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SCIENTIFIC INFORMATION REPORT

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PLEASE NOTE

This report presents unevaluated information extracted from recently received publications of the USSR, Eastern Europe, and China. The information selected is intended to indicate current scientific developments and activities in the USSR, in the Sino-Soviet Orbit countries, and in Yugoslavia, and is disseminated as an aid to the United States Government research.

SCIENTIFIC INFORMATION REPORT

Table of Contents

I. BEHAVIORAL SCIENCE

1. Goals of Soviet Education Realigned

"The Principal Aim of School Is Preparation for Life and for Useful Labor" (unsigned editorial); Moscow, Sovetskaya Pedagogika, No 6, Jun 58, pp 3-11

Salient points derived from this editorial in the organ of the Academy of Pedagogical Sciences RSFSR are presented below.

The editorial states that a plan for reorganization of the system of primary and secondary education is being formulated in the USSR. This reorganization is expected to lead the way for a transition to a new system of education in the USSR which aims to teach children greater respect for physical labor and to prepare them for productive work in industrial and agricultural establishments and on construction projects.

"Since the Communist Party gained control of the government, the Soviet Union's preoccupation with mass education has been exceeded only by its drive for industrial expansion. The country has made tremendous strides in the education of scientists and technicians, but has made little progress in spreading political literacy among the Soviet people."

The Soviet leaders claim that education has been and should remain the natural outgrowth of free association of children and teachers, with each other, and with everything surrounding them. "The general aim of Soviet education always was and still is the development of a new man: a healthy, strong, active, independently thinking man who would contribute all his knowledge, energy, talents, and abilities toward the building of Communism and toward progress, peace, and friendship among nations. Technology is to be used to create a Communist state; the function of educational system in the Soviet Union is to ensure perpetuation of the Communist state."

The present system of education in the secondary schools is to a degree, creating definite differences between physical labor and mental work. This is irreconcilable with the Communist philosophy, because as the country moves closer to Communism such differences become obliterated primarily as physical work becomes enriched with intellectual content.

The basic features of the present system of education were formed more than 20 years ago. The resolutions of the Central Committee of the Communist Party of the country played the decisive role in its formulation and subsequent development. Socialist construction was in full swing at that time and survival itself made it imperative that schools in the Soviet Union prepare people for technical schools and universities. The Soviet Union needed people with a good foundation in basic sciences: physics, chemistry, mathematics, geography, history, etc. The Soviet school has done well in that respect.

However, geared mainly for training its graduates for college entrance, the Soviet schools of primary and secondary education shoved polytechnical education and preparation for productive work in various industries into the background. All this led to one-sidedness in education and gave rise to a situation where the school became detached from life. This defect had already been felt on the eve of the war and became particularly manifest during the postwar period when a large number of graduates became members of the labor force. Education has had to adjust itself to meet new responsibilities presented by increasing mechanization of industry and agriculture.

At the 13th Congress of the All-Union Lenin Young Communist League (VLKSM), N. S. Khrushchev stated that "the 10-year school must offer a well-rounded education. The 10-year school must prepare youth in basic sciences who are able and willing to actively participate in building Communism and who will not be satisfied to remain on the sidelines as spectators and well-wishers of Communism."

In its message to the 13th Congress of the VLKSM, the Central Committee of the Communist Party of the Soviet Union said: "The Soviet Union places high value on the achievements of Soviet youth." The Central Committee expressed confidence that in the future Soviet youth will remain faithful to the spirit of Communism.

The 20th Congress of the Communist Party of the Soviet Union, in criticizing the Academy of Pedagogical Sciences for its intolerable slowness in reorganizing education in primary and secondary schools, proposed as follows: "Polytechnical education is to be developed, students must become acquainted with the most important branches of modern industrial establishments, and Soviet youth must be indoctrinated with the Communist attitude toward work." The 20th Congress of the Communist Party of the Soviet Union also expressed the opinion that "reorganization of primary

and secondary education will also help to improve the existing system of higher education, bringing it closer to life and linking it with industry in a more realistic manner." CPYRGHT

Until lately the dominant theory of education in Soviet educational circles was that the secondary school, by offering general education and instruction in many technical and applied sciences, cannot arm the students with knowledge and skill in a definite specialty and still remain a school of general education. Proponents of that view claimed that schools of general education, education devoted to instruction in many technical or applied sciences, and professional schools of technology and applied sciences are all different. They forget that all schools in the Soviet Union are elements of a single system for training the coming generation for life and for participation in Communist construction.

"Progress is impossible without improvement in the organization and administration of industry and agriculture, without improvement in training of qualified cadres, without further progress in methods of teaching and indoctrination of the coming generation for the changing conditions of life."

CPYRGHT

In presenting his plan for successful fulfillment of the Communist construction program for the next 15 years to the anniversary session of the Supreme Soviet USSR, held on 6 November 1957, N. S. Khrushchev stressed "the need for continued effort toward the solution of complex scientific and technical problems connected with the revolutionary changes in the following fields: electric power transmission, automation in industry, utilization of atomic energy for peaceful purposes, more rapid development of the chemical industry, and advancement in the science and production of computing machines." CPYRGHT CPYRGHT

"Marxism-Leninism teaches that socialism is not stagnant and that socialism is not something that is final: Socialism must gradually become transformed into Communism. This transformation is expected to be the result of the conscientious effort of the entire Soviet population who, under the guidance of the Communist Party, will promote economic growth of the country and thereby help in the improvement of their own material well-being, which in turn will produce individuals more profoundly indoctrinated in Communism."

CPYRGHT

The leaders of the Communist Party of the Soviet Union maintain, therefore, that "transition from a socialist principle (from each according to his ability, to each according to his labor) to a Communist principle (from each according to his ability, to each according to his needs) presupposes not only a gigantic growth in socialist production based on high technological knowledge, but also a colossal spiritual growth of the Soviet people, a rise in their cultural level, their Communist consciousness, and their attitude toward physical labor." CPYRGHT CPYRGHT

II. CHEMISTRY

Chemistry and Technology of Fuels and Propellants

2. High-Temperature Conversion of Hydrocarbon Gases by Reacting Them With Oxygen

'High-Temperature Conversion of Hydrocarbon Gases," by Ya. S. Kazarnovskiy and N. V. Karkhov; Moscow, Byulleten' Tekhniko-Ekonomicheskoy Informatsii, No 8, Aug 58, pp 12-14

Natural gas, petroleum well gas, coke gas, and other hydrocarbon gases are the most readily available and cheapest raw material for the production of technological gas to be used in the synthesis of ammonia, alcohols, and motor fuel. One of the newest methods for the conversion of gaseous hydrocarbons is high-temperature noncatalytic oxidation with oxygen. The reaction involved is expressed by the equation:

$$C H_4 + 0.5 O_2 = CO + 2 H_2 + 8.5 \text{ Kcal}.$$

The noncatalytic oxidation of natural gas, petroleum gas, the methane fraction, and coke gas was investigated at the State Institute of the Nitrogen Industry (GIAP) and at experimental installations of the Dneprodzerzhinsk Nitrogen Fertilizer Plant (DATZ) in 1951-1957.

Thermodynamic analysis shows that, when the process is conducted adiabatically at a temperature of 1,400-1,430° and a pressure of 30-35 atmospheres, there is quantitative oxidation of methane and of other hydrocarbons so that substantially only carbon monoxide and hydrogen are formed and no free carbon appears in the reaction products. Detailed investigation of the process at pressures from 0 to 35 atmospheres gauge has shown that, independently of the pressure within the system and the nature of the gaseous hydrocarbon converted, a practically quantitative noncatalytic oxidation of the gas is achieved at a temperature of about 1,450°.

The ratio of oxygen to methane in the initial mixture is actually somewhat higher than that corresponding to the stoichiometric coefficient of 0.5 which follows from the equation given above. The final reaction mixture contains a small quantity of carbon dioxide, water vapor, and methane (0.3-0.5% of methane). The high reaction temperature (1,450°) results

in a very high velocity of the reaction: the diffusion stage of the process, consequently, determines the rate of the conversion. Under the circumstances, preliminary mixing of the initial products is of importance.

The investigations that have been conducted demonstrate that the following can be achieved by the high-temperature conversion of hydrocarbons:

The process can be carried out under a pressure of 30-35 atmospheres, so that a considerable amount of electric power is saved which would otherwise be necessary for compressing the gas in the following stages of the synthesis, which is usually conducted at a higher pressure. There is no necessity to purify the hydrocarbon gas from organic sulfur compounds, because all organic sulfur is converted into hydrogen sulfide. The high pressure used and the high velocity of the conversion make it possible to conduct the process in equipment of small size. A simplified flow sheet of the conversion of 35 atmospheres gauge as applied to natural gas is shown (cf figure on p 13 [of source]). The natural gas is heated to 500-600° in a preheater under a pressure of 35-40 atmospheres gauge. The oxygen, after leaving the compressor or evaporator for liquid oxygen, is heated to approximately 350° in another preheater. The oxygen also has a pressure of 35-40 atmospheres gauge.

The natural gas and the oxygen enter into the reactor through the mixing device of the burner. The reactor is a cylindrical vessel lined with a special refractory material. The formation of some carbon black may occur during the reaction. On leaving the reactor, the converted gas is cooled to 400° by means of injected condensate and then washed with hot water in a tower to remove the carbon black. During the process of washing, the gas becomes saturated with water vapor. The ratio of water vapor to the gas slightly exceeds 1/1. This quantity of water is entirely adequate for the subsequent conversion of carbon monoxide.

When the conversion of methane is conducted under a pressure up to 35 atmospheres gauge and at the temperatures of preheating of natural gas and oxygen indicated above, the ratio of oxygen to methane in the initial mixture comprises 0.64-0.65. When a good preliminary mixing of the gas with oxygen has taken place, the heat potential in the reaction zone amounts to 10^7—10^8 kilocalories/ m^3 . hr, which makes it possible to construct highly productive reactors of small dimensions. Thus, at an ammonia plant with an output of 300 tons of ammonia per day the volume of the reaction zone will not exceed one cubic meter.

Conducting the conversion of methane and the conversion of carbon monoxide at a pressure of 35 atmospheres gauge and subsequent purification of the gas from carbon dioxide at the same pressure make it possible to reduce the power needed for compressing the synthesis gas by 50-60%.

By converting methane and carbon monoxide under pressure, a more efficient utilization of the reaction heat is achieved, because a large fraction of the heat of condensation of the water vapor is utilized.

High-temperature noncatalytic conversion of hydrocarbon gases under atmospheric pressure is being carried out on an industrial scale at the Rustavsk Nitrogen Fertilizer Plant. Coke gas is used as a raw material there.

The process conducted under a pressure of 35 atmospheres gauge has been brought up to the pilot-plant stage and is being introduced into industrial application for the conversion of natural gas and of the by-product gases of crude petroleum production.

3. New Equation Describing the Kinetics of the Decomposition of Explosives

"Formal Kinetic Laws of the Thermal Decomposition of Explosives in the Liquid Phase," by F. I. Dubovitskiy, G. B. Manelis, and A. G. Merzhanov; Moscow, Doklady Akademii Nauk SSSR, Vol 121, No 4, Aug 58, pp 668-670

The classical equation of autocatalysis does not accurately describe the thermal decomposition of explosives in the liquid phase except in the special case of autocatalysis by gaseous products in a closed system. By taking into account changes of volume during the process of decomposition, a formal equation has been derived which corresponds much more closely to experimental data. A. J. B. Robertson's experimental results on the decomposition of ethylenediamine nitrate (cf. Journal of the American Chemical Society, Vol 67, 1948, p 221) were used to check this equation. Robertson's data in regard to the dependence of the specific velocity of the reaction on the degree of decomposition were found to correspond to points on a curve plotted on the basis of the equation.

Chemistry and Technology of Nuclear Fuels and Reactor Construction Materials

4. The Relation of Characteristics of Metallic Uranium to the Behavior of This Metal Under Irradiation

"The Relation of the Structure and Properties of Uranium to Its Behavior Under Irradiation," by A. S. Zaymovskiy, G. Ya. Sergeyev, V. V. Titova, B. M. Levitskiy, and Yu. N. Sokurskiy; Moscow, Atomnaya Energiya, Vol 5, No 4, Oct 58, pp 412-420

Data are given on changes in the dimensions and shape of uranium smaples as a result of irradiation. It is shown that by controlling the composition of the uranium and the conditions of its treatment (specifically, the degree of deformation in the alpha region and the conditions of heat-treatment), the magnitude of the radiation distortion of the surface and the value of G_1 (the coefficient of radiation growth) may be changed within wide limits as a result of changes in the grain dimensions and orientation.

The dependence of changes in the grain size of hardened uranium as well as of the hardness, tensile strength, and yield strength of this metal on the contents of iron, silicon, and aluminum in it has been investigated. It was found that the rate of cooling and the content of the impurities mentioned exert an effect on the position of the critical point of the beta $\rightarrow$ alpha transformation in hardening. For instance, at a rate of cooling amounting to 400° C per second and a content of 0.05 percent of silicon by weight, this critical point is lowered to 530° C.

Experimental data indicate that there is acceleration of creep under irradiation ($nv = 6 \times 10^{12}$ neutrons/cm^2. seconds) by a factor of 50-100 (in other words, by 1.5-2 orders) for both preferentially oriented and randomly oriented uranium. The rate of creep of randomly oriented uranium depends on the rate of burn-out.

Data are reported that were obtained in an investigation in which the mechanical properties of uranium produced by extension without removing the metal from the reactor were studied. It was found that even after a short period of exposure to the action of a neutron field (up to one hour) the relative elongation is reduced to a certain extent and the tensile strength of the uranium increased.

5. The Use of Uranium-Molybdenum Alloys as Material for Fuel Elements

"Uranium-Molybdenum Alloys in the Construction of Reactors," by V. V. Kalashnikov, V. V. Titova, G. Ya. Sergeyev, and A. G. Samoylov; Moscow, Atomnaya Energiya, Vol 5, No 4, Oct 58, pp 421-431

The principal properties of uranium-molybdenum alloys and work on the use of uranium-molybdenum alloys as material for fuel elements of nuclear reactors are reviewed on the basis of non-USSR and USSR publications. A bibliography consisting of 4 USSR references and 14 non-USSR references is appended to the article.

