovered Particles) in Padua, 22 to 28 September, 1957. This study has been often referred to and the photos often reproduced in several textbooks. The reason for this is that we had succeeded in demonstrating and suceessfully photographing the neutrino recoil effect in the course of cloud-chamber experiments (see figure below).

Some pertinent publications from ATOMKI

Csikai Gy., Nuovo Cimento, 5 (1957) 1011.

A. Szalay and J. Csikai, International Conference on Mesons and Recently Discovered Particles e 43° Congresso Nazionale di Fizica, Padova-Venezia, 22 - 28.September 1957. Ciclografia Borghero, Padova, 1958., p. IV-8.

A photo showing the neutrino recoil effect in a cloud chamber

3. INVESTIGATIONS OF THE ELECTRON CAPTURE PROCESS, AND SOME HIGHER ORDER RADIOACTIVE DECAY PHENOMENA

It was in our institute that the nuclear spectroscopic investigation of radioactive radiation was started in this country for the first time (cf. articles by Horváth as well as Szalay and Berényi) and it is also here that the centre of this kind of research is to be found. In this field several internationally recognized results have been achieved by the institute. Investigations relating to the internal bremsstrahlung and some phenomena of electron capture processes deserve particular attention.

The measurement of the ε/β^{+} ratio in the $^{36}Cl - ^{36}S$ decay furnished the first experimental evidence for the theoretical prediction that in the case of higher not uniquely forbidden decays the above ratio would rise.

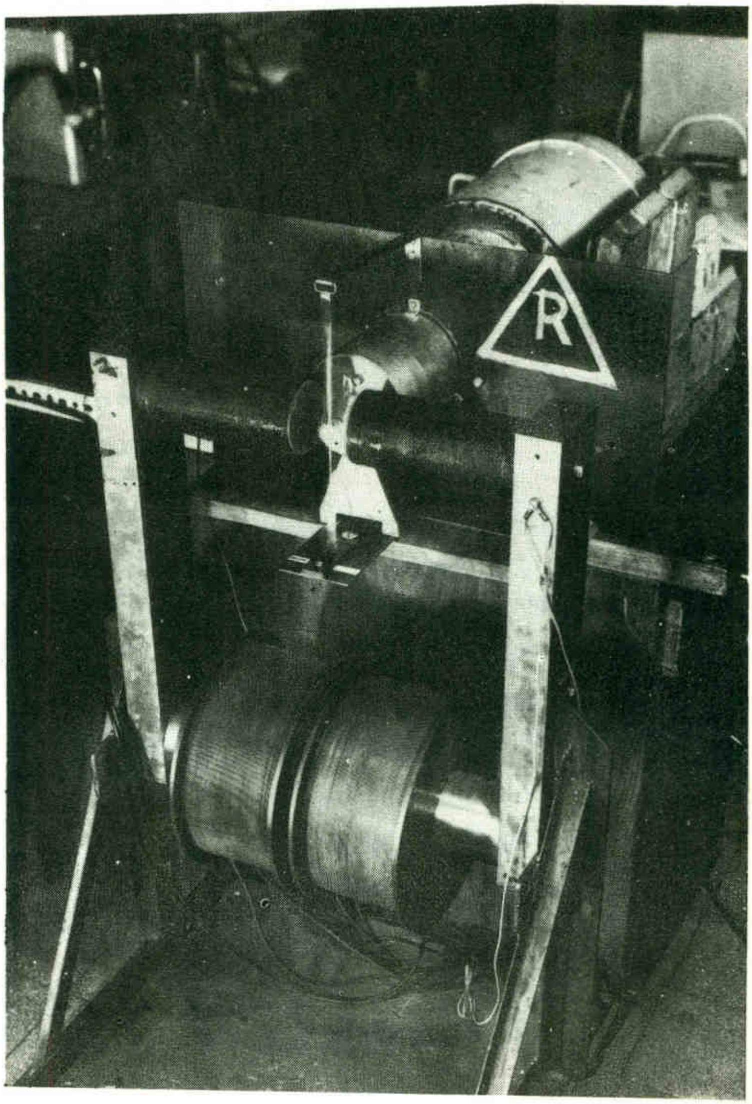
The above ratio has been similarly determined for the unfavourably allowed decays $^{56}Co - ^{56}Fe$ and $^{22}Na - ^{22}Ne$. In the latter case the accuracy of the measurements was approximately 1 %. A similar accuracy, as reported by the relating literature, has not been achieved in the case of other decays.

In the second order forbidden transition of ^{36}Cl we succeeded in studying the spectrum shape of the internal bremsstrahlung accompanying the electron capture more accurately than in the case of similar, hitherto conducted measurements. The obtained shape-factor which is one of the highest accuracy values hitherto measured in the case of an internal bremsstrahlung radiation spectrum, is in contradiction with the theoretical calculations.

Again, it was in our institute that the bremsstrahlung accompanying the positive beta decay has been successfully studied and its spectral distribution investigated for the first time. This measurement was carried out in the super-allowed beta decay of ^{11}C and, moreover, it was the first absolute investigation respecting the internal bremsstrahlung spectrum in a super-allowed beta decay.

Our investigations on the internal bremsstrahlung in the negative beta decay of ^{32}P, in which two different instrumental methods were compared in one measurement, appear to be of great importance. They finally clarified several issues of a decade-long controversy in the literature and the causes of the contradictions among the different measurements.

As put in H. Schopper's (Karlsruhe) summary at the International Conference on Electron Capture and Higher Order Processes in Nuclear Decays (Debrecen, 1968), the two latter results are a landmark in the research of this field. He spoke very highly also about our work on the exchange corrections in electron capture processes.



A device for the critical examination of the internal bremsstrahlung in beta decay

Some pertinent publications from ATOMKI

J.I. Horváth, Experientia, 5 (1949) 112.

А. Салаи и Д. Берени, Изв. АН СССР Сер. физ. 22. (1958) 877.

D. Berényi, Nuclear Physics, 8 (1958) 607.

D. Berényi, Physics Letters, 2 (1962) 332.

D. Berényi and L. Kazai, Nuclear Physics, 61 (1965) 657.

D. Berényi Cs. Ujhelyi and I. Fehér, Phys. Letters, 18 (1965) 293.

E. Vatai, D. Varga and J. Uchrin, Nuclear Physics, A116 (1968) 637.

D. Berényi, T. Scharbert and E. Vatai, Nuclear Physics, A124 (1969) 464.

D. Berényi and D. Varga, Nuclear Physics, A138 (1969) 685.

E. Vatai. Proc. Conf. Electron Capture and Higher Order Processes in Nucl. Decays. Eötvös L. Phys. Soc., Budapest, 1968. p. 71.

4. TENDENCIES IN THE CROSS-SECTION OF THE (n,2n) REACTIONS

In order to clarify the tendencies in the cross-section of the (n,2n) reactions, the cross-section of the (n,2n) reaction has been measured in our institute in the case of a number of nuclei (^{45}Sc, ^{48}Ca, ^{55}Mn, ^{56}Fe, ^{58}Ni, ^{63}Cu, ^{65}Cu, ^{64}Zn, ^{82}Se, ^{86}Sr, ^{97}Rb, ^{89}Y, ^{90}Zr, ^{92}Mo, ^{144}Sm) at the same excess energy above the reaction threshold (E_{exc} = 3 MeV), so that the excitation functions could be normalized. The data determined in this way show no shell effects. It has been established that the (n, 2n) cross-section values depend heavily on the N-Z symmetry parameter. The cross-section as a function of N-Z has the same shape in the $30 < N < 120$ range and it cannot be explained with any hypothetical reactions of the concurrent charged particles. For the dependence of the (n,2n) cross section on the atomic number an empiric expression could be given in the $30 < N < 120$ range. The empiric relation can be applied to other energies as well if the energy dependence of (n,2n) is taken into account on the basis of the Weisskopf formula. As shown by our measurements, the shape of the excitation function of the (n,2n) reactions is well described by the statistical model.