The following conclusions are made: (1) alloying of uranium with molybdenum makes it possible to obtain alloys which have better mechanical characteristics and superior resistance to corrosion at elevated temperatures as well as a high dimensional stability under conditions involving irradiation and cyclic temperature changes; (2) uranium-molybdenum alloys are suitable from the technological standpoint for the production of fuel elements; (3) although the use of uranium-molybdenum alloys in reactors operating on thermal neutrons necessitates a greater enrichment of the fuel because of the relatively high cross section of neutron capture by molybdenum, the high dimensional stability under irradiation and the good corrosion resistance of uranium-molybdenum alloys in water at high temperatures and pressures may in a number of cases be decisive factors in the selection of uranium-molybdenum alloys as material for fuel elements of nuclear reactors; and (4) one may assume that it is presumably of advantage to use uranium-molybdenum alloys as material for fuel elements of fast-neutron reactors.

6. Procedures for the Colorimetric Determination of Uranium and Thorium With Potassium Iodate

"Colorimetric Determination of Thorium and Uranium by Means of Potassium Iodate," by Ye. S. Przheval'skiy (deceased), A. P. Golovina, and Ye. R. Nikolayeva, Chair of Analytical Chemistry, Moscow State University; Moscow, Vestnik Moskovskogo Universiteta; Seriya Matematiki, Mekhaniki, Astronimii, Fiziki, Khimii, Vol 30, No 1, Sep 58, pp 171-175

The iodate method is applied rather extensively for the determination of tetravalent elements. Yu. A. Chernikhov and T. A. Uspenskaya have developed procedures for the determination of thorium, zirconium,

and tetravalent cerium by gravimetric and volumetric methods. The high sensitivity of the iodate method makes it suitable for microdeterminations. Colorimetric procedures developed by the authors of this article in 1950-1953 can be applied for the determination of quantities as low as 0.04 milligram in the case of thorium and 0.1 milligram in the case of uranium. These limits are set by the minimum concentrations at which the metals in question can still be precipitated with potassium iodate.

The iodate method should not be applied for determining tetravalent uranium in the filtrate after separation of thorium from it by the same method, because the separation of the two elements in this manner would be too cumbersome.

To determine thorium and tetravalent uranium colorimetrically, these metals are precipitated in the form of their iodates, which are then dissolved and reduced by potassium iodide to free iodine. The iodine that has formed as a result of the reduction is extracted with chloroform or carbon tetrachloride. The colored solutions of iodine are subjected to colorimetric examination.

Procedures for the colorimetric determination of thorium and tetravalent uranium by means of potassium iodate are proposed; these procedures are described in detail.

On the basis of the data obtained in work on the colorimetric determination of thorium with potassium iodate, one may assume that the formula of the thorium salt which is formed corresponds to that of a normal iodate.

7. I. V. Tananayev's Work on the Inorganic and Analytical Chemistry of Rare Elements and Actinides

"Election of Academicians and Corresponding Members of the Academy of Sciences USSR" (unsigned article); Moscow, Izvestiya Akademii Nauk SSSR, Otdeleniye Khimicheskikh Nauk; No 9, Sep 58, pp 1135-1154

I. V. Tananayev is one of the most important scientists active in the field of inorganic and analytical chemistry. He had done fundamental research on the chemistry of flourine and the application of physicochemical

analysis in the analytical chemistry of rare elements. Together with his collaborators, Tananayev carried out investigations on the chemistry of more than 20 elements, including lithium, rubidium, cesium, cerium, praseodymium, neodymium, samarium, titanium, zirconium, hafnium, niobium, tantalum, thorium, germanium, selenium, tellurium, and uranium. Particular attention was paid by Tananayev to the investigation of the composition, properties, and reactivity of flourides, oxalates, ferrocyanides, and hydroxides. The results obtained in the work in question madeit possible to establish a number of relationships and to make valuable proposals concerning methods applied in the industry of rare metals and actinides. For instance, Tananayev and his collaborators proposed technological flow sheets for the extraction of rubidium and cesium from raw materials consisting of salts (using the ferrocyanide method) and for the production of beryllium, actinides, and other metals (using flouride methods).

At present Tananayev is engaged in work pertaining to the chemistry of solutions of inorganic compounds. Simultaneous application in this research of different physicochemical methods would enable more complete characterization from the standpoint of composition and stability of the state in which dissolved substances are present in solutions. The exceptional stability of incompletely substituted ions that contain fluorine, which has been discovered by Tananayev and which determines the characteristics of processes of solution and precipitation of fluorides, is widely used in analytical chemistry and in connection with the application of a number of industrial procedures. Tananayev together with his collaborators proposed new analytical methods for the determination of a great number of elements and of impurities contained in pure materials that are of great importance in present-day technology. He published more than 170 scientific articles. Tananayev's achievements in scientific work were recognized on two occasions by the award of Stalin Prizes.

At a general meeting of the Academy of Sciences USSR held on 20 June 1958, I. V. Tananayev was elected Academician in the Department of Chemical Sciences within the specialized branch of inorganic chemistry.

8. Work by V. M. Vdovenko on Radiochemistry and the Extraction and Purification of Nuclear Fuels

"Election of Academicians and Corresponding Members of the Academy of Sciences USSR" (unsigned article); Moscow, Izvestiya Akademii Nauk SSSR. Otdeleniye Khimicheskikh Nauk; No 9, Sep 58, pp 1135-1154

V. M. Vdovenko is a prominent radiochemist. He has published more than 90 scientific works, principally in the fields of radiochemistry and inorganic chemistry. His first investigations dealt with the behavior of

ions in complex systems. From the standpoint of the theory of ion exchange, Vdovenko investigated the effect of ion absorption by solid electrolytes on the electrochemical properties of the latter. At the same time he completed a number of investigations in the field of hydrochemistry and subsequently did work on the absorption of radium on glass.

The principal scientific investigations by Vdovenko were carried out after World War II. These investigations are of great importance for the national economy of the USSR. As head of a large group of scientific workers, he expanded to a great extent the line of research initiated by B. A. Nikitin. Vdovenko amplified in a considerable measure Nikitin's ideas, checked them experimentally, and introduced the results of his own work into industrial production. Of particular interest from both the theoretical and practical standpoint is Vdovenko's work on the distribution of radioactive elements between two immiscible solvents. He investigated the distribution of the nitrates of uranium, neptunium, plutonium, and a number of other nitrates between aqueous solutions and some organic solvents containing oxygen. The results of the work done in this field opened up possibilities of applying the extraction method for the isolation of uranium and plutonium from aqueous solutions and the purification of these elements. In the work in question, the basic principles of the application of the extraction method for the treatment of irradiated uranium were developed. Vdovenko is one of the greatest authorities in the field of solvent extraction chemistry.

At a general meeting of the Academy of Sciences USSR held on 20 June 1958, the election of V. M. Vdovenko as Corresponding Member of the Academy of Sciences USSR (in the specialized branch of radiochemistry) by the Department of Chemical Sciences was confirmed.

9. The Work of V. I. Spitsyn in the Fields of Inorganic Chemistry and the Chemistry and Technology of Rare and Radioactive Elements

"Election of Academicians and Corresponding Members of the Academy of Sciences USSR" (unsigned article); Moscow, Izvestiya Akademii Nauk SSSR, Otdeleniye Khimicheskikh Nauk; No 9, Sep 58, p 1135-1154

V. I. Spitsyn is a prominent investigator in the fields of inorganic chemistry and the chemistry and technology of rare and radioactive elements. His early work was on the chemistry of molybdenum and tungsten and was concerned with investigations of the composition of isopolytungstates and of

reactions of their reduction as well as the preparation of chemically pure ammonium molybdate and other compounds. The results of this work were utilized as early as the 1920s in connection with the organization of the production of tungsten and molybdenum in the USSR. Work done by him in 1928-1934 on the mechanisms of the reactions of chlorination of oxides of beryllium, aluminum, niobium, tantalum, and other elements played an important role in connection with the organization of the production of metallic beryllium and other metals.

Spitsyn investigated problems pertaining to the volatility and thermal stability of different inorganic substances including chlorides, sulfates, and other compounds. With the application of present-day physicochemical methods, specifically methods of isotope exchange, he and his collaborators investigated in detail the structure, properties, and conditions of formation of the most important complex compounds of molybdenum and tungsten. As a result of this research, using the concept of the hydrogen bond, he proposed in 1957 a new theoretical treatment of the structures of aquapolycompounds and heteropolycompounds, i.e., substances which comprise an important class of inorganic complex compounds.

For a number of years Spitsyn and members of his group have conducted extensive investigation on the chemistry of uranium. He investigated the uranates of different elements, their composition and properties, the conditions of their formation, their crystal structure, and their thermal stability. The research in question gave information on the theroetical aspects of a number of production processes.

In recent years, research on different radioactive isotopes and methods for their separation and concentration was conducted under the direction of Spitsyn. Spitsyn has also carried out a number of investigations on the isotope exchange of hydrogen and oxygen in different oxygen compounds. The work in question was conducted with the use of deuterium and oxygen-18. In 1955, Spitsyn and his collaborators published a manual entitled Metody Raboty s Primeneniyem Radioaktivnykh Indikatorov (Methods of Work With the Application of Radioactive Tracers).

On 20 June 1958 at a general meeting of the Academy of Sciences USSR, V. I. Spitsyn was elected Academician in the specialized branch of inorganic chemistry at the Department of Chemical Sciences.

10. Adsorption of Radioactive Strontium on Montmorillonite

"A Study of the Adsorption of Radioactive Strontium on Montmorillonite and of Its Fixation by Calcination," by V. I. Spitsyn and V. V. Gromov; Moscow, Atomnaya Energiya, Vol 5, No 4, Oct 58, pp 446-452

Montmorillonite clays are the best natural adsorbents for radioactive isotopes of strontium and other splinter elements.

The conditions under which Sr^{89} and Sr^{90} are adsorbed by montmorillonite have been investigated in detail. It was established that different cations can be arranged in the following order as far as their capacity to lower the adsorption of radioactive strontium is concerned:

$$Al^{3+} > Fe^{3+} > Be^{2+} \gg Ca^{2+} > Mg^{2+} \gg H^{+} > NH_4^{+} > K^{+} > Na^{+}$$

It was found that the adsorption of radioactive strontium by montmorillonite is of the ion-exchange type and is subject to the mass law. The presence in the solution of CO_3^{2-}, SO_4^{2-}, and $C_2O_4^{2-}$ anions, with which strontium forms difficulty soluble salts, does not alter the mechanism of adsorption. However, the presence of these ions lowers the quantity of adsorbed radioactive strontium, apparently by reason of the formation of radioactive colloids.

The process of fixation of radioactive strontium on montmorillonite clays by calcination was investigated. Calcination at a temperature about 850-900° and an increase of the time of calcination above 1-2 hours have no effect on the degree of fixation of radioactive strontium. After treatment of this type, the amount of activity removed by washing with river water or sea water comprises approximately 2%.

It is assumed that before the changes in the crystalline lattice at T = 800° C fixation is caused by the formation of difficulty soluble chemical compounds of strontium with the adsorbent. Above 800° C the course of the process is determined by changes in the crystalline lattice and gradual vitrification of the mineral.

11. Work on High-Molecular Compounds at Moscow State University

"At the Chair of High-Molecular Compounds," by G. Gol'denberg and G. Skvortsova; Moscow, Vestnik Moskovskogo Universiteta; Seriya Matematiki, Mekhaniki, Astronomii, Fiziki, Khimii Vol 30, No 1, Sep 58, pp 237-239

The work done at the Chair of High-Molecular Compounds, Chemical Faculty of Moscow State University, is of particular importance in connection with the current emphasis on an expansion of the production of polymers. The Chair of High-Molecular Compounds is the newest in the faculty; it was organized 2 years ago. This chair is headed by Academician V. A. Kargin. New methods for the synthesis of polymers are being developed at the chair and the results obtained transferred to institutes engaged in work of this type.

Two principal lines of research pursued in work done at the Chair of High-Molecular Compounds are (1) synthesis of new polymers and investigation of their properties and (2) investigation of the structure of polymers. The first line of research comprises the synthesis and investigation of polymers with an isotactic structure as well as work on block and graft polymers. Catalytic methods by means of which one can accomplish stereospecific polymerization have been discovered quite recently. With the use of these methods, it became possible to synthesize polymers which exhibit an isotactic structure and crystallize readily.

Academician V. A. Kargin, V. A. Kabanov, junior scientific associate; and I. Yu. Marchenko, candidate for a diploma, have developed a catalytic method for the stereospecific synthesis of polystyrene. It was found that crystalline polystyrene has a higher heat resistance, but lower mechanical strength than ordinary polystyrene. To improve the strength of isotactic crystalline polystyrene, this polymer must be oriented. Experiments which have been conducted established that the orientation must be carried out at as low a temperature as possible. However, this temperature must be above the vitrification point. After orientation, the film is heated in the oriented state.

Prof P. V. Kozlov; V. A. Kabanov, junior scientific associate; and A. A. Frolova, candidate for a diploma, investigated the deformation of crystalline polyethylene terephthalate films. It was found that, after a film of this type has been stretched, destruction of crystals takes place and that this destruction is followed by recrystallization. When the crystalline film was heated and then stretched at some temperature above the vitrification point, recrystallization with the formation of

spherolites took place and the film became opaque. The result obtained demonstrated that, in order to obtain crystals which are rigidly oriented with respect to the field of mechanical force, one must stretch the amorphous film at a low temperature and then heat it above the temperature of vitrification. By this method, films with advantageous mechanical characteristics are produced which are devoid of spherolites.

Work is being done at the chair on the mechanism of the formation of polymers with a regular structure. Methods for obtaining new catalysts which will make it possible to synthesize such polymers are being developed.

A major part of the work done at the chair is concerned with the investigation of the properties of block and graft polymers and comparision of these properties with those of the individual polymer components. The purpose of this research is to establish in what manner the properties of the components are transferred to copolymers prepared by different methods and how the length of chains affects the properties of copolymers. Investigation of the mechanical characteristics of copolymers and of their properties in solution is of great interest. Different methods are used for the preparation of copolymers. The mechanochemical method, applied for the synthesis of block copolymers involves subjecting the polymer to mechanical destruction in the absence of oxygen. As a result of the action of the mechanical force which is applied, the macromolecules are torn and macroradicals are formed from them. When radicals of different species combine, block copolymers are formed.

Another method for the synthesis of block copolymers involves mechanical destruction of polymers swollen in vinyl monomers. The macroradicals that are formed initiate polymerization of the monomers with the result that graft and block copolymers are formed. This method is convenient for industrial application, but requires careful fractionation.

The synthesis of copolymers can also be accomplished by applying purely chemical methods. Active groups (peroxide or hydroperoxide groups) are formed that are bound to the polymers by strong covalent bonds. These groups are capable of initiating polymerization of monomers with the result that copolymers are formed.

N. A. Plate, junior scientific associate, and I. I. Konoreva, candidate for a diploma, synthesized a graft copolymer by ozonizing an aqueous suspension of starch and polymerizing styrene on the starch activated in this manner. The graft copolymer which was obtained in this manner proved to be good emulsifying agent. It forms emulsions stable toward both water and oil. At temperatures higher than 80°, the polymer softens, notwithstanding a content of starch in it amounting to 60%; it undergoes deformation of a highly elastic type and does not flow at temperatures lower

than that of chemical decomposition because of the effect exerted by the rigid starch molecules. Investigation of the properties of this copolymer confirmed that the characteristics of graft polymers are as a rule additive and represent a sum of the properties of the components from which they are formed.

A block copolymer of epoxy resin with nitrile rubber, which was prepared by A. Dobrynina, was found to exhibit an elasticity typical for rubber. At the same time it was harder and had a higher mechanical strength than rubber. This copolymer exhibited a high stability to oil and a high degree of adhesion.

This investigation also proved that the principal characteristics of block and graft polymers are derived additively from the properties of the components. By virtue of this rule, unlimited possibilities are open to the polymer industry as far as development of products with predetermined properties is concerned. At present work is being conducted on the use of new monomers for the production of graft polymers. Furthermore, attempts are being made to graft organic polymers onto inorganic residues such as salts and carbon black.

N. A. Plate and L. Dudnik synthesized a new polymer, namely, polybicycloheptadiene, which exhibits a high thermal stability: it does not yet melt at temperatures higher than 350°. The monomer for the synthesis of polybicycloheptadiene was obtained from petroleum at the Institute of Organic Chemistry, Academy of Sciences USSR.

X-ray diffraction analysis, electron microscopy, and electrochemical methods are used in the investigation of the structure of polymers. The shape and structure of polymer molecules, specifically molecules of electrolyte polymers (e.g., polyacrylic acid and its salts, copolymers of methacrylic acid with methylmethacrylate, polyvinyl alcohol, and polyacrylamide) are being investigated. The formation of molecular structures is also subjected to study. Of great importance is the investigation of synthetic polymers representing models of biological polymers and of the structural changes which take place in them under the effect of various factors.

With the aid of electron microscopy, N. F. Bakeyev and Kh. Vergin established a theoretically important relationship concerning the formation of secondary structures. According to a concept advanced by V. A. Kargin, A. I. Kitaygorodskiy, and G. L. Slonimskiy, polymers have a bundle structure. Vergin's experimental work confirmed the accuracy of this idea. By using an electron microscope, it could be established that bundles of molecules are present in dilute solutions of polymers. It was shown that high-polymer electrolytes may give rise to two types of structure, a globular and a fibrillar. For instance, salvarsan gives rise to a geometrically regular structure when present in the amorphous state.

The structure of amorphous polymers can be regarded as formed by a system of regularly arranged molecular bundles. S. Ya. Mirlina, senior scientific associate, and Yu. Nagornaya, candidate for a diploma, investigated changes in the electrical conductivity of high-polymer electrolytes as affected by their orientation. Important relationships were established in regard to these changes, which depend on the shape of the macromolecules and the density of their packing.

The work of the Chair of High-Molecular Compounds is closely coordinated with that of other chairs of Moscow State University. Its activities involve collaboration with the Chair of Physics of the Solid State at the Physics Faculty, the Chair of Biophysics and Biochemistry, etc.

Some of the work being done is carried out jointly with the institutes of the Academy of Sciences USSR and institutes under the ministries, e.g., the Physicochemical Institute imeni L. Ya. Karpov, the Institute of Synthetic Fibers, the Petroleum Institute, the Cinephoto Institute, the Chemicopharmaceutical Institute, etc.

12. Work on Polyester Urethane Films at the Moscow Chemicotechnological Institute

"Polyester Urethane Films," by I. P. Losev and L. A. Datskevich; Moscow, Byulleten' Tekhniko-Ekonomicheskoy Informatsii, No 8, Aug 58, pp 10-11

At the Chair of Technology of High-Molecular Compounds, Moscow Order of Lenin Chemicotechnological Institute imeni D. I. Mendeleyev, polyester urethanes have been synthesized by interacting diisocyanates with high-molecular polyesters derived from dicarboxylic acids and glycols. A distinguishing characteristic of the polyester urethanes is the presence of free hydroxyl groups in the polyester molecules.

Polyester urethanes can be synthesized with the use of a solvent or without a solvent. Polyester urethanes produced in the manner described are stable up to temperatures of plus 90° and down to minus 50-65°. The stability at high temperatures can be increased by using aromatic compounds as initial materials. However, the elasticity of the films is considerably reduced thereby. The films have a tensile strength of 150-350 kg per square centimeter. The tensile strength can be increased to 800-850 kg per square centimeter if the film have been oriented by applying a load of 5 kg. The polyester urethane films are suitable as a material for gaskets stable to the action of organic solvents and as a substitute for special rubber resistant to the action of organic solvents.

Polyester urethanes have a lower specific weight than solvent-resistant types of synthetic rubber. A polyester urethane adhesive has been developed which is suitable for gluing together polyurethane films, so that different articles can be produced from them and these films used as a leather substitute. Polymers of this type can be rolled similarly to polyvinyl chloride, except that no plasticizer should be used.

Isotopes

13. Selective Effect in the Reaction of Hydrogen and Tritium With Some Metal Oxides

"The Kinetic Isotopic Effect in the Reaction of Hydrogen and Tritium With Some Metal Oxides," by V. A. Shushunov and B.Ya. Andreyev, Chemistry Scientific Research Institute, Gor'kiy State University imeni N. I. Lobachevskiy; Moscow, Doklady Akademii Nauk SSSR, Vol 121, No 4, Aug 58, pp 689-692

Among the metal oxides investigated in the work reported in this instance, those of one group (Group I: Ag_2O, Cu_2O, CuO, HgO, PbO_2, MnO_2, and Fe_2O_3 -- ferric oxide in the high-temperature range) react with hydrogen faster than with tritium whereas those of another group (Group II: Mn_3O_4, Mn_2O_3, NiO, CoO, Fe_3O_4, and Fe_2O_3 -- ferric oxide in low-temperature range) show a faster rate of reaction with tritium than with hydrogen. The kinetic isotopic effect ($\delta = k_1/k_2$) is greater than unity for oxides of Group I and smaller than unity for oxides of Group II.

The reaction $HT + H_2O \rightleftharpoons HTO + H_2$ may take place because of the catalytic effect produced by the oxides or the metals formed from them and affect the results obtained in regard to the kinetic isotopic effect in the reduction. It was established that the reaction formulated above is catalyzed rather weakly by oxides of the first group and the metals corresponding to them. On the other hand, the oxides of the second group and the metals formed from them were found to exert a pronounced catalytic effect in accelerating this reaction. However, the effect of the interfering reaction could be eliminated by removing rapidly from the reaction sphere the water that had formed. The fact that the reaction of tritium exchange with water did not play a significant role under the experimental conditions applied was confirmed by the results obtained in an investigation of the reduction of the metal oxides with hydrogen and deuterium. It was found that reduction of oxides of the first group proceeds 1.4-1.8 times faster with hydrogen than with deuterium and reduction of oxides of the second group 1.4-1.6 times faster with deuterium than with hydrogen.

On the basis of the temperature coefficients of $\partial\lambda$, the energies of activation of the reduction with hydrogen (E_1) and of the reduction with tritium (E_2) were calculated.

It was found that the nature of the oxide has a rather strong effect on E_1-E_2 in the first group and an insignificant effect in the second group. From oxides of the first group, $E_1 < E_2$ and $\partial\lambda$ drops with increasing temperatures. For oxides of the second group, $E_2 < E_1$ and $\partial\lambda$ rises as the temperature goes up. An anomalous dependence of $\partial\lambda$ on the temperature was observed in the cases of silver oxide and iron oxides.

14. Distribution of Deuterium in Isotopic Exchange Between Water and Thiols

"Coefficients of the Equilibrium Distribution of Deuterium in Isotopic Exchange Between Water and Some Thiols," by K. I. Sakodynskiy, S. I. Babkov, and N. M. Zhavoronkov, Corresponding Member, Academy of Sciences USSR; Moscow, Doklady Akademii Nauk SSSR, Vol 121, No 4, Aug 58, pp 681-684

The coefficients of equilibrium distribution of deuterium at 20-80° between water and n-butylthiol, water and sec-butylthiol, water and isoamylthiol, water and n-hexylthiol, and water and thiophenol were determined. They were found to lie in the range of 1.80-2.46. The temperature dependence of the coefficients of equilibrium distribution ($\partial\lambda$) was determined from data plotted in the $\lg\partial\lambda$ -1/T system of coordinates. Using the relationship between $\partial\lambda$ and the equilibrium constant of the reaction K formulated by A. I. Brodskiy, the heats of the reactions of deuterium exchange between water and the thiols ($-\Delta H$) were calculated and found to be equal to 600-1,200 calories per mol. On the basis of the data that were available, no correlation between the value of $\partial\lambda$ and the size and structure of the hydrocarbons radicals could be found.

Organic Chemistry

15. Organoboron Compounds

"Organoboron Compounds. Report No 24, The Action of Acetic Acid and Acetic Anhydride on Phenylboron Dichloride and Diphenylboron Chloride," by B. M. Mikhaylov and N. S. Fedotov, Institute of Organic Chemistry imeni N. D. Zelinskiy, Academy of Sciences USSR; Moscow, Izvestiya Akademii Nauk SSSR, Otdeleniye Khimicheskikh Nauk, No 7, Jul 58, pp 857-859

As a result of the investigation which has been carried out, the following conclusions were derived:

"1. Phenylpyroboric acetic anhydride is obtained by the action of acetic acid or acetic anhydride on phenylboron dichloride.

"2. Diphenylboron chloride reacts with acetic anhydride, forming diphenylboric acetic anhydride.

"3. As a result of the action of acetic acid on diphenylboron chloride, diphenylboric acetic acid is formed initially. Later, it is converted by the action of acetic acid, to phenylpyroboric acetic anhydride.

"4. Para-chlorphenylboron dichloride reacts with acetic acid, forming para-chlorophenyl pyroacetic anhydride."

"Organoboron Compounds. Report No 25, Concerning the Action of Organic Acids on the n-Butyl Ester of n-Propylchloroboric Acid," by B. M. Mikhaylov and T. A. Shchegoleva, Institute of Organic Chemistry imeni N. D. Zelinskiy, Academy of Sciences USSR; Moscow, Izvestiya Akademii Nauk SSSR, Otdeleniye Khimicheskikh Nauk, No 7, Jul 58, pp 860-865

On the basis of the investigation reported, the following conclusions were derived:

"1. The n-butyl ester of n-propylboric acid, n-propylpyroboric acetic anhydride, butyl chloride, and the butyl ester of acetic acid are formed by the action of acetic acid on the n-butyl ester of n-propylchloroboric acid.

"2. The n-butyl ester of n-propylchloroboric acid, n-propylpyroboric propionic anhydride, butyl chloride, and the butyl ester of propionic acid are formed by the action of propionic acid on the n-butyl ester of n-propylchloroboric acid.

"3. The mechanism of the reaction between organic acids and the ester of n-propylchloroboric acid was clarified.

"4. The n-butyl ester of n-propylboric acid reacts with acetic anhydride in the presence of hydrogen chloride, forming n-propylpyroboric acetic anhydride, the butyl ester of acetic acid, butyl chloride, and acetyl chloride."

"Preparation of the Bromides of Organoboron Compounds From the Esters of Organoboric Acids and Organoboron Chlorides," by B. M. Mikhaylov, A. N. Blokhina, and N. S. Fedotov, Institute of Organic Chemistry imeni N. D. Zelinskiy, Academy of Sciences USSR; Moscow, Izvestiya Akademii Nauk SSSR, Otdeleniye Khimicheskikh Nauk, No 7, Jul 58, pp 891-893

The following conclusions were derived on the basis of the work described:

"1. Diphenylboronbromide and the isobutyl ester of phenylbromoboric acid are formed by the action of phosphorus pentabromide on the isobutyl ester of diphenyl boric acid.

"2. The isobutyl ester of phenylbromoboric acid is prepared by the action phosphorus pentabromide on the diisobutyl ester of phenylboric acid.

"3. Diphenylboronbromide and phenylborondibromide are formed, respectively, by the action of hydrogen bromide on diphenylboron chloride or phenylboron dichloride."

16. Some Phosphinic Acid Polyesters

"Investigations in the Field of Organophosphorus Polymers. Report No 4, On Polyesters of Certain Phosphinic Acids and Hydroquinone," By V. V. Korshak, I. A. Gribova, and M. A. Andreyeva, Institute of Organoelemetal Compounds, Academy of Sciences USSR; Moscow, Izvestiya Akademii Nauk SSSR, Otdeleniye Khimicheskikh Nauk, No 7, Jul 58, pp 880-885

The polyesters of methylphosphinic, phenylphosphinic, phenoxyphosphinic, para-nitrophenoxyphosphinic, para-methoxyphenoxy-phosphinic acids and hydroquinone were synthesized. It was shown that the nature of the substitutent at the phosphorus atom has a noticeable effect on the properties

of the polyesters. The introduction of an aromatic group into the polymer chain leads to the formation of products that are solid, as distinguished from analogous polymers obtained from aliphatic glycols. Investigation of the binary systems over the entire range of compositions indicated that a copolymer with a definite composition has the minimum melting point.