Some pertinent publications from ATOMKI:

J. Csikai, B. Gyarmati, I. Hunyadi, Nucl. Phys., 46 (1963) 141.

J. Csikai, J. Bacsó, A. Daróczy, Nucl. Phys., 41 (1963) 316.

J. Csikai, B. Gyarmati, I. Hunyadi, J. Németh, Phys. Letters, 4 (1963) 33.

J. Csikai and A. Szalay, Nucl. Phys., 60 (1965) 546.

J. Csikai, Acta Phys. Hung. 21 (1966) 229.

J. Csikai, G. Pető, Phys. Letters, 20 (1966) 52.

5. THE DISCOVERY OF NEW ALPHA-DECAYING ISOTOPES

The alpha spectroscopic group of our institute conducts its experiments in the Joint Institute for Nuclear Research, Dubna, while the preparatory work and the evaluation of the data is done partly in ATOMKI

Among our results the discovery of four new hitherto unknown Hg isotopes and the determination of their alpha-radiation parameters stand out. The isotopes in question are these: 179, 180, 182, 183.

In the case of the alpha decay of several other mercury, gold and platinum isotopes more accurate data have been determined than were known before.

Some pertinent publications from ATOMKI:

К.Я. Громов, И. Махунка, М. Махунка и Т. Фенеш, Изв.АН СССР, Сер.физ. 29 (1965) 194.

И. Махунка, М. Махунка и Т. Фенеш, Ядерная Физика, 2 (1965) 291.

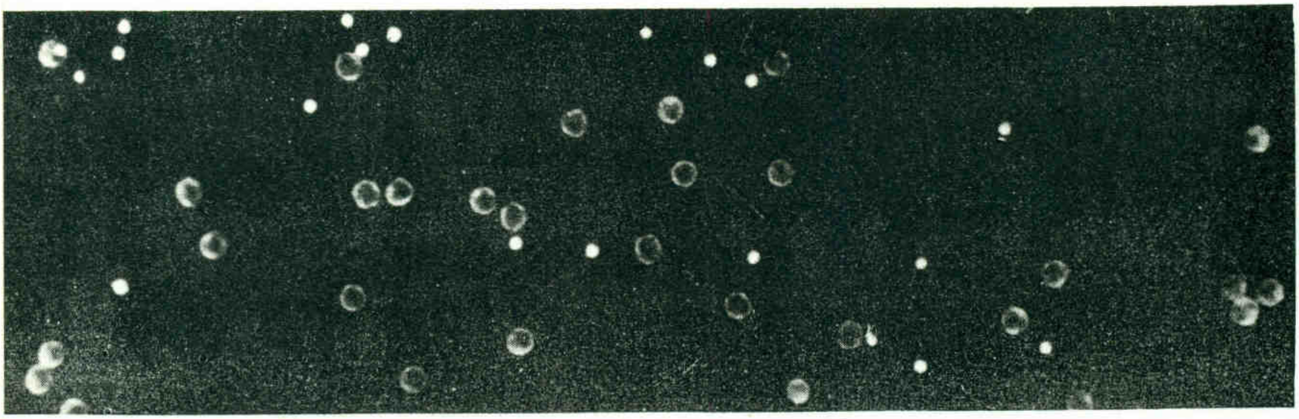
И. Махунка, Л. Трон, Т. Фенеш и Е.А. Халькин, Изв. АН СССР, Сер. физ. 30 (1966) 1375.

A.G. Demin, T. Fényes, I. Mahunka, V.G. Subbotin and L. Trón, Nuclear Physics A106 (1967) 337.

6. OUTSTANDING RESULTS CONCERNING THE INVESTIGATION OF CHARGED PARTICLE REACTIONS

Before the installation of the accelerators, we produced charged particle reactions with the alpha rays of polonium then with deuterons in the 2 MV Van de Graff generator of the Institute of Experimental Physics of KLTE (Kossuth L. University) and the 0.8 MV Cockcroft-Walton generator of ATOMKI.

In this way, for instance, we have studied the gamma radiation emerging from the Mg isotopes bombarded with the alpha rays of Po, the excitation function of the $^{9}Be(d,n)^{10}B$ process, the angular distribution of the alpha groups in the $^{19}F(d,\alpha)^{17}O$ nuclear reaction. In the latter case the measurement was carried out



The tracks of two alpha groups with different energies in a cellulose acetate track detector shown in dark field illumination (see the investigation of the $^{19}(F(d,\alpha)^{17}O$ nuclear reaction) with solid-state track detectors. Our collaborators have conducted successful research work for nuclear reactions in other institutes as well (see above). Theoretical calculations relating to nuclear reactions have been also carried out.

Some pertinent publications from ATOMKI

E. Csongor, Nucl. Physics, 23 (1961) 107.

E. Koltay, Acta Phys. Hung., 16 (1963) 93.

G. Somogyi, B. Schlenk, M. Várnagy, L. Meskó and A. Valek, Nucl. Instr. Methods, 63 (1968) 189.

J. Zimányi and B. Gyarmati, Phys. Letters, 27B (1968) 120.

B. Gyarmati and J. Sawicki, Nuclear Physics, A111 (1968) 609.

B. Gyarmati and J. Sawicki, Phys. Rev., 169 (1968) 966.

L. Meskó, B. Schlenk, G. Somogyi and A. Valek, Nuclear Physics, A130 (1969) 449.

7. SOME RESULTS REGARDING THE CONSTRUCTION OF ACCELERATORS

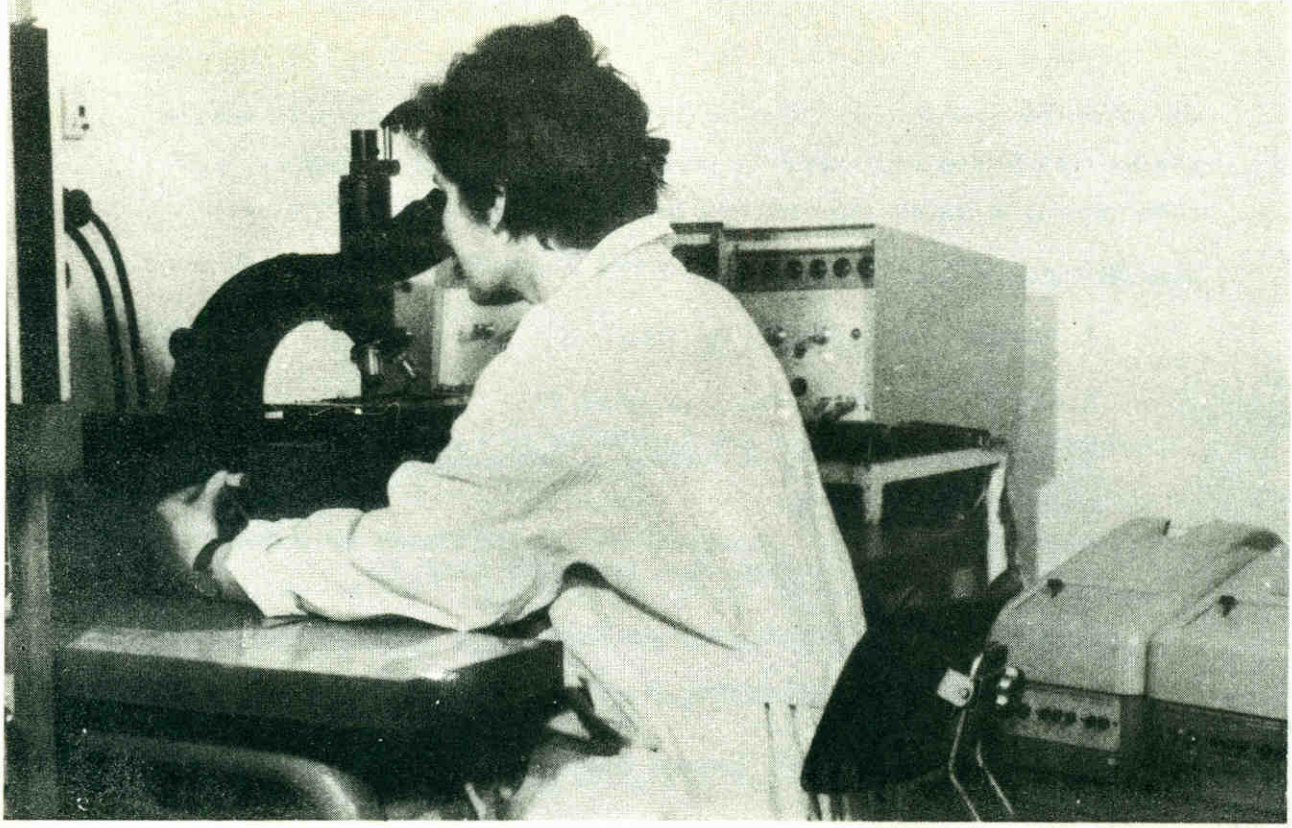
Thorough investigations have been carried out respecting some problems of the construction of high-voltage accelerators. New solutions have been found for the design of the electrode system, as well as for the electron optics of the accelerator tubes and the asymmetrized quadrupole lenses.