17. The Structure of the Products of Some Reactions Leading to Organophosphorus Compounds

"Concerning the Structure of the Products of the Reaction of Certain Alpha-Halogen-Ketones of the Carbocyclic Series With Triethylphosphite and Sodium Diethylphosphite," by Academician B. A. Arbuzov, V. S. Vinogradova, and I. A. Polezhayeva, Scientific Research Chemical Institute imeni A. M. Butlerov at Kazan' State University imeni V. I. Ul'yanov-Lenin; Moscow, Doklady Akademii Nauk SSSR, Vol 121, No 4, Aug 58, pp 641-643

The authors present data concerning the structure of the products of the reaction of triethylphosphite or sodium diethylphosphite with alpha-chlorocyclohexanone, alpha-chloro-alpha-methylcyclohexanone, alpha-chlorocyclopentanone and bromopyruvic acid ester. The complex reactions which are presented in the text led to the formation of unsaturated esters of phosphoric acid, esters of epoxyphosphinic acids, and, in some instances, esters of beta-ketophosphinic acids -- depending on the nature of the halogen, the conditions of the reaction, and the substituted alkyl radicals.

18. The Synthesis of Di-beta, beta'-chloroethyl Ester of Vinylphosphinic Acid

"The Problem of the Synthesis of the Di-beta,beta'-chlorethyl Ester of Vinylphosphinic Acid," by Ye. L. Gefter, Scientific Research Institute of Plastics; Moscow, Zhurnal Obshchey Khimii, Vol 28, No 9, Sep 58, pp 2500-2502

One of the lesser-studied compounds of the ester series of vinylphosphinic acid is the di-beta,beta'-chlorethyl ester, a compound first synthesized by M. I. Kabachnik which at present has good prospects for industrial applications. However, the Kabachnik method has several shortcomings which prompted the author to suggest the following method; a mixture of the di-beta,beta'-chloroethyl ester of beta-chloroethylphosphinic acid and triethylamine (in a molecular ratio of 1:1.02) is slowly heated while being agitated in benzene. The triethylamine hydrochloride precipitate is easily removed and the di-beta,beta'-chloroethylvinylphosphinate obtained (after the benzene has been distilled off) by fractionation in vacuum. The yield is approximately 70% of the theoretical. The di-beta,beta'-chlorethyl ester of beta-chlorethylphosphinic acid was prepared by a method described earlier by the author.

19. Some New Organophosphorus Insecticides

"New Results in the Field of Phosphate Ester Insecticides," by Gyorgy Matolcsy, Plant Protection Research Institute; Budapest, Magyar Kemiai Folyoirat (Hungarian Journal of Chemistry), No 7-8, Jul/Aug 58, pp 304-305

"Several new types of phosphate ester insecticides were synthesized. The esters synthesized belonged to the following groups: 0,0-dialkyl-S-thiocarbamyl-thiophosphate; 0,0-dialkyl-S-xanthogenyl-thiophosphates; 0,0-dialkyl-0-(S-thiocarbamylmercaptoethyl)-thiophosphates; 0,0-dialkyl-0-(S-dialkylthiophosphoryl-mercaptoethyl)- thiophosphates; 0,0-dialkyl-0-(S-xanthogenyl-mercaptoethyl)-thiophosphates; 0,0-dialkyl-0-(S-dialkylthiophophoryl-mercaptomethyl)-thiophosphates; 0,0-dialkyl-S-(alpha-furyl-beta-carbethoxy-ethyl)-dithiophosphates; and 0,0-dialkyl-S-(alpha-furyl-beta-acetyl-ethyl)-dithiophosphates. The method of synthesis is illustrated by the equations accompanying the text."

Radiochemistry

20. The Effect of Radiation on the Rate of Isotope Exchange

"Concerning the Effect of Radiation Emitted by Radioactive Substances on the Rate of Isotope Exchange," by V. I. Spitsyn and I. Ye. Mikhaylenko; Moscow, Atomnaya Energiya, Vol 5, No 4, Oct 58, pp 463-464

The effect of beta-radiation emitted by S^{35} on the rate of isotopic exchange of sulfur in the system $K_2 S^* O_4 - SO_3$ at high temperatures was investigated. Two samples of potassium sulfate containing different quantities of the radioactive isotope S^{35} were used. The results obtained, which are discussed in detail, indicate that the effect brought about by radiation is not ordinary radiation-chemical decomposition of potassium sulfate. It is to be assumed that the beta-particles emitted by S^{35} produce excitation and additional ionization of sulfate anions in the potassium sulfate lattice. The sulfate ion, on being brought to the excited state, enters more actively into isotope exchange -- with sulfuric acid anhydride. It is also possible that the beta-particles bring about ionization of sulfuric acid anhydride molecules in the gas phase. Partial decomposition of the sulfuric acid anhydride results; the products of this decomposition then enter more readily into isotope exchange with potassium sulfate.

[For additional information on radiochemistry, see Item No 8.]

Physical Chemistry

[For information on physical chemistry, see Item No 3.]

III. ELECTRONICS

Communications

21. Self-Activity Amateur Radio Clubs

"Every Possible Help to Self-Activity Clubs" (unsigned article); Moscow, Radio, No 10, Oct 58, pp 2-3

The article contains the following passages:

"At the All-Union Volunteer Society for Cooperation with the Army, Air Force, and Navy (Dosaaf) there is growing and expanding a newly initiated movement for establishing self-activity Dosaaf clubs. Now, that the Dosaaf organizations are struggling to realize the resolutions of its Fourth Conference, i.e., a decided improvement in training of radio experts, widening the network of radio-amateur stations, and raising the experience of amateurs, the self-activity radio clubs are acquiring outstanding significance.

"Each large primary Dosaaf organization must establish its own self-activity radio club.... Responding to numerous suggestions from active members of the society, the Central Committee Secretariat of Dosaaf has ratified the "Charter of Self-Activity Sports Clubs of Dosaaf" which was based on the experience of the best self-activity collectives. This document can and should play a prominent role in large-scale organization of the defense society.

"The charter of self-activity clubs specifically stresses that all the work within the clubs should be based on the principle of broad initiative among its members. And this is quite obvious. All activities of the club collectives, its sections, design groups, and sports teams are carried out by the society members without staff workers; the success of the undertaking will rest solely on their activity."

22. Frequency Modulation and Pulse-Time Modulation

"The Influence on Pulse-Time Modulation by a Frequency Modulation of the High-Frequency Carrier," by R. Ebermann, Institute for High-Frequency Engineering and Electron Tubes, Dresden Technische Hochschule; Leipzig, Hochfrequenztechnik und Elektroakustik, Vol 67, No 2, Sep 58, pp 48-59

A study is made of the shift, with respect to time, of the leading and of the trailing edges of high-frequency pulses, the carrier of which is frequency-modulated. The shift is a result of the dependence of the value of the build-up and decay process on the detuning of the carrier

from the mean frequency of the transmission quadrupole. This shift of the pulse flank is responsible for the cross-talk attenuation, if the pulse is subjected to a pulse-time modulation in addition to the frequency modulation. This cross-talk attenuation can be kept within admissible limits through a proper choice of the frequency deviation. Diagrams are given for single-circuit, two-circuit, and three-circuit filters (Tschebyscheff filter and filters with circuits of equal attenuation) with regard to the influence of the leading edges of the pulses.

23. Radiation of Open Waveguides

"Investigation of the Radiation Behavior of Open Waveguides," by K. E. Mueller, Institute for High-Frequency Engineering and Elektron Tubes, Dresden Technische Hochschule; Leipzig, Hochfrequenztechnik und Elektroakustik, Vol 67, No 2, Sep 58, pp 35-42

Any radiation field, according to the Huygen principle, can be represented by a superpositioning of the partial field strengths produced by elementary radiators. This article discusses an orientation of elementary dipoles to the field strength prevailing in the aperture, this field strength being considered, for the sake of simplicity, a superpositioning of the wave which arrives from the generator and is reflected at the open end, in such a way as to be used to determine the radiation field of the waveguide. A general formula is derived for the computation of the remote field and is applied especially for a rectangular and circular waveguide. The computed radiation diagrams are compared with measurement values for the rectangular waveguide excited by the H_{10} and H_{30} wave. The comparison shows satisfactory agreement.

Radar

24. Automatic Range Scope

"Transient and Steady-State Processes in Automatic Range Scopes," by F. M. Kilin; Moscow, Avtomatika i Telemekhanika, No 10, Oct 58, pp 901-916

Modern radar and navigation aid systems generally incorporate automatic range scopes, which are often called "autorange finders." Automatic-range-scope equations with stepwise-changing variable parameters can be converted generally into a system of discrete equations with a constant coefficient. The solution and analysis of such equations present no difficulty. Conditions were found for which the analysis of automatic-range-scope performance can be reduced to the analysis of an equivalent continuous system.

The article discusses the transient and steady-state processes in an automatic range scope with due consideration of specific peculiarities of its performance, such as discontinuous processes in individual components of the system, variation of circuit parameters, and pulse conversion in the coincidence amplifiers.

Instruments and Equipment

25. Ultraviolet Radiation Meter

"Experiment in Measuring Natural Ultraviolet Radiation," by O. P. Shelkova-Dorf, D. A. Shklover (All-Union Illumination Engineering Institute), and I. F. Yakovleva (Yevpatoriya Bioclimatic Station); Moscow, Svetotekhnika, No 11, Nov 58, pp 20-23

In the summer of 1957 the All-Union Illumination Engineering Institute (VNISI), in conjunction with the Yevpatoriya Bioclimatic Station, conducted the measurement of total and scattered ultraviolet radiation with the aid of a photoelectric registering device developed at VNISI.

An antimony-cesium vacuum phototube having a violet ray transmitting window STsV-6 and a set of filters (λ =290 to 340 millimicrons and λ =340 to 400 millimicrons) was used as an ultraviolet radiation pickup. The power supply to the phototube was taken from two small batteries (GB-80) connected in series. Photocurrent reading was taken with electronic potentiometer EP-100.

In 1958 VNISI and the Institute of Biophysics, Academy of Sciences USSR, were engaged in developing a more precise instrument for measuring ultraviolet radiation which will incorporate photoelectric multipliers. Such an instrument will permit radiation measurement in separate, narrow sections of the ultraviolet spectrum.

26. Semiconductor Bolometers Designed by the Institute of Physics, Academy of Sciences Ukrainian SSR

"Semiconductor Bolometers" by I. D. Konozenko; Moscow, Byulleten' Tekhniko-Ekonomicheskoy Informatsii, No 8, Aug 58, pp 40-41

Semiconductor bolometers have been designed at the Institute of Physics, Academy of Sciences Ukrainian SSR. Semiconductor bolometers, just like metal bolometers, are devices sensitive to infrared radiation. It was established in work done at the institute mentioned that semiconductor bolometers can be used in various fields of science and

technology. In spectroscopic investigations, the 4.22 and 4.28 carbon dioxide bands can be resolved in a reliable manner with their aid. The width of the spectral interval isolated by the monochromator in this work amounts to 0.03-0.04 micron. In addition to their application in spectroscopy, these bolometers can be used for the investigation of radiation emitted by heated objects and measurement of the temperature of heated objects at a distance. They can be used in dosimeters measuring radiation emitted by the Sun, for the control of the temperature of rotating machine parts, etc.

When used for absolute measurements of the total intensity of radiation energy, semiconductor bolometers can be applied in an extensive range of electromagnetic radiation beginning with wave lengths of visible light and ending with a wave length of 25 microns in the infrared region. An appliance has been designed for investigating the radiation characteristics of heated bodies. This appliance consists of an oxide bolometer of the nonvacuum type located in the focus of a spherical mirror and a bridge circuit. This circuit is coupled with a galvanometer. In the case that modulated infrared radiation is used, the input end of an amplifier replaces the galvanometer.

Practical experience showed that the production and use of semiconductor bolometers are much simpler than those of metal bolometers. Because semiconductor bolometers have a high sensitivity and a large resistance, they do not require complex amplifiers or an input transformer.

To satisfy the large demand for semiconductor bolometers on the part of various USSR organizations, the Experimental Production Division of the Institute of Physics, Academy of Sciences Ukrainian SSR, has organized a series production of these devices on a small scale.

27. The von Ardenne Molecular Mass Spectrograph

"The Dresden Molecular Mass Spectrograph," by G. Kukavadze; Moscow, Atomnaya Energiya, Vol 5, No 4, Oct 58, p 476

"At a meeting of the German Physical Society held at Dresden on 27 April 1958, Prof Manfred von Ardenne described a molecular mass spectrograph which he had developed. The principal new part of this spectrograph is an ion source of original design with electron capture.

"In ordinary ion sources applied in mass spectrometry, the ionization of the molecules being analyzed is achieved by electron impacts and is generally accompanied by decomposition of the molecules. The decomposition of complex molecules at the ion source interferes with the molecular analysis.

"Von Ardenne succeeded in eliminating the decomposition of complex molecules into less complex molecules and atoms by designing a novel ion source. He achieved the desired object by compressing the plasma formed under the effect of a low-voltage discharge through the gas being investigated or the vapors of the substance being investigated. The compression is brought about by means of an inhomogeneous magnetic field generated by a nonsymmetric magnetic lens.

"As a result of work which took 10 years, it was possible to eliminate by means of this arrangement the decomposition of molecules and to obtain a sufficient intensity of the ion bundle, notwithstanding the low cross section of electron capture by molecules and the short half-life of the negative ions.

"In consequence of the improvement of the ion source, a precise molecular mass spectrograph was developed which has a high resolving capacity and can be used for the investigation of molecules with mass numbers from 20 to 1,000 without decomposition of these molecules.

"A multilinear spectrum of paraffin was taken in which an unexpected fine structure became apparent.

"The new method apparently makes it possible to investigate organic molecules and macromolecules. It will play a considerable role in chemical research pertaining to petroleum, fuels, and polymers and in work in the field of analytical chemistry."

28. Mass Spectrometers Designed and Produced in the USSR

"USSR Mass Spectrometers," by L. P.; Moscow, Atomnaya Energiya, Vol 5, No 4, Oct 58, pp 474-476

Pribory i Tekhnika Eksperimenta, No 3, 1958, contains an article by workers at the State Union Design Bureau of Analytical Instrument Building in which information on mass spectrometers developed in the USSR and produced by the USSR industry is reviewed. A table on pp 474-475 of Atomnaya Energiya, Vol 5, No 4, October 1958, lists the principal technical characteristics of USSR mass spectrometers. The characteristics of the following mass spectrometers are given in the table:

MI 1301 for the analysis of the isotope composition of gases and easily evaporating substances (supplied by the State Union Design Bureau of Analytical Instrument Building); MI 1303 for the analysis of the isotope composition of gases and vapors of liquids and solid substances (supplied by the State Union Design Bureau of Analytical Instrument Building); MI 1305 for the analysis of the isotope composition of gases and vapors of liquids and solid substances (replaces MI

1301 and MI 1303 -- supplied by the State Union Design Bureau of Analytical Instrument Building); MKh 1302 for the analysis of the isotope and molecular composition of gases and easily evaporating substances (supplied by the State Union Design Bureau of Analytical Instrument Building); MKh 1303 for the analysis of the molecular and isotope composition of gaseous, liquid, and solid mixtures of substances with a vapor pressure higher than 0.5 millimeter of mercury at temperatures no higher than 300°C (developed by the Institute of Chemical Physics, Academy of Sciences USSR, and the State Union Design Bureau of Analytical Instrument Building); MV 2301 for the analysis of the isotope and molecular composition of gases and easily evaporating substances (supplied by the State Union Design Bureau of Analytical Instrument Building); MI 1101 for the rapid analysis of the isotope composition of alkali metals (developed by the Physicotechnical Institute, Academy of Sciences USSR, and the State Union Design Bureau of Analytical Instrument Building).

Also, MI 1306 for the analysis of the isotope composition of microquantities of solid substances and solid substances present in microconcentrations (developed by the State Union Design Bureau of Analytical Instrument Building); MI 5201 for the continuous analysis and indication of different components of complex mixtures of gases under conditions encountered at industrial enterprises (developed by the Academy of Sciences USSR and the State Union Design Bureau of Analytical Instrument Building); MKh 6401 for the analysis of the molecular composition of gases in the mass range of 2-60 (developed by the Western Siberian Affiliate, Academy of Sciences USSR, and the State Union Design Bureau of Analytical Instrument Building); a magnetodynamic mass spectrometer for the analysis of the isotope and molecular composition of gases (developed by the Physicotechnical Institute, Academy of Sciences USSR, and the State Union Design Bureau of Analytical Instrument Building).

29. Distortion in Electron Lens Computed

"Isotropic and Anisotropic Distortion of Weak Magnetic Electron Lenses," by R. Gobrecht, Heinrich Hertz Institute for Oscillation Research, German Academy of Sciences, Berlin-Adlershof; Berlin, Experimentelle Technik der Physik, No 3, 1958, pp 97-109

The distortion of weak magnetic electron lenses is determined by means of a pointwise plotting of an eccentrically oriented anode diaphragm used as an object point which can be rotated out of the optical axis. The total distortion error is divided into isotropic and anisotropic portions and each portion is determined separately. To describe the distortion properties, a distortion factor V is defined, which relates the magnification β to the magnification β_0 within the Gauss dioptic, when abaxial beams are used. The value of the aberration, or Seidel coefficient, is computed from the measurements.

Components

30. Cathode-Grid Vacuum Tubes

"New Tubes for Wide-Band Amplification," by B. Govorov and V. Rachenko; Moscow, Radio, No 10, Oct 58, pp 54-57

The 6Zh20P, 6Zh21P, and 6Zh22P pentodes with supplementary cathode grid and possessing superior characteristics were recently developed in the USSR. These new pentode tubes have an additional grid placed between the cathode and control grid, to which a positive potential with respect to the cathode is applied. This sixth electrode is called the cathode grid.

Electrons emitted from the cathode, while traveling in the accelerating field of the cathode grid, will be in part attracted to the cathode grid and others will enter the space between cathode grid and control grid. The electrons thus entering into the retarding field of the control grid begin to lose some of their velocity and form an electron cloud at the surface of the control grid. This electron cloud, being a source of electrons for the plate circuit and screen grid, is called the virtual cathode. Small spacing between the virtual cathode and control grid and a greater spacing between the control grid and cathode grid result in a high value of transconductance and low input capacitance, i.e., high Q-factor.

The cathode-grid tubes can be used in video amplifiers, "traveling wave" amplifiers, and wide-band resonance amplifiers. These tubes can be used also single-grid frequency converters.

Computers and Automation

31. Soviet Computers in Science and Engineering

"Mathematical Machines and Their Significance to Science and the National Economy," by V. I. Loskutov, Moscow, Priborostroyeniye, No 11, Nov 58, pp 8-12

"In the Soviet Union unique differential analyzer, was built -- the most powerful in the world, incorporating 24 integrators and characterized by a high degree of automation of all of its units."

This machine was installed at Kiev University and has since been successfully solving problems related to investigations in the field of science and engineering. At present, Soviet industry has mastered series production of specialized analog computers, linear and nonlinear models designated IPT-4, IPT-5, MPT-9 MPT-11, MN-5, MN-8, and others, capable of investigating dynamic systems and other processes described by differential equations of the order 6 to 32.

"An illustration of the effectiveness of such type machines is the matrix-type electrointegrator EI-1, which is capable of solving problems connected with efficient exploitation of oil fields. This machine has a matrix of electric resistors and capacitors placed at 20,000 points, and is thus a unique machine of this class.

"The development of universal digital computers is at present directed toward increased calculating speed, expansion of storage capacity, improvement of logical capabilities of the machine, incorporation of more stable elements, and reduction of their size and power consumption. All these tendencies are vividly reflected in two new machines, the prototypes of which will soon be completed.

"One of these will be universal digital computer intended for installation at large computing centers and will be used for investigation and calculation of complex scientific and engineering problems. Its calculating speed will be 20,000 operations per second. The circuit of the machine will incorporate a series of storage units: internal storage with ferrite capacity for 2,047 numbers, intermediate storage with three magnetic drums each having a capacity for 4,096 numbers, and external strage with four magnetic tapes having total storage capacity for 100,000 numbers.

"Simultaneously, work is being conducted on a second universal digital computer intended for investigation and calculation of complex problems at scientific research institutes and design establishments. The control unit and arithmetic unit of this machine will be built with circuits incorporating transistors and semiconductor diodes. The capacity of internal ferrite storage will be 2,048 forty-column binary digits or 4,096 commands. The external storage will consist of two magnetic tape units each holding 70,000 forty-column digits.

"The new machine will operate with a speed of 2,000-2,500 single-address operations per second and will be one of the first models of a small-size universal digital computer built with circuits incorporating transistors, ferrites, and miniature radio tubes."

32. Ferromagnetic Resonance at Low Temperature

"Ferromagnetic Resonance in Certain Ferrites at Low Temperature," by N. I. Krivko, Leningrad Physicotechnical Institute, Academy of Sciences USSR, Moscow, Zhurnal Tekhnicheskoy Fiziki, No 8, Aug 58, pp 1703-1710

This article presents basic findings on ferromagnetic resonance behavior at low temperature and frequency range of about 9.4×10^9 cycles. The investigation of ferromagnetic resonance has acquired great practical significance in the light of the recent development of high-frequency and superhigh-frequency radio engineering.

Polycrystalline ferrites $NiO \cdot ZnO \cdot Fe_2O_3$ and $Li_2O \cdot ZnO \cdot Fe_2O_3$ with variable molar ratio of their components were examined. The basic resonance parameters according to Pil'shchikov's formula and the extremums of the absorption and dispersion curves were determined. A considerable reduction of the spectroscopic desintegration factor for certain ferrites during the transition from 290°K to the temperature of liquid helium (4.2°K) was observed. The relaxation time had but a slight temperature dependence throughout the whole range up to the temperature of liquid helium.

Theoretical explanation of some of these phenomena can be based on the fact that pronounced disturbances of spin dipole interaction can exist in the actual ferrite lattice. An interesting phenomenon observed was decrease of g-factor with decrease in temperature for the following: 16.7% NiO, 37.3% ZnO, 46% Fe_2O_3; 18% NiO, 42% ZnO, 40% Fe_2O_3 and 20% Li_2O, 80% Fe_2O_3.

The author thanks A. P. Komar, N. M. Reynov, and L. E. Gurevich for assistance given in this research.

33. Pulse-Operated Hydroacoustic Transducers

"The Determination of the Directional Characteristic and Efficiency of Pulse-Operated Hydroacoustic Transducers," by H. Markgraf and G. Spengler, German Office for Measurement and Weight, Berlin; Leipzig, Hochfrequenztechnik und Elektroakustik, Vol 67, No 2, Sep 58, pp 64-67

This article describes research directed toward finding the determinative electroacoustic properties of hydroacoustic transducers which operate as pulsed transmitters. These properties are derived from the directional characteristic and efficiency of a transducer The directional characteristic was recorded with the aid of a special underwater microphone; a new type of calorimetric measuring device was used to determine the efficiency. The measurement accuracy was less than plus-minus 4 percent. The tests were conduction at the Laboratory for Acoustics, Physicotechnical Central Institute, German Office for Measurements and Weight.

IV. ENGINEERING

34. New Power Presses

"Conformity," by S. Sinel'nikov; Moscow, Izobretatel' i Ratsionalizator, No 10, Oct 58, pp 16-18

This article contains the following passages:

"Recently, we decided to make another step forward by building a 75,000-ton press which will have no equal. The design of such a press was undertaken by the Central Scientific Research Institute of Technology and Machine Building (TsNIIIMash). The institute's Laboratory of Press-Forging Equipment under the direction of Rozanov has successfully accomplished the undertaking. The construction of these unique giants has begun. It is clear that when they are put into operation the Soviet Union will take first place in the world in regard to the power capacity of presses, although the Americans have also begun the erection of a giant of almost 70,000 tons."

"In the meantime, modern technology has set forth new demands. TsNIIIMash has accepted the challenge and has again entrusted Rozanov with the problem of design. In the winter of 1956 the Scientific Council of the institute was already in a position to examine the sketch drawings of a 150,000-ton supergiant. It was originally expected that the discussion would be confined to the details, since it was assumed that the basic design could not raise any doubts because all the recent, profitable experience was fully taken into consideration. However, it turned out to be otherwise. Certain experts have criticized the design in its principle."

35. Superlong-Distance Electric Power Transmission Lines

"Economy of Long-Distance and Superlong-Distance Electric Transmission Lines Operating on DC and AC," by N. N. Krachkovskiy, Moscow; Elektricheskiye Stantsii, No 10, Oct 58, pp 64-70

The article contains the following passages:

"In the Soviet Union, at present, 500,000-v tension is introduced as a rated voltage for long-distance electric power transmission; such a voltage is well suited to the requirements of the Unified Power System (YeES), which is now being created in the European part of the USSR.

"In conjunction with the existence of tremendous resources of very cheap hydraulic power in Eastern Siberia, as well as great resources of low-cost coal mined in open pits, the problem of transmitting large amounts of electric power from Siberia to the European USSR, in particular to the Urals, a distance of 2,000-2,500 km, is now being given full consideration."

"In a series of recently conducted works, the technical feasibility of transmitting electric power to such great distances with 500- to 600-kv, three-phase AC was conclusively proved; however, the cost of transmission becomes high and a question arises as to the expediency, on the whole, of the construction of such superlong-distance electric transmission lines. The use of 800- to 1,200-kv direct current might substantially lower the cost of power transmission."

"Technical-economical comparison of electric power transmission by means of direct or alternating current for any predetermined capacity and distance can give only a limited answer and will not permit any general conclusion as to the advantage of any method."

The author proceeds with the discussion of several specific cases of predetermined power capacity and distance of a power line.

36. New Method of Testing High-Voltage Circuit Breakers

"Simulation Method of Testing High-Voltage Circuit Breakers," by V. V. Kaplan, V. M. Nashatyr', and V. L. Ivanov, Moscow, Elektrichestvo, No 11, Nov 58, pp 29-35

In 1957 the Laboratory of High-Voltage Engineering imeni Gorev of the Leningrad Polytechnic Institute designed and built a circuit which can test the performance of a fast-operating automatic reclosing switch using the simulation method. The testing installation consists of two oscillatory circuits tuned to the industrial frequency. Actual testing of automatic reclosing switches with the aid of this simulation circuit was carried out at the laboratory.

Oscillograms of the performance of automatic reclosing switches were taken with a moving-coil oscillograph and cathode-ray tube oscilloscope. The oscillograms have shown that the developed synchronizing device permits very precise adjustment of the testing installation. This new testing installation can solve the most complex problems by applying the simulation method. Conditions equivalent to actual conditions were set up to check the commutation capability of automatic reclosing circuit breakers. The testing circuit is capable of reproducing conditions for any ratio of reclosing and recovery voltages.

37. Solutions of Second Order Ordinary Differential Equations Expressed in Terms of an Asymptotic Expansion in Banach Spaces

"Asymptotic Expansion of Solutions of Second Order Ordinary Differential Equations in Banach Spaces," by L. A. Groza, Novosibirsk Institute of Engineers of Geodesy, Aerial, Surveying and Cartography; Moscow, Doklady Akademii Nauk SSSR, Vol 121, No 6, Aug 58, pp 963-966

This work concerns an investigation of the behavior of the solutions of differential equations of the second order as ϵ approaches zero, ϵ, greater than zero, being a small parameter multiplier of the highest derivative y ''.

The article's introduction reads as follows:

"Let Y be a Banach space with the elements multiplied by real numbers. Let the function $f(\epsilon) \in Y$ (ϵ real) be given in a particular neighborhood of the point $\epsilon = 0$. Let the series

$$c_0 + c_1\epsilon + c_2\epsilon^2 + \ldots + c_n\epsilon^n + \ldots, \tag{1}$$

where $c_n \in Y$, be such that for any fixed n

$$\lim_{\epsilon \to 0} \left\| \frac{f(\epsilon) - (c_0 + c_1\epsilon + c_2\epsilon^2 + \ldots c_n\epsilon^n)}{\epsilon^n} \right\| = 0. \tag{2}$$

Then we will say that (1) serves as an asymptotic expansion of $f(\epsilon)$ and describe that by:

$$f(\epsilon) \sim \sum_{n=0}^{\infty} c_n\epsilon^n. \tag{3}$$

By an arbitrary choice of the elements $c_0, c_1, \ldots, c_n, \ldots \in Y$ it is possible to construct a function $f(\epsilon) \in Y$, for which (3) is satisfied.