Some pertinent publications from ATOMKI:

E. Koltay, Nucl. Instr. and Methods, 6 (1960) 45.

E. Koltay, Phys. Letters, 4 (1963) 66.

E. Koltay and Gy. Szabó, Nucl. Instr. and Methods, 35 (1965) 88.



Three-coordinate digitized microscope

E. Koltay and S. Czeglédy, Nucl. Instr. and Methods, 37 (1965) 179.

A. Kiss, E. Koltay and A. Szalay, Nucl. Instr. and Methods, 46 (1967) 130.

B. Gyarmati and E. Koltay, Nucl. Instr. and Methods, 66 (1968) 253.

L.P. Ovsyannikova, S.A. Yavor, E. Koltay and D. Szabó, Nucl. Instr. and Methods, 74 (1969) 185.

A. Kiss, E. Koltay, L.P. Ovsyannikova, S.Ya. Yavor, Nucl. Instr. and Methods 78 (1970) 238.

8. CORPUSCULAR PHOTOGRAPHY

Our institute has achieved valuable results also in the field of the application and improvement of nuclear research emulsions and solid-state track or dielectric detectors (corpuscular photography). It is the energy spectrum of the Po + Be neutron source that is best-known among the results achieved by means of nuclear emulsion methods in ATOMKI. The above-mentioned spectrum is referred to as standard in the international literature. During the last few years the corpuscular photography investigations in our institute have been extended to solid-state track detectors as well.

The possibilities of the application of these detectors have been considerably extended by a method, elaborated here, according to which the energy of the particle hitting the target at right angles can be determined on the basis of the diameter of the pit.

Some pertinent publications from ATOMKI

L. Medveczky, Acta. Phys. Hung. 6 (1956) 261.

E. Bujdosó and L. Medveczky, Acta Phys., Hung., 7 (1957) 135.

E. Bujdosó and L. Medveczky, Nucl. Instr. 2 (1958) 270.

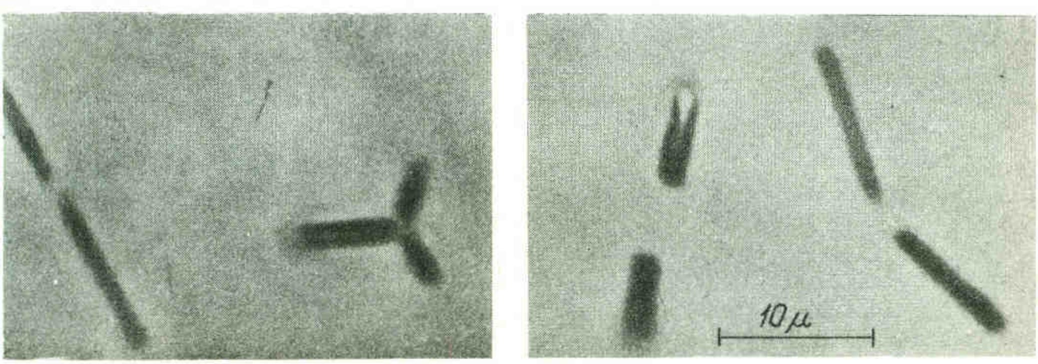
Л. Медвецки, Атомная Энергия, 13 (1962) 583.

G. Somogyi, Nucl. Instr. and Meth. 42 (1966) 312.

L. Medveczky and G. Somogyi, Proc. VIth Int. Conf. on Corpuscular Photography, 1966 July 19-23, Florence. C.E.P.I. Roma, 1967. p. 461.

G. Somogyi, Proc. VIth Int. Conf. on Corpuscular Photography, 1966 July 19-23, Florence. C.E.P.I., Roma, 1967. p. 476.

L. Medveczky, G. Somogyi and G. Götz, Acta Phys. Hung. 28 (1970) 169.



The ternary photo-fission of uranium detected in a mica track detector

G. Somogyi, M. Várnagy and L. Medveczky, Proc. Int. Conf. on Nuclear Track Registration in Insulating Solids and Applications, Clermont-Ferrand, May 1969. Université de Clermont, 1969. p. III-86.

9. PULSE-SHAPE DISCRIMINATION

In the case of scintillation and semiconductor detectors it is possible to find out the type of the detected particle (alpha particle, electron, etc.) on the basis of the shape of the pulse received in the detector. This can be obtained by means of a so-called zero-crossing pulse-shape discriminator.

This method makes it possible to eliminate the so-called pile-up pulses which distorts the nuclear spectroscopic measurements. The same method is also suitable for separating the noise pulses in the scintillation detectors from the scintillation pulses, which therefore facilitate the measurement at very low energies. In the latter two cases again it is the differences in the shapes of the pulses that are used.

Some pertinent publications from ATOMKI

Gy. Máthé, Nucl. Instr. and Meth. 23 (1963) 261.

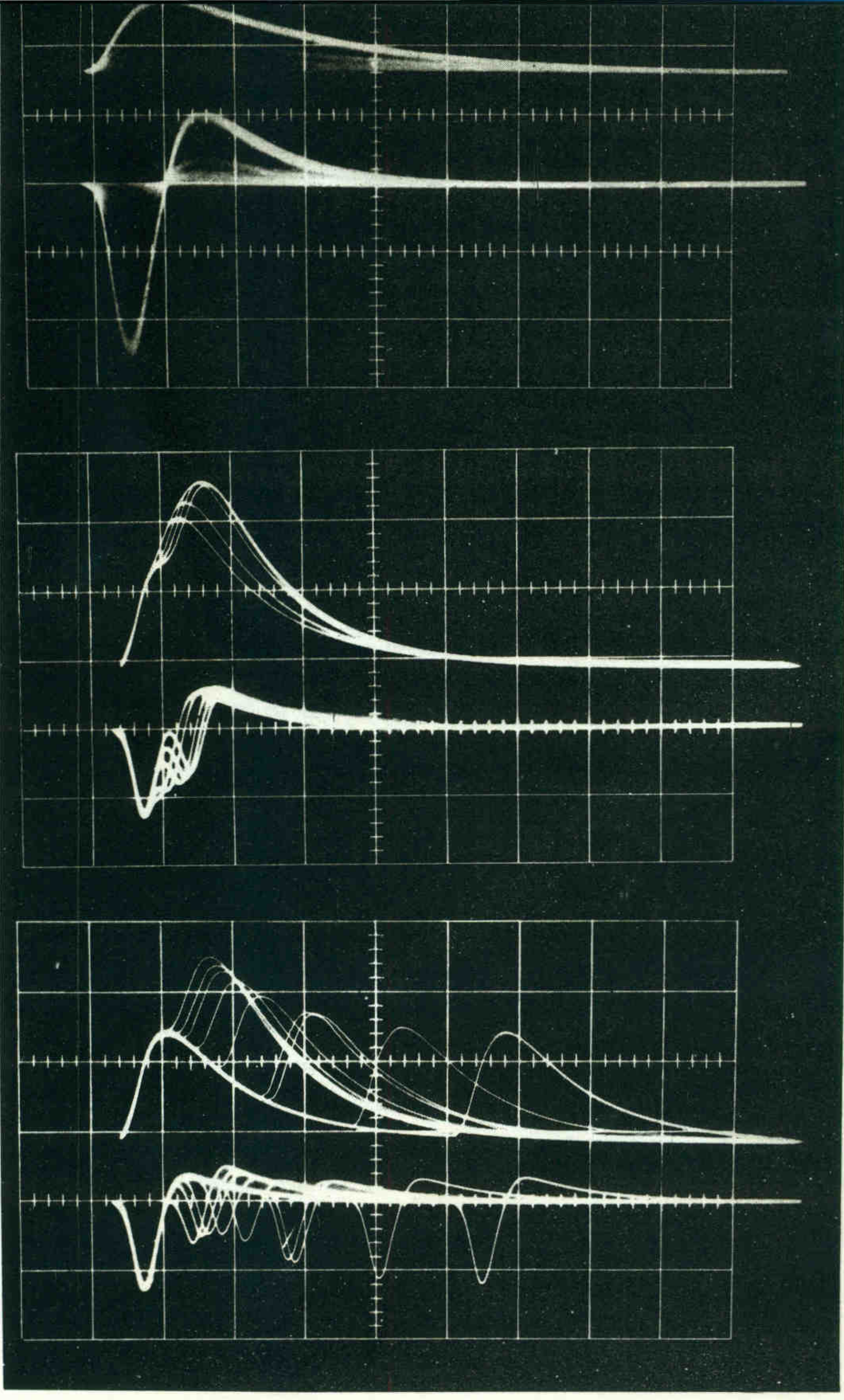
Gy. Máthé and B. Schlenk, Nucl. Instr. and Meth. 27 (1964) 10.

R. Fülle, Gy. Máthé and D.Netzband, Nucl. Instr. and Meth. 35 (1965) 250.

Gy. Máthé, Acta Phys. Hung. 23 /4/ (1967) 407.

Gy. Máthé, Nucl. Instr. and Meth. 63 (1968) 117.

Photographs taken of the screen of a cathode-ray oscillograph to show the method used in our institute for pulse-shape discrimination →



THE ECONOMIC AND CULTURAL EFFECTS OF THE INSTITUTE'S WORK

Apart from fundamental research the institute makes efforts to conduct research projects that may be important and profitable also from the point of view of national economy, and endeavours to contribute to the utilization and application of the results, obtained in the course of fundamental research, in other branches of Science, industry and culture.

The institute has achieved significant results in this field. Through the discovery of uranium enrichment in Hungarian brown coals, and contrary to the views of geologists at that time, it was shown that in Hungary uranium deposits could be found in the vicinity of the Mecsek Mountains and elsewhere. The subsequently initiated industrial exploration did prove the rightness of this recognition and led to important results for the national economy.

ATOMKI had an important role, for instance, in introducing radio-isotopes into the research of medical biology and actual medical treatment in this country, particularly in the Medical University, Debrecen. It is also here that the exact dating of Hungarian rocks is done with the methods of nuclear physics (mass spectrometry).

A new discovery of our institute in the field of agriculture appears to be of great importance also from the point of view of national economy. It has been discovered (by Professor A. Szalay and his collaborators) why plants in boggy areas starve due to the absence of nutritive microelements, and the rate of this phenomenon has been measured accurately. This scientific discovery seems to be highly significant from the point of view of increasing the fertility of large territories (e.g. 100 thousand hectares in Hungary, 50 million hectares in the USSR, and huge territories in the northern countries) and the nutritive value of the plants grown there.

The insufficient development of the domestic industry of nuclear instruments and the known difficulties of purchasing foreign equipment made us produce a considerable quota of our instrumental needs.

In the development of instrumentation not only our engineers and the personnel of the workshop took part but, of necessity, also the research workers. It was mainly during the first years following the establishment of the institute that our work tended to concentrate on the development of the institute, a fact well reflected in the smaller number of our foreign publications. For the most part, the efforts of our research workers had to be devoted to the purposes of development at that time.

Suffice it to say that all our accelerators are home-made (a 100 and a 300 kV neutron generator, an 800 kV Cockcroft-Walton generator) and that we also helped the completion, of the 2-million volt Van de Graaff generator of the Institute of Experimental Physics of Kossuth L. University.

In the first years of the institute we developed a Wilson cloud chamber which is completely automatic and can be faultlessly operated even at a quite low gas pressure (40 Hgmm).

All our beta spectrometers have been made in the institute. Among them mention should be made of a toroid-sector beta-spectrometer which, at the time of its construction, was built according to an original design on principle, and our high resolving permanent magnet beta-spectrometer, the so-called band spectrometer with a working radius of 75 centimetres.

We have done important work in the field of developing scintillation gamma spectrometry. Our results regarding scintillation crystals have been utilized industrially too. At present we are making efforts to produce semi-conductor detectors in our institute.

In the case of the various nuclear experiments the vacuum systems play an important role. In this field, too, we have done important engineering work by designing as well as constructing different types of diffusion and other big vacuum pumps, vacuum gauges and vacuum systems.

At the beginning of the existence of the institute we were quite backward

The institute's ODRA-1013 electronic computer

in electronics. However, towards the mid-sixties, through establishing and properly staffing a division of electronics, a rapid development began and today considerable results in instrumental development can be recorded to their credit. Internationally high-quality low noise charge-sensitive preamplifiers and amplifiers, necessary for semiconductor detector spectrometers, have been produced.

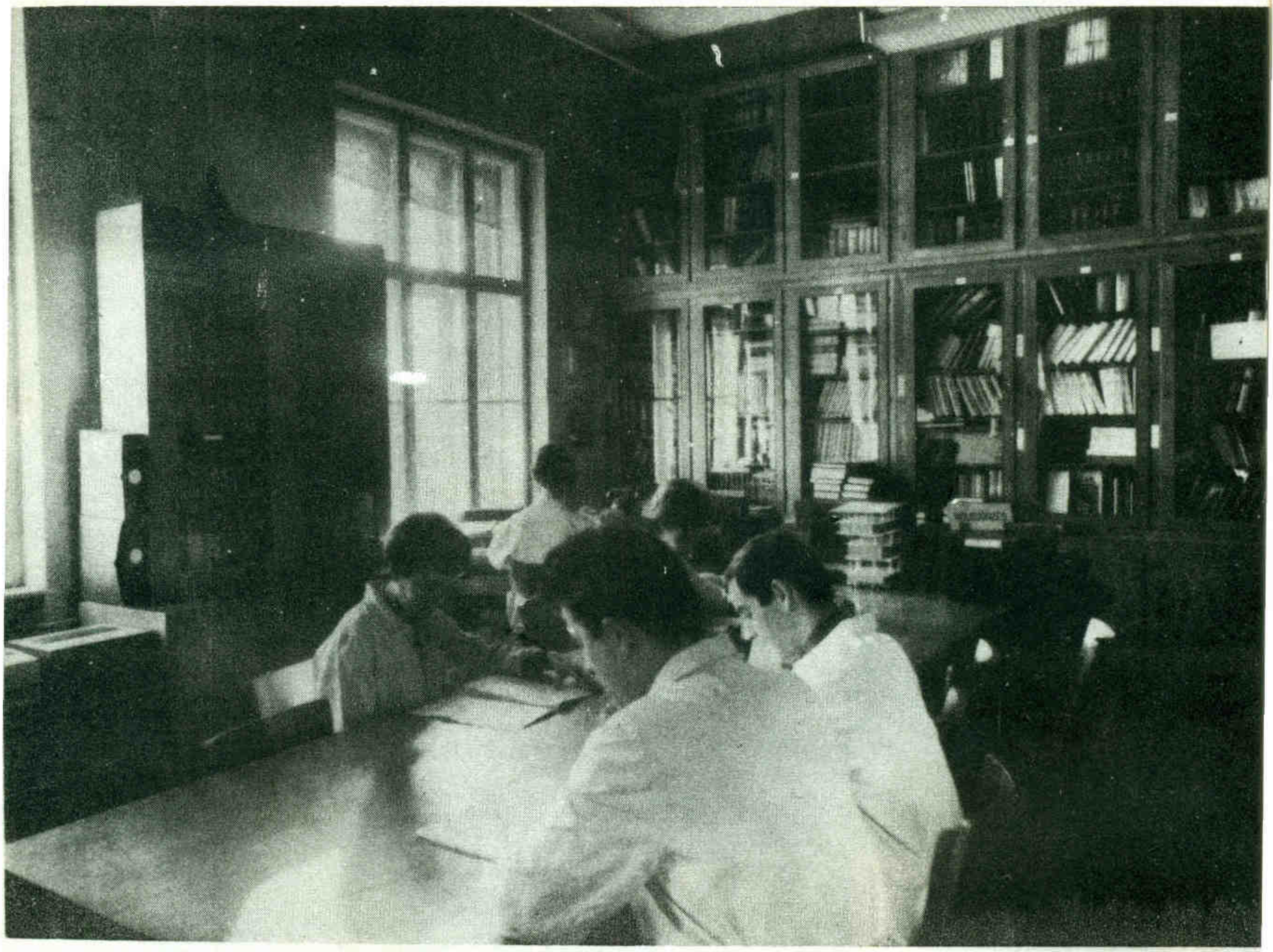
At present large-scale development work is being carried on in the institute for the construction of a 5 million volt Van de Graaff generator on our own. A 1 MV model generator has been almost completed, and measurements are carried on on its proton beam.