"Next the equation $\epsilon y'' + y' + Ay = 0$ is considered where $\epsilon > 0$ is a small parameter; $y(x, \epsilon) \in Y$; A is any linear, bounded operator mapping the space Y into Y, ie, $A \in \{Y \to Y\}$. We will consider the solution of equation (4) on an arbitrary fixed segment $[x_0, x_1]$ $(x_0 < x_1)$ of the OX axis. Multiplying (4) by ϵ and introducing the notation $\epsilon y' = y^{[1]}$, $\epsilon^2 y'' = y^{[2]}$, we can place the equation in the form

$$A(y) = y^{[2]} + y^{[1]} + \epsilon Ay = 0. \tag{5}$$

(4)

"The set of all possible polynomials of the form $a_0 + a_1A + a_2A^2 + \ldots + a_sA^s$, where $a_0, a_1, \ldots, a_s$ are any real numbers and s is any natural number, is designated by $\{A^s\}$. On the strength of the completeness of the space Y we may close the space $\{A^s\}$ and obtain a commutable Banach algebra $\{\overline{A^s}\}$.

"In addition to the equation (5), the equation

$$A(\bar{y}) = \bar{y}[2] + \bar{y}[1] + \mathfrak{C}_A \bar{y} = \bar{\theta} \quad (6)$$

was considered in the space $\{\overline{A^s}\}$."

38. New Formulas for Use in Aerotriangulation

"The Correction of the Three-Dimensional Aerotriangulation Made With Stereo Instruments," by V. Pavlov, Leningrad; Berlin, Vermessungstechnik, No 11, Nov 58, pp 246-250

This article on aerial strip surveying discussed the influence of systematic errors in the mutual orientation and conjunction of a model on the falsification of the point coordinates of a three-dimensional aerotriangulation. In the derivation of the formulas, the following has been assumed: flat land, straight line of flight, constant lengthwise overlap, and regular location of the orientation points. The aerotriangulation conducted for the study made use of f = 100-mm images on two C-5 stereoplanigraphs. The following conclusions are drawn on the basis of the study:

"1. Of the methods of correcting for the distortion of the model of a strip, the method employing the newly derived formulas is equally as good as the traditional method, when the partial models are extended to 12 or 13 in number.

"2. Correcting for the distortion of the model in accordance with the new formulas leads to an improvement of accuracy by a factor of 1.5-2 over the traditional formulas, when the strip is extended further (more than 13 partial models).

"3. In correcting for the distortion of the model of a strip by the use of traditional formulas for a surface of the second order, the use of an excessive number of points of minor control leads only to an insignificant improvement of accuracy in the determination of the point coordinates."

39. On Finding the Saturation Class in Gelder's Method of Summing Fourier Series

"Concerning the Saturation Class for Gelder's Method of Summing Fourier Series," by A. Kh. Turetskiy, Belorussian State University imeni V. I. Lenin; Moscow, Doklady Akademii Nauk SSSR, Vol 121, No 6, Aug 58, pp 980-983

The author's introduction to the problem and a statement of the results follow:

"Let $f(x)$ be a continuous periodic function of period 2π and $a_0 + \sum_{k=1}^{\infty} (a_k \cos kx + b_k \sin kx)$ be its Fourier series. We shall designate by γ the process of summing this series, determined by the sequence of constants γ_k^n $(k = 1, \ldots, n;\ n = 1, 2, \ldots)$, that is, γ is the process approximating the function $f(x)$ with the help of trigonometric polynomials of the sequence

$$P_n^{\gamma}(x) = a_0/2 + \sum_{k=1}^{n} \gamma_k^n (a_k \cos kx + b_k \sin kx).$$

"J. Favard (Bull Sci. Math., 61, 209, 1937) presented the following conclusion: to give the process of summing γ it is necessary to determine the class of functions for which this process is the best.

"M. Zamansky (Ann. Sci. Ecole Norm. Sup. [3], 66, 19, 1949) made the statement of the problem of Favard more precise and introduced the concept of the saturation class for the given method of summing. He defined, this concept in the following manner: If there exists an increasing function $\varphi_\gamma(n)$ such that for any continuous periodic function $f(x)$, of period 2π, different from a constant, and any natural n the max $\varphi_\gamma(n) \left| P_n^{\gamma}(x) - f(x) \right| > a$ where a, another constant, is greater than zero and dependent on f, then we will say that the process of summing γ is saturated. The set of continuous periodic functions of period 2π, different from a constant and such that

$$\left| P_n^{\gamma}(x) - f(x) \right| = O\left(\frac{1}{\varphi_\gamma(n)}\right)$$ we will call the saturation class pertaining to the process γ."

The results of the work are in the form of four theorems which are stated below.

"Theorem I. Let τ, a process of summing, be given defined by the sequence of constants τ_k^n ($k = 1, \ldots, n$; $n = 1, 2, \ldots$) and let there exist a nonnegative function of the natural argument $\psi(n)$ such that $\lim_{n\to\infty} \psi(n) = 0$, and let

$$1 - \tau_k^n \sim C_k \psi(n),$$

for every fixed k, where C_k, greater than or equal to zero, is a constant depending on k. Then the process τ is saturated with an approximate saturation of order $\psi(n)$.

"Theorem 2. In order that the best approximation $\mathcal{E}_n(f)$ of the periodic function f(x) of period 2π by trigonometric polynomials of order not greater than n ($n = 2, 3, \ldots$) satisfy the condition

$$\mathcal{E}_n(f) = O\left(\frac{\ln^{r-1} n}{n}\right),$$

it is necessary and sufficient that a constant A, greater than zero, exists, and is such that for all real values of x and the values of h from the interval $0 \leq h \leq 1/2$ the following condition

$$\left| f(x+h) + f(x-h) - 2f(x) \right| \leq Ah \left| \ln \right|^{r-1} \text{ is satisfied.}$$

"Theorem 3. In order that $\left| H_n^2(x) - f(x) \right| = O\left(\frac{\ln n}{n}\right)$, it is necessary and sufficient that the integral

$$\int_{\epsilon}^{1/2} \left(1 - \frac{\ln t}{\ln \epsilon}\right) \frac{f(x+t) + f(x-t) - 2f(x)}{t^2}\, dt$$

be uniformly bounded relative to x and $\epsilon > 0$.

"Theorem 4. In order that $\left| H_n^3(x) - f(x) \right| = O\left(\frac{\ln^2 n}{n}\right)$, it is necessary and sufficient that the integral

$$\int_{\epsilon}^{1/4\varphi'(t)} \frac{1}{t^2} \left[\left(1 - \frac{\ln t}{\ln \epsilon}\right)^2 + \frac{2(C + \ln 2) \ln t/\epsilon + C'}{\ln^2 \epsilon}\right] dt$$

be uniformly bounded relative to x and $\epsilon > 0$. Here $\varphi(t)$ is determined by the formula

$\varphi(t) = f(x+2t) + f(x-2t) - 2f(x)$, which was developed in the paper, and C and C' are absolute constants."

40. Extremum Functions in Approximation Theory

"On the Question Concerning Extremum Functions in Certain Problems of Approximation Theory," by S, I. Rabinovich, Dnepropetrovsk Metallurgical Institute; Moscow, Doklady Akademii Nauk SSSR, Vol 121, No 6, Aug 58, pp 977-979

The following is the text of the author's statement of the problem.

"Let $W^{(r)} H^{(a)}$ be the class of periodic functions of period 2π, having a derivative of the r^{th} order satisfying the Lipschitz condition of order a with the constant 1, and let $\lambda_k^{(n)}$ $(k = 0, 1, \ldots, n+1;$ $\lambda_0^{(n)} = 1;$ $\lambda_{n+1}^{(n)} = 0)$ be a triangular matrix of numbers, satisfying the conditions

$$\mu_k^{(n)} \leq \mu_{k+1}^{(n)}, \quad \Delta^2 \mu_k^{(n)} \geq 0,$$

where $$\mu_k^{(n)} = \frac{1 - \lambda_k^{(n)}}{k^2}.$$

"For each function $f(x) \in W^{(r)} H^{(a)}$ we make up a sequence of trigonometric polynomials of the n-th order

$$U_n(f; x; \lambda) = a_0/2 + \sum_{k=1}^{n} \lambda_k^{(n)} (a_k \cos kx + b_k \sin kx), \quad (1)$$

where a_k and b_k are the Fourier coefficients of the function f(x), and invesitgate the question concerning the behavior of the absolute value of the deviation $f(x) - U_n(f; x; \lambda)$.

"A. F. Timan (Izv. AN SSSR, Ser. Matem., 10, 393, 1946) proved that the asymptotic inequality

$$\left| f(x) - U_n(f; x; \lambda) \right| \leq 2^{a+1}/\pi^2 \; n^a \int_0^{\pi/2} t^a \sin t \, dt \cdot \left| \sum_{k=1}^{n} \frac{\mu_k^{(n)}}{n-k+1} - \frac{\ln n}{n^r} \right| + O\left(\frac{1}{n^{r+a}}\right) \quad (2)$$

holds for any function $f(x) \in W^{(r)} H^{(a)}$, where $r \geq 0$ is any whole number and $0 \leq a < 1$, for n approaching infinity (in the case $a = 0$ the right side must be increased twofold), since for each n there exists a function $\varphi_n(x)$ for which the inequality (2) is converted to an asymptotic equality.

"However, the following question still remains open: does there exist a function $f(x)$, not dependent on n, in the class $W^{(r)} H^{(a)}$ for which the inequality (2) would become an asymptotic equality along a particular sequence of the values of n? Such a problem was first considered by S. M. Nikol'skiy, where it was applied to the polynomial of best approximation (see Izv. AN SSSR, Ser. Matem., 17, No 2, 1958).

"The purpose of this work is the solution of this problem for linear methods of approximation."

41. Generalized Solution for Systems of Quasilinear Equations Examined

"On the Uniqueness of the Generalized Solution of the Cauchy Problem for Systems of Quasilinear Equations of the Hyperbolic Type," by B. L. Rozhdestvenskiy; Moscow, Doklady Akademii Nauk SSSR, Vol 122, No 5, Oct 58, pp 762-765

The uniqueness of the generalized solution of the Cauchy problem for systems of quasilinear equations of the form

$$\partial u_i/\partial t + \partial \varphi_i(u, t, x)/\partial x = 0$$

$$i = 1, 2, \ldots, n; \quad u = [u_1, u_2, \ldots, u_n]$$

are considered. The generalized solution is that system of functions $u_i(t, x)$ which takes on assigned values at the line $t = 0$ and satisfies the integral relationships

$$\oint_C u_i(t, x)\, dx - \varphi_i(u(t, x), t, x)\, dt = 0$$

$$i = i, 2, \ldots, n,$$

where C is any sectionally smooth closed curve lying entirely within the half-plane $t \geq 0$.

42. Solution of Differential Equations in Banach Space Treated

"Application of the Theory of Semigroups to an Investigation of Differential Equations in Banach Spaces," by M. Z. Solomyak, Leningrad Shipbuilding Institute; Moscow, Doklady Akademii Nauk SSSR, Vol 122, No 5, Oct 58, pp 766-769

The solution of the equation

$$du/dt + Au = f(t)$$

with the initial condition

$$u/_{t=0} = u_0$$

is considered, where $u = u(t)$ and $f(t)$ are elements of a complex Banach space X and depend on the parameter $t \in [0,T]$ and A is a closed unrestricted operator with a dense region of definition D(A) in X.

A more general form

$$du/dt + Au + B(t)u = f(t)$$

is also considered, where B(t) is an operator, which is in some sense subordinate to A.

43. Uniqueness of Solution of Quasilinear Differential Equation Considered

"On the Cauchy Problem for Quasilinear Equations, " by B. L. Rozhdestvenskiy; Moscow, Doklady Akademii Nauk SSSR, Vol 122, No 4, Oct 58, pp 551-554

The discontinuous solutions of a conservative system of equations

$$\frac{\partial u_1}{\partial t} - \frac{\partial \varphi_i (u_1, u_2, \ldots, u_n, t, x)}{\partial x} = 0, \quad (i = 1, 2, \ldots, n)$$

are considered. A generalized solution of the Cauchy problem for the above system of equations is defined as those functions $u_i(t, x)$ that take on certain values at the line of origin $t = 0$ and satisfy the integral expression

$$\oint_C u_i(t, x)\, dx - \varphi_i (u, t, x)\, dt = 0, \quad (i = 1, 2, \ldots, n)$$

where $u = u_1 (t, x); u_2(t, x); \ldots; u_n(t, x)$ and C is any sectionally smooth closed curve lying entirely within the region $t \geq 0$.

The paper outlines a method by which the question of the uniqueness of the generalized solution of the Cauchy problem for the above system of equations may be reduced to the question of the uniqueness of a continuous solution of the Cauchy problem for a certain system of quasilinear equations. The method is illustrated in an example of the proof of the uniqueness of the generalized solution of the Cauchy problem for a particular quasilinear equation.

44. Solution of an Elliptical System of Equations Described

"General Representation of the Solutions of an Elliptical System of 2n Equations in a Plane," by B. V. Boyarskiy; Moscow, Doklady Akademii Nauk SSSR, Vol 122, No 4, Oct 58, pp 543-546

An elliptical system of first-order equations

$$u_x = Au_y + Bu + f$$

is considered, where u is an unknown 2n-component real vector, A and B are square matrices of order 2n, and f is a real vector defined in a certain plane T of the variable $z = x + iy$. Certain necessary and sufficient conditions that a solution must satisfy are given as theorems.

VI. MEDICINE

Aviation Medicine

45. Effect of Para-Aminobenzoic Acid on Altitude Tolerance

"The Effect of Novocain on the Tolerance of White Rats to High Altitudes," Report II, "The Effect of Para-Aminobenzoic Acid," by Yu. F. Udalov (Moscow) (Received by the editorial office 1 Nov 57; Presented by Active Member of Academy of Medical Sciences USSR V. V. Parin), Byulleten' Eksperimental'noy Biologii i Meditsiny, No 8, Aug 58, pp 71-72

"Para-aminobenzoic acid increases the resistance of the body to oxygen starvation encountered at high altitudes. This conclusion was reached as the result of experiments with 114 adult white rats. Of these 114 white rats, 56 served as a control group and 58 were given food containing para-aminobenzoic acid (200 mg per 100 of body weight). The experimental rats were raised (in an altitude chamber) to an 'altitude' of 11,000 m at a speed of 30 m/sec, remaining at that altitude for 10 minutes. The mortality rate among rats which received para-aminobenzoic acid was half as great as in the control group.