ATOMKI takes an active part in university education. The members of the research staff give several lectures a week. Every year quite a few physics students work on their theses, do their extracurricular papers or, spend their time of training practice here in summer. The library of ATOMKI has been used extensively by university students, the teaching staff of the Institute of Experimental Physics of the University and other university departments. In addition, further essential help is offerred by ATOMKI to the teaching staff of the Institute of Experimental Physics of the Kossuth L. University by making it possible for them to conduct research work in the institute as guests. Several members of the teaching staff have worked for a candidate's or a doctor's degree in ATOMKI or through the help of ATOMKI.

The members of ATOMKI's staff also take part in the after-school scientific education of teachers and in popularizing science. This is present not only in the form of giving lectures and contributing appropriate articles but also in the form of organizing special tours in ATOMKI for pupils, students, teachers and occasionally for the general public, too.

Some nuclear electronic units made in the institute

ODRA-1013 electronic computer of this Institute is at the disposal of scientific institutions and industrial enterprises. We have also organized a course in computer programming for industrial experts.



Research-workers in the institute's library

THE ACTIVITY OF THE INSTITUTE'S COLLABORATORS (SCIENTIFIC PRODUCTIVITY)

Since 1954, the year the institute was established, to the middle of 1970 altogether more then 750, scientific and nearly 100 popular scientific publications came out, of which about 250 were published in foreign languages.

Below the number of these publications is shown in a table from the point of view of the different fields of the subject-matters.

Subjects:

I. Nuclear reactions with charged particles

II. Nuclear reactions with neutrons (since 1st January, 1968, this subject belongs to the Institute of Experimental Physics of the Kossuth L. University)

III. Nuclear spectroscopy

IV. The application of the methods of nuclear physics in other branches of science

V. Nuclear electronics and instrumental technology.

THE NUMBER OF PUBLICATIONS FROM ATOMKI

	I	II	III	IV	V		Total
1954 - 1956	7	2	4	50	3		66
1957 - 1959	19	13	13	33	4		82
1960 - 1962	24	15	23	57	14		133
1963 - 1965	38	24	56	49	14		181
1966 - 1968	~~52~~ 54	~~40~~ 42	~~44~~ 54	~~48~~ 54	31		~~215~~ 235
1969	6	3	10	15	18		52
Total	146	97	150	252	84		729
1970 - 1973	42	—	63	39	130	28	302
1954 - 1973	190	99	223	297	214	28	1051

The complete bibliography of the publications from the institute, arranged according to the different fields, is available as a separate edition (two booklets). Upon request the library of the institute sends them as complimentary copies. A supplement to these booklets is published every year now.

The number of dissertations (theses) made since the establishment of the institute:

doctor of sciences (at the university)	33
candidate of sciences	12
doctor of physical sciences (at the Academy of Sciences)	2

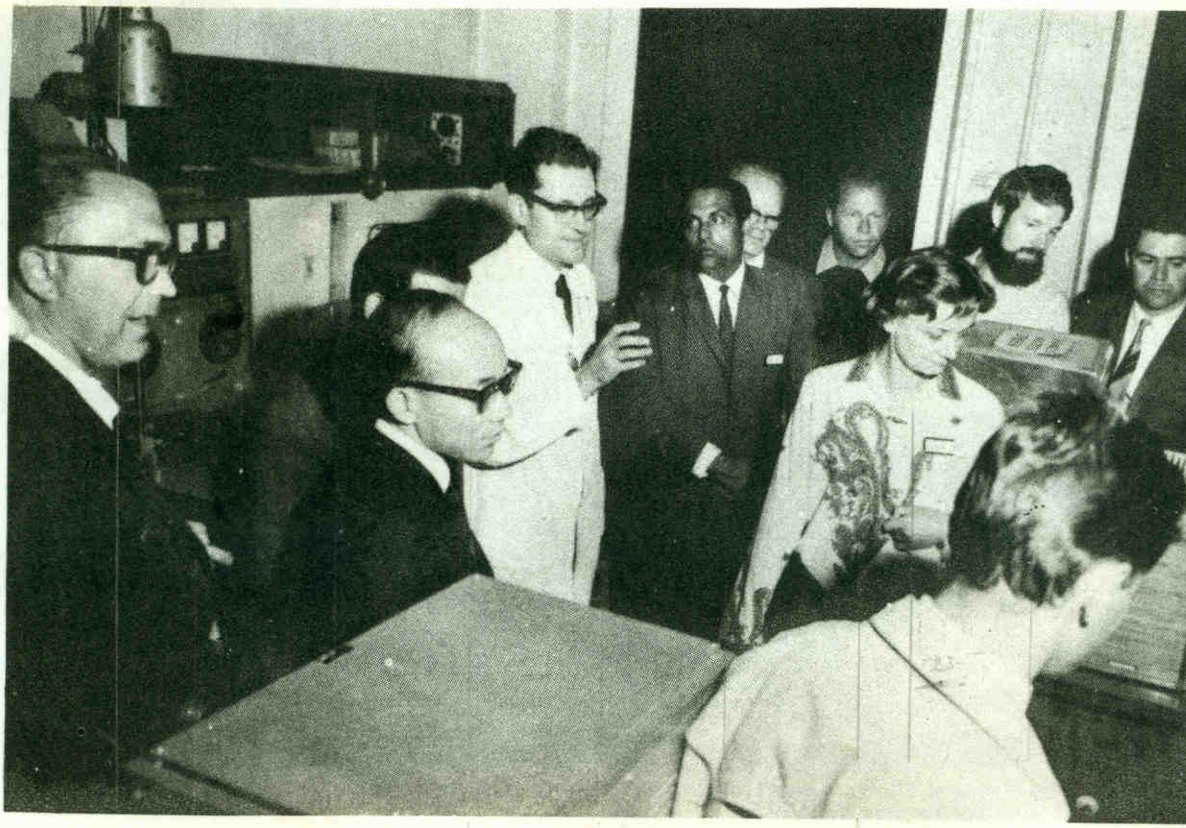
Altogether 9 inventions have been submitted, which have yielded a profit of about 10 million forints for the national economy.

The institute's director shown with Tibor Erdey-Grúz, the president of the Hungarian Academy of Sciences

ATOMKI CONNECTIONS WITH OTHER INSTITUTIONS

Since the time it was established, a large number of visitors from all over the world, from Japan and the United States, have come to see the institute. The number of our visitors adds up to several hundred.

Some foreign research workers spent long periods of time in our institute to carry on joint research projects. Harald Prade (University of Technology, Dresden), for instance, stayed in ATOMKI for three years and did postgraduate work for his candidate's degree here; Nabil A. Eissa (Al-Azhar University, Cairo) conducted, together with the collaborators of ATOMKI, successful experiments for almost a year.



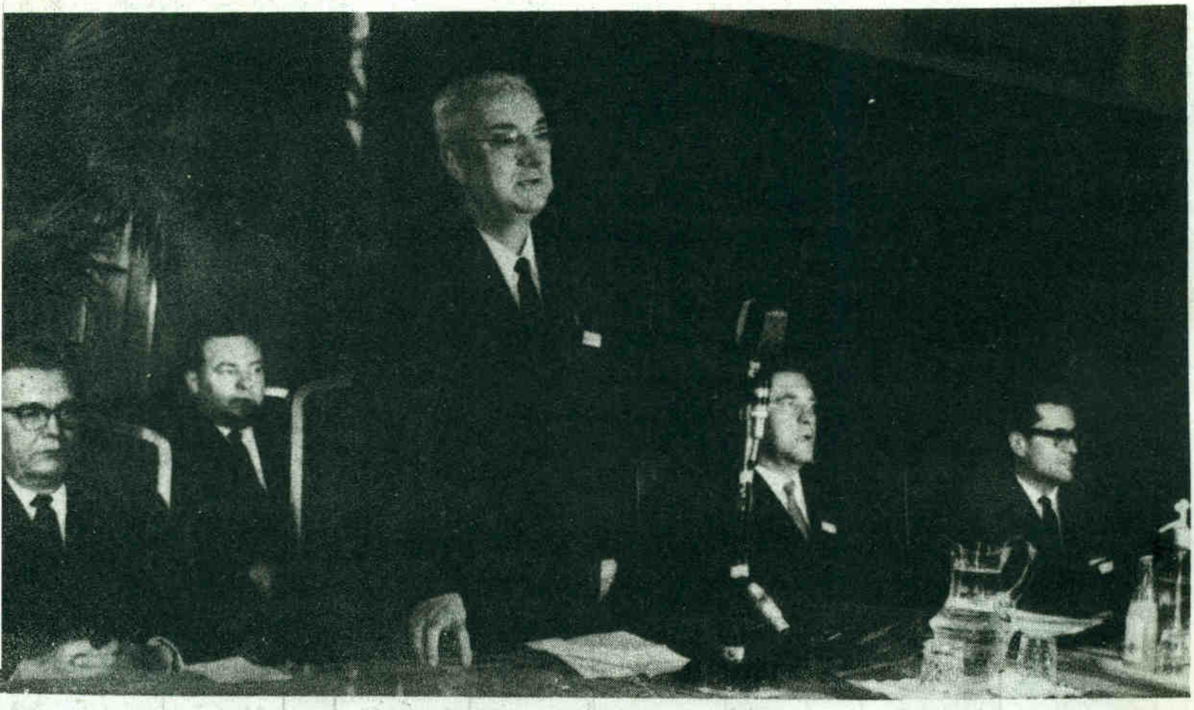
Foreign guests in the institute

Dr. D. S. Srivastava (Department of Applied Physics, Aligarh Muslim University, Aligarh, India) spent more than a year in the Institute and worked at different groups successfully.