"In the previous report it was shown that novocain increases the resistance of an organism to oxygen deficiency. It was hypothesized that since novocain produces a local effect on nerve endings of interoceptors, it also causes a general effect on the central nervous system. Use of para-aminobenzoic acid was decided on because it has been shown that it causes physiological effect on the central nervous system similar to that of novocain."

46. Neurophysiological Research on Radial Acceleration

"The Effect of Radial Accelerations on the Secretion of Salivary and Gastric Glands and on Periodic Stomach Contractions," by P. M. Suvorov, Central Institute for Advanced Training of Physicians (head, V. P. Lebedeva), Moscow, (received by the editorial office on 4 March 1958; presented by Active Member of Academy of Medical Sciences V. N. Chernigivskiy), Byulleten' Eksperimental'noy Biologii i Meditsiny, No 9, Sep 58, pp 28-34

"Results of 310 experiments on six dogs revealed that radial accelerations in cranio-caudal and caudo-cranial directions cause inhibition of reflex salivary secretion as well as of periodic stomach contractions. A spontaneous secretion of gastric juice was noted, in

response to great acceleration, in dogs with a Basov stomach fistula. However, no spontaneous secretion of gastric juice was noted in a dog with an isolated Heidenhain stomach pouch, i.e., only a prolonged period of inhibition of gastric secretion was noted. It can be assumed that the above-mentioned changes are connected with changes that take place in the nervous system, particularly in the parasympathetic and sympathetic branches.

"Radial accelerations in all experiments were created by rotating the animals in a centrifuge with a radius of 3.6 m."

47. Air Sickness Discussed in Czechoslovak Periodical

"Air Sickness," by Maj Vladimir Malcik, MD, Air Force Institute of Health; Prague, Vojenske Zdravotnicke Listy, Oct 57, pp 459-467

US, British, Czechoslovak, German, Russian, and French sources concerning physiological and psychological causes, symptoms, cures, and exceptional cases of air sickness are surveyed in the article.

48. Czechoslovak Aeromedical Research on Word Audiometry

"Air Force Word Audiometry," by Maj Vladimir Malcik, MD, Institute of Air Force Health, Alois Pospisil, MD, and Engr Frantisek Zatocil, MD, Clinical "ORL" laboratory, Czechoslovak Academy of Sciences, Charles' University; Prague, Vojenske Zdravotnicke Listy, special 18-page supplement to Jan 58 issue, pp 1-18

The article first narrates the history of Czechoslovak audiometrical research and explains the use of word, rather than mechanical, audiometry. The rest of the article is devoted to efforts to draw up an effective word list for testing the hearing of airmen.

The article states that the first list of words drawn up consisted of terms used in Air Force communications. This list was divided phonetically into ten groups of ten words each. These ten groups were to be interchangeable. By testing the hearing of a large number of airmen, a curve was drawn showing the average hearing ability of the airmen. The results obtained with different groups of words were so diverse, however, that the word groups could not be considered interchangeable.

According to the article, a second list of words was drawn up in which less common words and new methods were employed. The average curve resulting from tests with this word list confirmed the advisability of using special word lists for Air Force personnel and the word groups of this second list proved to be interchangeable. This concluded the first step of the research program.

Immunology and Therapy

49. Combined Live Vaccine Against Plague, Tularemia, Brucellosis, and Anthrax

"The Effectiveness of Combined Vaccination With Live Vaccines Against Plague, Tularemia, Brucellosis, and Anthrax;" Report I: Compatibility of Live Vaccines (Plague, Tularemia, Brucellosis, and Anthrax) in Experiments on Guinea Pigs," by N. K. Vereninova, Ye. I. Smirnova, N. F. Kalacheva, N. I. Kuznetsova, and Z. N. Karaseva, Institute of Microbiology and Epidemiology of Southeastern USSR; Moscow, Zhurnal Mikrobiologii, Epidemiologii i Immunobiologii, Vol 29, No 11, Nov 58, pp 45-52

This article is introduced with the following statements concerning the use of live vaccines: "The diversity of prophylactic inoculations and the difficulty of carrying them out suggested to investigators the idea of using combined vaccines consisting chiefly of killed microorganisms, anatoxins, and complete antigens. Practical experience has shown that the problem of using associated preparations manufactured from killed vaccines, anatoxins, and complete antigens is close to being resolved, and several associated preparations have always been introduced into Soviet public health practice. This cannot be said about live vaccines. Until recently, the possibility of simultaneous inoculation against several infections with live vaccines was almost unstudied. Meanwhile, under certain epidemic conditions the necessity arises for vaccinating the population simultaneously against several infections --- the specific prophylaxis of which is accomplished with live vaccines in our country

"The possibility of conferring immunity to several infections with combined vaccines of live and killed [microorganisms] is indicated by investigations devoted to the problem of antigen compatibility in associated preparations (Kompaneyets, Dmitriyev, and Nikol'skaya, 1932; Ruchkovskiy and Mach, 1933; Neshchadimenko and Golub, 1934; Akimenko, 1949; Korobkova and associates, 1950; Kalacheva, 1954; Pilipenko and Polyakova, 1955; Gubina, 1957, etc.). The data obtained led to the

conclusion that the use of combined vaccination with live vaccines for the prophylaxis of a number of infections is completely feasible. It is necessary to take into account the fact that competition of antigens in the organism is decreased or altogether absent when they are selected correctly."

The object of the research discussed in this article was to study the effectiveness of combined vaccination of guinea pigs simultaneously against plague, tularemia, brucellosis, and anthrax to evaluate the compatibility of these components. The immunogenic characteristics of monovaccines against the four infections were the main criteria employed in selecting doses for the experiments performed. The experiments are described in detail in the texts and results are summarized in tabular form.

The following conclusions are presented on the basis of the results obtained over a period of 2 1/2 years (1955-1957):

"1. Following combined vaccination with four kinds of live vaccines (plague, tularemia, brucellosis, and anthrax), sufficiently intense immunity against plague (500 Dcl), tularemia (1,000 Dcl), and brucellosis (2 infecting units) was produced in guinea pigs; the immunity was almost the same as immunity which developed after immunization with the corresponding monovaccines.

"2. The anthrax antigen as a weaker stimulant of the physiological mechanisms of the vaccinal process was suppressed by the other three antigens in the combination; as a result, immunity against anthrax was not developed to a sufficient extent. Survival in these animals following infection with the anthrax pathogen was extremely low in comparison with survival in guinea pigs vaccinated with the anthrax monovaccine.

"3. Weak resistance to infection with B. anthracis was observed in guinea pigs vaccinated with the combined vaccine both subcutaneously and cutaneously.

"4. In view of the insufficient resistance to anthrax infection after combined inoculation of guinea pigs, weak immunity was observed with respect to mixed infection.

"5. The method of introducing anthrax vaccine in advance, up to 10 days before inoculation of the trivaccine, guaranteed a pronounced effect following both separate and simultaneous infection with pathogens of the four infections.

"6. The suggested method was harmless in experiments on guinea pigs."

50. Simultaneous Immunization With Live Brucellosis Vaccine and Tetanus Anatoxin

"The Effectiveness of Simultaneous Immunization With Live Dry Brucellosis Vaccine and Tetanus Anatoxin," by Tzyan Shun'-tsyu, Institute of Epidemiology and Microbiology imeni Gamaleya; Moscow, Zhurnal Mikrobiologii, Epidemiologii i Immunobiologii, Vol 29, No 10, Oct 58, pp 83-93

After introductory remarks concerning principles of and previous research on combined immunization, the author of this article presents results of his studies on the effectiveness of simultaneous immunization of guinea pigs with live brucellosis vaccine (Br. abortus 19-BA) and natural tetanus anatoxin. The experiments are described in detail; results are discussed and summarized in the following three tables: Titers of Tetanus Anatoxin in Guinea Pigs Immunized With Live Brucellosis Vaccine and Tetanus Anatoxin and With Tetanus Anatoxin Alone; Wright, Opsono-Phagocytic, and Burnet Reactions in Guinea Pigs Immunized With Live Brucellosis Vaccine Alone and Combined With Tetanus Anatoxin; and Results of Testing Immunity Against Brucellosis.

Conclusions offered on the basis of these results are as follows:

"1. Upon simultaneous action of live brucellosis vaccine 19-BA and tetanus anatoxin on the guinea pig organism, immunological reconstruction of the organism with respect to brucellosis was the same as it was in pigs immunized with brucellosis vaccine 19-BA alone, i.e., tetanus anatoxin combined with brucellosis vaccine action does not affect the dynamics of the development and extinction of the immunological process against brucellosis. Titers of tetanus anatoxins in pigs immunized simultaneously with two antigens were considerably higher than in pigs immunized with only tetanus anatoxin.

"2. Guinea pigs were found to be uniformly resistant to a virulent Br. melitensis strain and tetanus toxin both after simultaneous immunization with both antigens and after their separate administration.

"3. Subcutaneous inoculation with live brucellosis vaccine 19-BA can be employed successfully in combination with active immunization against tetanus."

51. Double Vaccination Against Q Fever

"Experimental Double Vaccination Against Q Fever," by S. M. Kulagin, A. D. Fukts, R. I. Zubkova, and L. D. Popova, Institute of Epidemiology and Microbiology imeni Gamaleya and Krasnodar Kray Sanitary-Epidemiological Station; Moscow, Zhurnal Mikrobiologii, Epidemiologii i Immunobiologii, Vol 29, No 11, Nov 58, pp 25-29

This report concerns research on specific prophylaxis of Q fever. After some introductory discussion on previous experimental work with the Q fever vaccine, the authors present evidence to support their recommendation that the vaccine be administered in two doses instead of three. Vaccinations were performed in Krasnodarskiy Kray from July 1956 to January 1957; 643 workers from meat combines and milk factories where high indexes had been obtained in 1955 investigations for Q fever were inoculated. One group was vaccinated once; and the other, twice. Results are discussed in the text and tabulated.

Conclusions presented on the basis of these observations are as follows:

"1. Experimental vaccination of 643 persons against Q fever with a vaccine having a prolonged period of preservation (15 months) demonstrated that it was entirely adequate to guarantee specific prophylaxis in inoculated persons.

"2. Complete tolerance to the vaccine, which produced reactions in 8.2% of the persons inoculated, was noted. Three severe reactions and 11 infiltrates were observed out of 1,105 persons inoculated. No abscesses occurred.

"3. The immunological effectiveness of two-time vaccination in doses of 0.5 and one ml at 2-week intervals during a 5-month period completely corresponded to that of three-time vaccination. The immunological effect was lower at a remote period (8 months) than in persons inoculated three times.

"4. Although 15% of the persons in collectives where the vaccinations were performed reacted positively to Rickettsia burneti antigen, allergic reactions following inoculation were not observed. This indicates the possibility of specific vaccination of threatened groups without preliminary serological testing.

"5. Two-time vaccination in doses of 0.5 and one ml at 2-week intervals can be recommended to simplify mass vaccination against Q fever."

52. Hungarians Develop Psychosis-Producing Drug

"The Effect of Dimethyl-Tryptamine (DMT) on Normal Individuals," by Dr Ferenc Kajtor, Neuropsychiatric Clinic of Debrecen Medical Sciences University (director, Dr Pal Juhasz) Ideggyogyaszati Szemle, Budapest, Vol XI, No 4, Oct 58, pp 122-126

Dimethyl-tryptamine is a new psychoticum produced and used in Hungary. It produces model psychoses similar to those produced by lysergic acid (LSD-25) and mescaline. In this experiment, electroencephalograms were taken from five normal adults while they were in a model psychosis produced by DMT.

The DMT was administered intramuscularly and produced a two-phase change in the EEG depending on the seriousness of the psychic changes. The change in the EEG due to the effect of DMT is very similar to that which takes place due to LSD; however, DMT has a quick effect and thus probably acts directly, whereas LSD has a slow effect and thus acts more likely in an indirect manner.'

The experimenter presumes that DMT produces two effects: it facilitates certain activating and sensitizing systems in low concentrations but causes inhibition of differentiation in higher concentrations.

53. Study of the Effect of Diethyl-4-Nitrophenylthiophosphate on Warm-Blooded Animals

"Study of the Permeability of Diethyl-4-Nitrophenylthiophosphate Tagged With Radioactive Isotopic Phosphorus (P^{32}) in the Bodies of Warm-Blooded Animals," by K. A. Gar, N. A. Sazonova, and V. I. Chernetsova, Tr. Tsentr. N. I. Dezinfekts. Inta (Works of the Central Scientific Research Disinfection Institute), 1957, No 10, 263-273 (from Referativnyy Zhurnal--Khimiya, No 18, 25 Sep 58, Abstract No 62025, by I. Mil'shteyn)

"Investigations were conducted on the permeability of diethylparanitrophenylthiophosphate (1) tagged with isotopic P^{32} in the body of warm-blooded animals (white rats, guinea pigs, rabbits, and cats). After

poisoning the animal with (1) either orally or by application on the skin, P^{32} appears in all the organs of the investigated animals. The distribution of P^{32} in all types of animals investigated proceeds approximately equally. The transmission of (1) in the organism of warm-blooded animals is accomplished by the blood. (1) quickly decomposes in the organism; the hydrolysis products of (1) are excreted in the urine. In animals receiving a lethal dosage, an increased amount of undecomposed (1) is observed in the important vital centers."

54. Effects of Carbon Tetrachloride on Serum Protein

"The Effect of Carbon Tetrachloride on the Level of Buffer Acids in the Serum Protein Picture of Dogs," by I. D. Mansurova, Tr. Stalinabadsk. Med. In-ta. (Works of the Stalinabad Medical Institute), 1957, No 27, pp 21-27 (from Referativnyy Zhurnal--Khimiya-Biologicheskaya Khimiya, No 22, 25 Nov 58, Abstract No 29993, by I. El'man)

"The subcutaneous administration of CCl_4 to dogs produced a marked decrease in the quantity of buffered acids in the blood serum (up to the administration of 58 mol. eqv./l, following the administration of 39 mol. eqv/l) which is analogous to the decrease in buffer acids during cerosis of the liver in humans. The effect produced by CCl_4 led to a marked decrease in the A/G coefficient and an initial increase in the quantity of $alpha_2$ globulins (from 5% to 16.4%), with a subsequent increase in the content of the $beta_2$-globulin fraction (to 25%). In the beginning, the gamma-globulin content doubled during this type of liver affection. Later, it gradually decreased."