Apart from shorter or longer stays and visits, ATOMKI upholds close relations with other institutions both in Hungary and abroad.

Joint research projects have been carried on as well as joint publications have been brought out, for instance, with the following Hungarian institutions:

Central Research Institute of Physics, Budapest
Institute of Theoretical Physics, Eötvös Loránd University, Budapest
Institute of Experimental Physics, Kossuth L. University, Debrecen
Institute of Meteorology, Kossuth L. University, Debrecen



The director of ATOMKI opens the international conference on nuclear spectroscopy sponsored by ATOMKI

Institute of Inorganic and Analytical Chemistry, Kossuth L. University, Debrecen

Institute of Mineralogy and Geology, Kossuth L. University, Debrecen,

University Medical Clinic for Internal Diseases II., Medical University, Debrecen

Central Research Laboratory, Medical University, Debrecen

Obstetrical and Gynaecological Clinic, Medical University, Debrecen

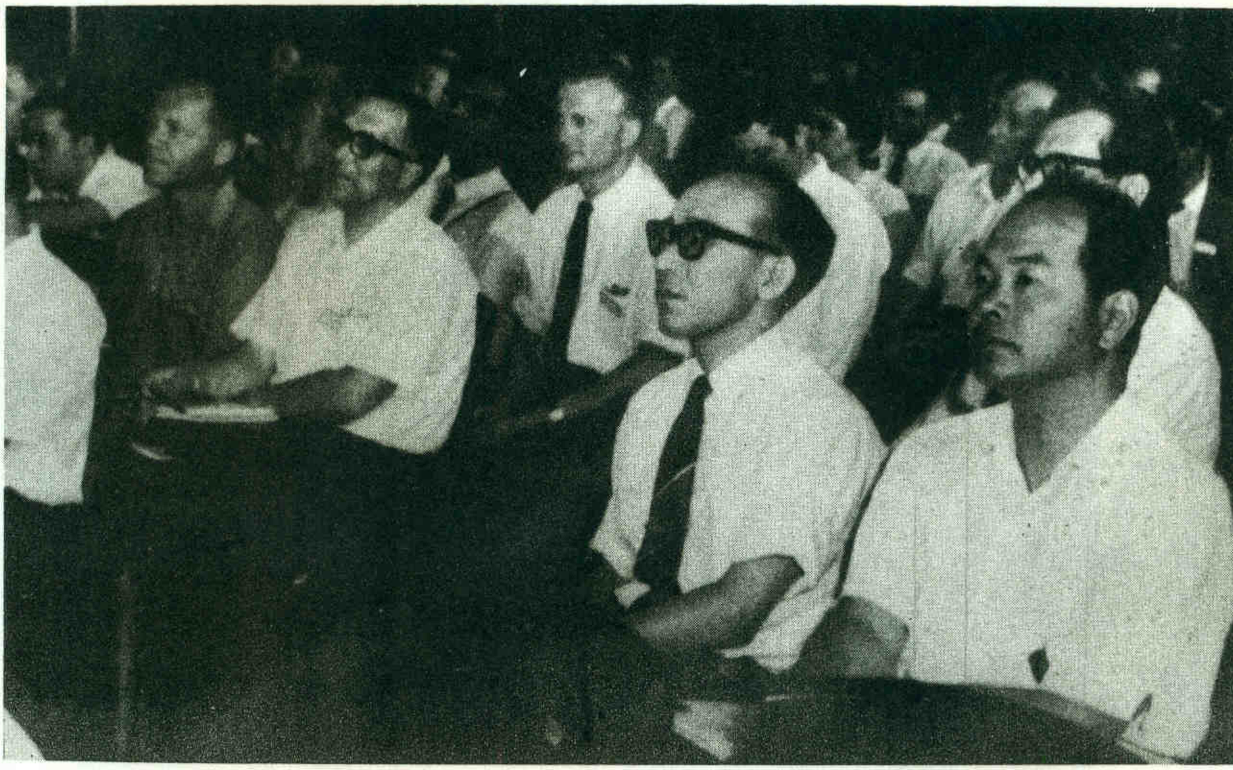
Institute of Public Health and Epidemics, Medical University, Debrecen

Electronic and Precision-Engineering Research Institute, Budapest,

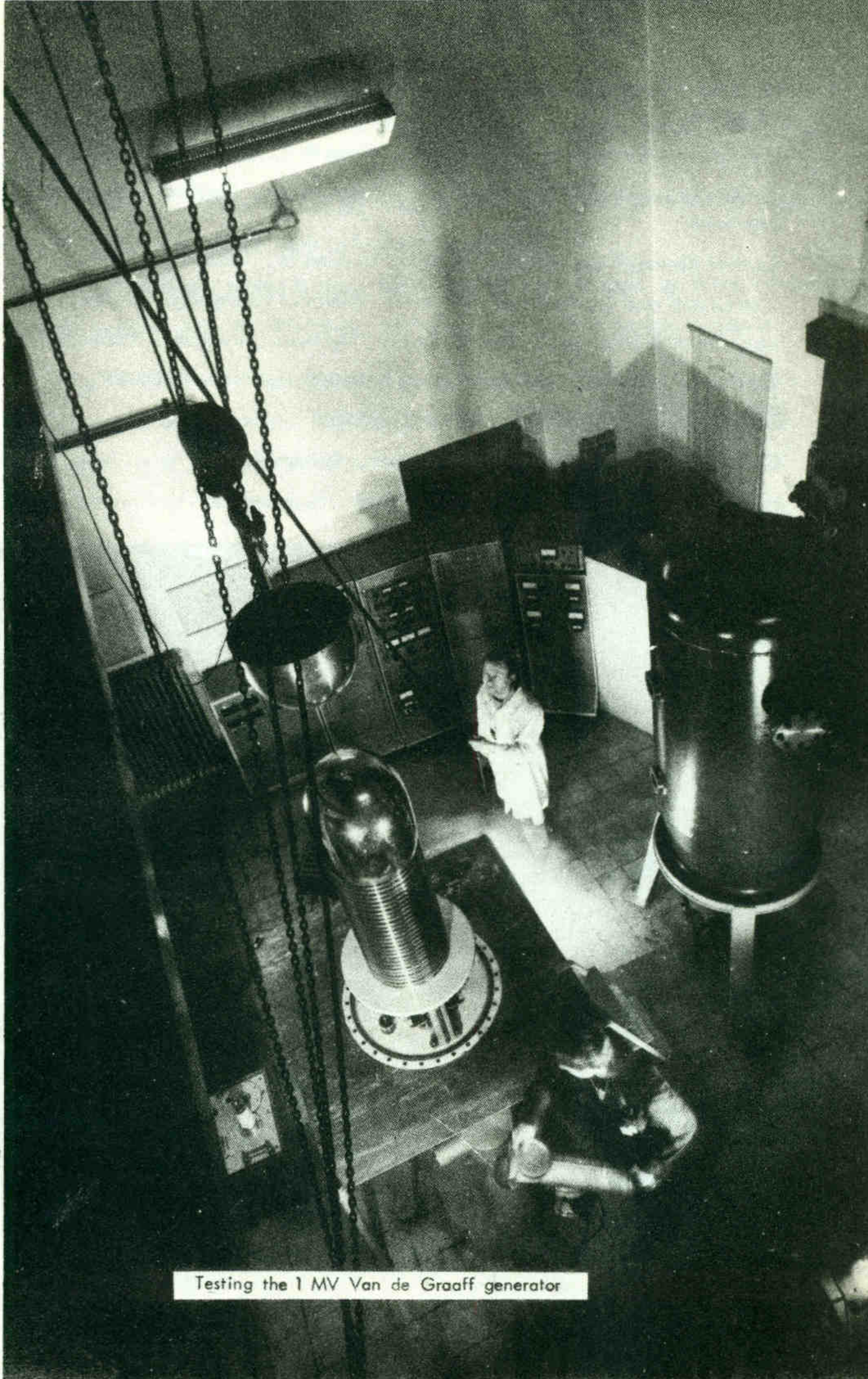
College of Agricultural Sciences, Keszthely

Central Institute for Chemical Research, Budapest

Hungarian National Institute of Geology, Budapest



The participants of the international conference on nuclear spectroscopy in Debrecen



Testing the 1 MV Van de Graaff generator

Research Institute for Technical Physics of the Hungarian Academy Sciences, Budapest

Similar mutual relations have been maintained with several foreign institutions, such as

Joint Institute for Nuclear Research, Dubna, USSR

Central Institute for Nuclear Research, Rossendorf-Dresden, GDR

The Bohr Institute, Copenhagen, Denmark

Institute of Nuclear Research, Řež- Prague, Czechoslovakia

Institute of Nuclear Research, Swierk -Warsaw, Poland

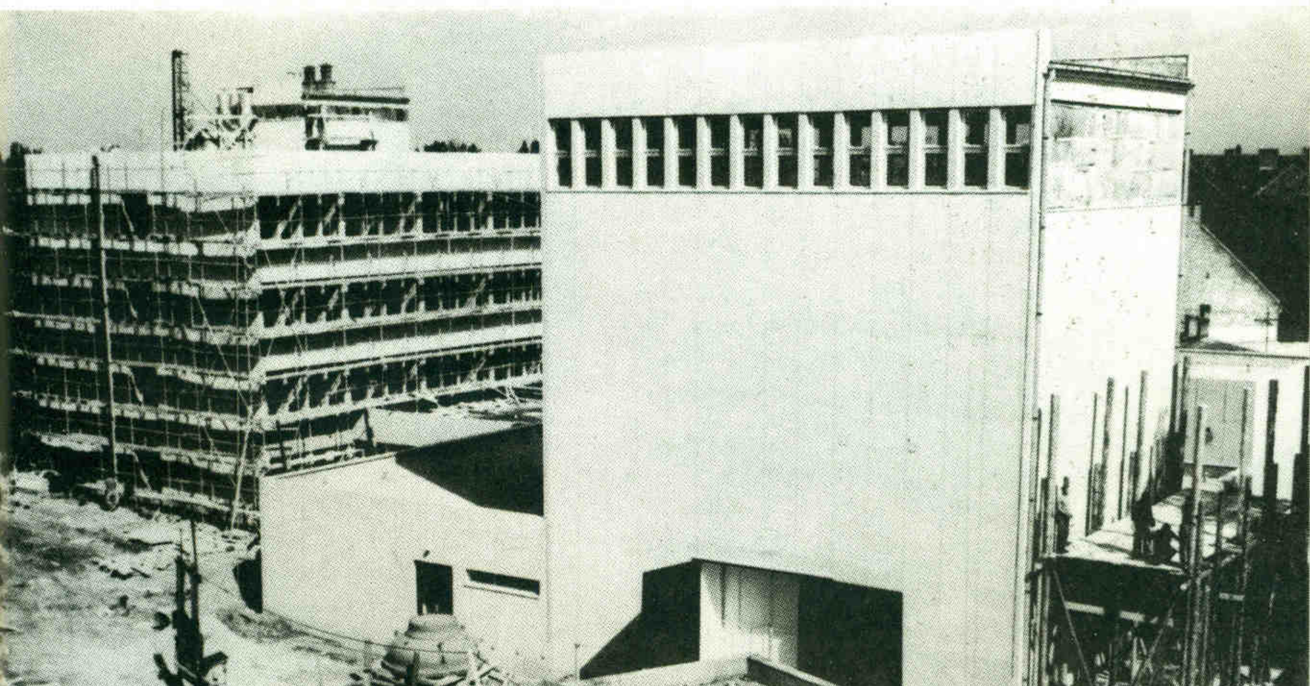
Institute for Technical Physics, Leningrad, USSR

Department of Physics, F. Schiller University, Jena, GDR

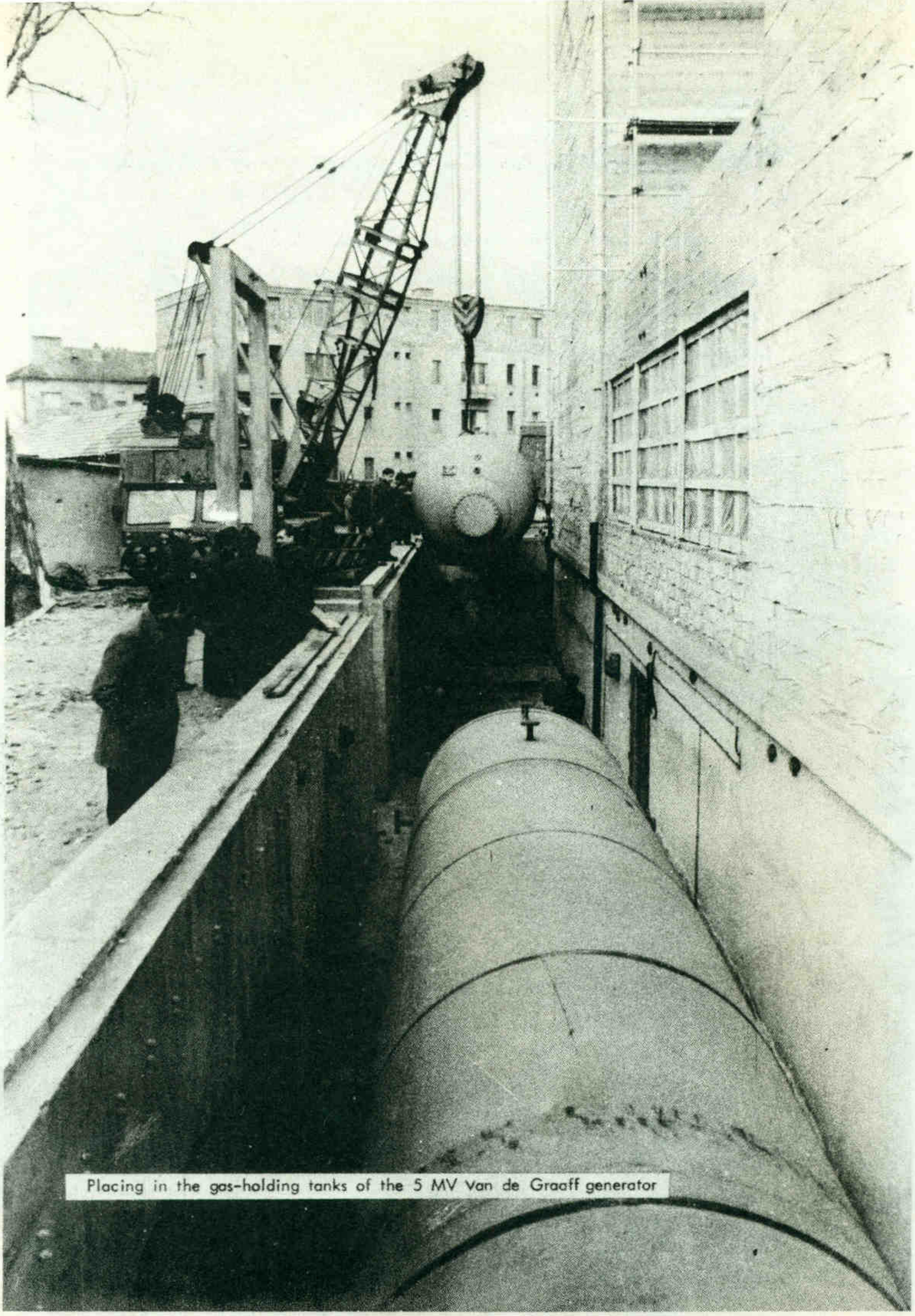
The Research Institute for Physics, Stockholm, Sweden

AB Atomic Energy Institute, Studsvik, Sweden

CISE Laboratory, Milan, Italy



The erection of ATOMKI's new buildings


Placing in the gas-holding tanks of the 5 MV Van de Graaff generator

ACCELERATORS

At present the following accelerators are available in the institute:

Cockcroft-Walton generator

Nominal voltage 80C kV , max. target current 2 mA in the direct beam.

Neutorn generator

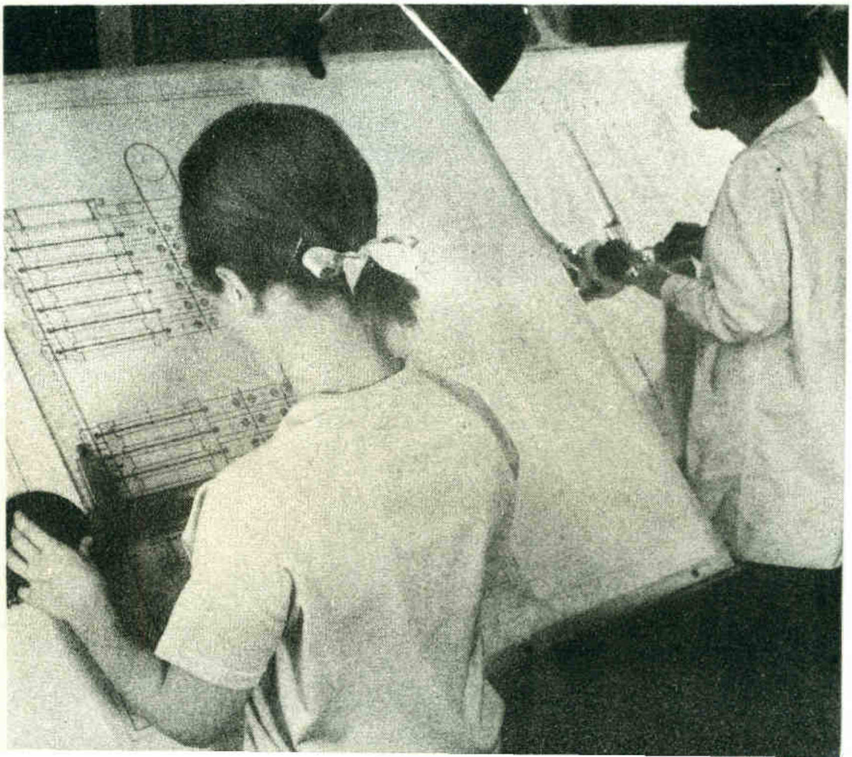
A Cockcroft-Walton generator, accelerating voltage 300 kV. With tritium target 10^{10} 14 MeV neutron/sec in the 4π solid angle; with deuteron target 10^{8} 3 MeV neutron/sec in the 4π solid angle.

Van de Graaff generator - 1

Pressure generator. A model of the new generator under construction. Nominal voltage 1 MV . Under adjustment.

Van de Graaff generator-5

Pressure generator. Nominal voltage 5 MV . Under construction.



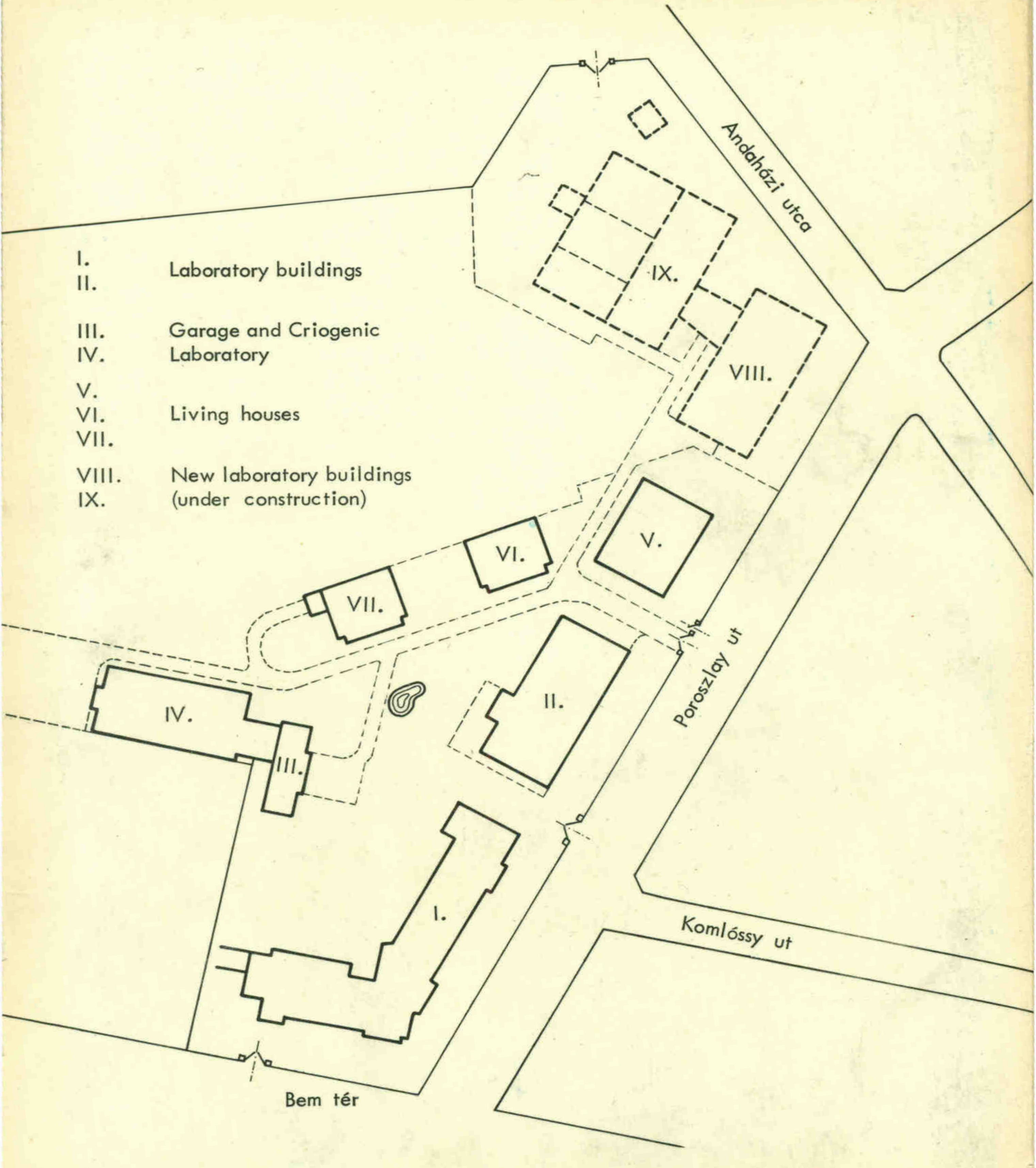
Designing the accelerating tube of the Van de Graaff generator

Felelős kiadó: Dr. Szalay Sándor
Szerkesztő: Dr. Berényi Dénes
Technikai szerkesztő: Vencsellei István
A borító Horváth István terve
Az angol nyelvü kiadás készült 500 példányban
Nyomva az MTA Atommagkutató Intézet ofszetgépén
Debrecen, 1970 - 1

ATOMKI is an institute of nuclear research with a relatively small staff and with modest financial means, which is not equipped with big accelerators. Its strength is due not to its equipment and financial means but to the research experiences and mentality as well as the friendly cooperation of its collaborators which is the result of several decades work of education and talent scouting.

As far as the choice of topics is concerned, the institute lays stress upon problems of nuclear physics that require a relatively modest instrumentation and financial investment on the one hand, but much effort and inventiveness on the other, as well as problems of nuclear physics relevant to other fields, and applications.

The attained achievements are well illustrated by the objective data. Since the establishment of ATOMKI (1954) more than 700 scientific publications by the intitute's staff have come out in print, of which a considerable quota has been published in foreign languages, in distinguished international periodicals. In ATOMKI several scientific discoveries have been made (e.g. mechanism of uranium enrichment, photographing the recoil effect of the neutrino in a cloud-chamber, the demonstration and investigation of the internal bremsstrahlung following positron emission etc.), which have deserved international credit and acknowledgement for the institute.



70.4942.66-43 Alföldi Nyomda, Debrecen