55. Effect of Various Substances on Blood Serum Phosphatase

"Concerning the Effect of Dichloroethane and Carbon Tetrachloride on the Phosphatase Activity of the Blood," by S. L. Danishevskiy, Tr. Leningr. San.-Gigiyen. Med. In-ta. (Works of the Leningrad Sanitary Hygiene Medical Institute), 1958, No 44, pp 155-163 (from Referativnyy Zhurnal--Khimiya-Biologicheskaya Khimiya, No 22, 25 Nov 58, Abstract No 29992, by I. El'man)

"Dichloroethane and CCl_4 in vitro produces a decrease in the activity of alkaline blood phosphatase. After single or repeated inhalation of dichloroethane or CCl_4 fumes by rabbits, as well as subcutaneous

administration, the alkaline phosphatase content in the blood decreases. This decrease varies over a wide range (from 12 to 80% after the inhalation of dichloroethane fumes) and does not depend on the concentration of the intoxicating substances."

56. Effect of Various Substances on the Toxicity of Dichloroethane

"The Course of Dichloroethane Poisoning During Functional Changes in the Thyroid Gland," by O. I. Kharitonov, Sb. Tr. Byuro Gl. Sudebnomed. Ekspertisy i Kafedry Sudebn. Med. Alma-Atinsk. Med. In-ta. (Collected Works of the Bureau of the Main Forensic Medicine Commission of Experts and the Chair of Forensic Medicine of the Alma-Ata Medical Institute), 1957, No 1, pp 42-45 (from Referativnyy Zhurnal--Khimiya-Biologicheskaya Khimiya, No 22, 25 Nov 58, Abstract No 29990, by L. Gol'dberg)

"It was determined that the preliminary administration of thyroidin to rabbits produces a 50% decrease in the LD of dichloroethane. The intoxication proceeds rapidly with death occuring within 20-30 minutes. By inhibiting the hormone function of the thyroid gland with methylthiouracil, the LD of dichloroethane is unchanged, with death occuring in the animals within 6-8 hours."

57. Magnoline, a New Alkaloid

"The Pharmocology of a New Alakaloid, Magnoline," by E. Ye. Aleshinskaya, Tr. Krimsk. Med. In-ta. (Works of the Crimean Medical Institute), 57, No 18, pp 675-682; (from Referativnyy Zhurnal--Khimiya, Biologicheskaya Khimiya, No 22, 25 Nov 58, Abstract No 29976, by S. Dolina)

"In experiments on cats, magnoline, an alkaloid from Michelia fuscata, possesses hypotensive action in doses of 0.5 mg/kg and higher when administered intravenously. This action is connected with the inhibitory effect of magnoline on the sympathetic ganglia and on the medulla oblongata, and its adrenolytic properties. Magnoline possesses anticholinesterase properties."

58. Helicopter Equipped With an Aerosol Generator

"Tests of a Helicopter With an Aerosol Generator," by V. F. Dunskiy and A. F. Funikov, Candidates of Technical Sciences; Moscow, Zashchita Rasteniy ot Vrediteley i Bolezney, No 3, May-Jun 58, pp 20-21

"Type AG-L6 aerosol generators are not adaptable to agricultural aviation inasmuch as their performance at existing speeds of flight are wholly inefficient and a better aerosol generator has not yet been developed. However, during the past few years, new possibilities for aviation application of aerosols have appeared with the use of the helicopter in agriculture.

"The helicopter can fly at slow speeds. Its rotor throws a great mass of air downward and, as an ordinary blower, creates a strong current directed to the ground. This current carries along the aerosol injected into it and forces it onto the plantings to be sprayed (e.g., the tops of trees) and ensures a uniform deposit of the finest droplets of insecticide liquid on the upper and lower surfaces of leaves in all parts of the trees. A helicopter equipped with the aerosol generator can be an extremely effective agent against pests in mountainous orchards where the use of an airplane or ground vehicles is difficult or impossible.

"The initial tests of this type were conducted in 1957 under airport-operating conditions by the Mosstazra [Moscow Plant Protection Station] and the State Scientific Research Institute of the Civil Air Fleet with a Ka-15 helicopter equipped with an AG-L6 generator. A supercharger was installed inside the fuselage and was driven in the engine at a rate of 3,000 rpm. Air from the supercharger enters the combustion chamber of the generator and then passes into a Venturi tube. The gasoline is fed into the combustion chamber from a tank situated inside the fuselage. The agent enters the narrow section of the nozzle through a measuring valve from a bunker.

"Exhaust from the combustion chamber of a land-based aerosol generator is usually produced by decreasing the engine speed. But in helicopter flight it is not possible to reduce the engine rpm rate. Hence,

the valve in the air duct is controlled by an electromagnetic governor. At the release point the pilot opens the valve and allows part of the air from the supercharger to pass out. This is equivalent to decreasing the revolutions of the supercharger.

"The gasoline enters the chamber from the fuel tank under 0.2 atm pressure and flows through a carburetor jet which provides a supply of an enriched fuel mixture in the chamber. After the release the electric gasoline valve is closed and the gasoline flows consecutively through running and starting jets; by this process the mixture arriving in the chamber is leaned down in accordance with the needs of the operating system. The temperature of the exhaust gas is 500°.

"At the airport, measurements were made of agent deposits on the ground and of the droplets which settled. The helicopter flew over a transverse line of cuvettes and slides at a fixed height (5 or 10 meters) at a speed of 13-45 kilometers per hour. At a distance of 100 meters from the line of cuvettes release of the aerosol was begun and was discontinued 200 meters beyond this line.

"Twenty-five slides were placed 3-5 meters apart so that the deposits of the aerosol were measured in a belt 75-125 meters wide. To decrease oil spread the slides were coated with a special silicone substance.

"After the test the drops were counted and measured under a microscope calculating the area of the examined portion of glass. The quantity of liquid deposited on a unit area was determined by adding the volume of all deposited droplets. In addition, a colorimetric method was used to determine the quantity of dye deposited in the cuvettes. (This dye had been dissolved in the employed liquid in the quantity of 0.1%. In an aerosol formed by a thermomechanic process deposition of the dye is equivalent to deposition of a nonvolatile type of toxicant, such as DDT.)

"The tests were conducted in the early morning when the wind speed at a height of 1.5 meters was 0.25-3.9 meters per second. The characteristics of the aerosol stream and its dispersion were as follows: at a flight speed of 35 kilometers an hour the aerosol stream was directed at the ground at an angle of nearly 30°, at the slow speed of 13 kilometers an hour the aerosol stream was directed sharply downward and diffused. It was wider in its transverse direction than in its longitudinal direction. On both sides of the flight line the aerosol is carried along by

the upward air eddies; at speeds greater than 45 kilometers an hour it is diffused at a slight angle to the earth and the action of the strong downward current from the rotor is sharply decreased. Therefore, the helicopter speed for aerosol processing should not exceed 40-45 kilometers an hour; the flight altitude over the surface to be treated, 5-10 meters; and the lateral dispersion, 30 meters.

"The degree of deposition of the liquid during the different tests amounted to 10-42% but up to 66% of the dye which had been substituted for the poison deposited. The remaining portion of the liquid and dye was carried by winds beyond the limits of the investigation zone.

"The increase in deposition in comparison with the characteristics of a generator operating under ground-based conditions should be attributed to the action of the downward air current produced by the helicopter rotor.

"During 1958, tests of a helicopter equipped with an aerosol generator under actual operating conditions are intended."

59. Czechoslovak Article on Membrane Filters

"The Possibilities of Using Membrane Filtration in Microbiological Diagnoses," by Col Josef Chvapil and Jan Svejcar, Central Military Hospital in Prague; Prague, Vojenski Zdravotnicke Listy, Jun 57, pp 274-281

Experiences using membrane filters in bacteriological and hygienic practice are reviewed and their advantages listed. The use of membrane filters is particularly valuable whenever the presence of inhibitory substances and small quantities of the microorganism are an obstacle to the successful outcome of cultivation.

The membrane filter method was introduced by the authors in the investigation of the most varied clinical materials (CSF, exudates, urine, separtion of bacteriophages, etc.). Furthermore, a modification was worked out for the detection of microorganisms in the blood which is more advantageous than methods hitherto employed.

According to the authors, the possibilities of utilizing membrane filters under field conditions are clear. They recommend that laboratories acquaint themselves with the technique. In this respect, they say, it will be necessary to catch up with other countries, such as the Soviet Union, the US and Germany.

60. Insect Control Research in Czechoslovakia

"The Fight With Insects in Open Terrain" by Lt Col Jan Svoboda, MD, "Jan Ev. Purkyne" Military Medical Institute; Prague, Vojenski Zdravotnicke Listy, Aug 57, pp 362-366

Insects which are injurious to human health and means of controlling them in open terrain are discussed in an article based on insect control research carried out in temporary bivouac areas, field kitchens, and field slaughterhouses in the Czechoslovak army.

The use of Nerafum insecticide preparation is proposed. For more thorough extermination, an improvised fumigator which allows both the choice of the desired insecticide mixture and the application of a concentration adequate to a given situation is recommended.

Radiology

61. Course of Thermal Burns of the Cornea During Radiation Sickness of Varying Severity in Rabbits

"The Course of Thermal Burns of the Cornea During Radiation Sickness in Rabbits," by P. I. Lebekhov (Leningrad); Moscow, Vestnik Oftal'mologii, No 1, Jan/Feb 58, pp 3-10

The aim of this research was to study the anatomical-physiological processes characterizing the organs of sight during thermal burns against a background of radiation sickness.

Tests were conducted on 88 rabbits, of which 60 were irradiated by 700 r of X rays, or 700 or 1,000 r of gamma rays. The experimental animals were also subjected to second, or third degree, or diffuse thermal burns.

Details of the experimental method, blood analysis, inflammatory changes, and frequency of infectious complications are presented.

Results confirm that corneal thermal burns of medium severity against third degree radiation sickness are frequently characterized by the presence of secondary infection which causes a significantly more severe course of the burns than the course of burns uncomplicated by irradiation. Infection in the foci of corneal burns of irradiated rabbits showing weak symptoms of radiation sickness appears at the same rate as that in the foci of burns of nonirradiated rabbits. The only difference between the course of corneal burns against mildly expressed symptoms of radiation sickness (second degree), and that of corneal burns of nonirradiated rabbits is the greater frequency in the former case of erosion at the site of the corneal burns. In animals showing weak symptoms of radiation sickness (first degree), remission of inflammatory changes and regeneration of epithelium of the cornea proceed at a faster rate than in nonirradiated control animals.

62. Conference on Ionizing Radiation

"Scientific Conference on the Problems of the Action of Ionizing Radiation on Animal Organisms," by Ya. L. Shekhman; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Biologicheskaya, No 6, Nov-Dec 58, pp 758-760

A conference organized by the biological section of the Institute of Biology imeni A. A. Bogomol'ets, Academy of Sciences Ukrainian SSR (Director of the Biophysics Section, Corresponding Member of Academy of Sciences Ukrainian SSR, A. A. Gorodtskiy), was held 9-13 June 1958 in Kiev.

As the title indicates, the conference was dedicated to problems connected with the mechanism of the action of radiation on the animal organism. Corresponding to this, the content of the reports were centered around the following basic problems:

The general mechanism of the action of radiation on the biological system in simpler organisms was reported by A. A. Gorodetskiy (Kiev), Ya. L. Shekhman and L. Kh. Eydus (Moscow), V. K. Tkch Kharkhov and I. F. Kovalav (Odessa), and others; the dynamics of the pathomorphological and biochemical changes caused by radiation sickness, by A. I. Smirnova-Zamkova, O. P. Chepinoga, S. A. Korol (Kiev), P. F. Minayev (Moscow);

Nucleic and protein metabolism during radiation sickness, by I. F. Lipkan, R. Ya. Marchuk, N. V. Zelenskiy (Kiev), and others; dosimetry and the action of small doses, by S. N. Ardashnikov (Moscow), Ye. F. Morgan (Kiev), B. I. Kirichinskiy (Kiev), and others; and the pathogenesis and therapy of radiation sickness, by A. O. Bogomolets, Yu. A. Spasokukotskiy, N. N. Lebedev, and others. The distribution, accumulation, and excretion of radioactive isotopes from an organism, and the course of infection during radiation sickness were also discussed.

The conference, according to the author, was well organized on the whole and the reports presented in the program were very timely. In addition, the conference afforded the individual members an opportunity for personal contact -- between biologists, physicists, and clinicists -- which was very fruitful and facilitated the development of work on the study of the mechanisms of the radiobiological effect.

63. Czechoslovak Radiological Research

"Present Day Possibilities of Decontaminating an Organism Internally Irradiated by U-235 Fission Products," by Lt Col Prof J. Nosek, MD, "Jan Ev. Purkyne" Military Medical Academy; Prague, Vojenske Zdravotnicke Listy, Jan 58, pp 9-12

Studies made at the "Jan Ev. Purkyne" Military Medical Academy of the possibilities of decontaminating organisms internally contaminated with U-235 fission products are described. The objective of the studies was to determine if the calcium salt of ethylenediaminetetracetic acid (Ca/-EDTA) shortens the biological half-life of long-lived U-235 fission products. The article includes a section on methodology, a discussion, and a summary.

The author believes that EDTA has not succeeded in satisfactorily clearing contaminated bone of the fission products of U-235 but that it is a very valuable aid in ridding the gastrointestinal tract, liver, and kidneys of heavy metals and rare earths. Ca/EDTA shortens the biological half-life of U-235 fission products in the liver, spleen, small and large intestines, and kidneys.

64. Hungarians Produce Medicines to Protect Against Radiation

"Hungarian Medicines Against Old Age and Radiation" (unsigned article); Magyar Nemzet, 9 Nov 58, p 11.

The Hungarian pharmaceutical industry has prepared a 15-year development plan and factories have already started to execute the plan with innovations costing several hundred million forints.

Next year, construction of a new headquarters for the Pharmaceutical Industry Research Institute (Gyogyszeripari Kutato Intezet) will begin in Budapest. The 500 researchers of the institute are developing new antibiotics, medicines for virus diseases, and medicines for tumorous ailments, heart and circulatory diseases, rheumatism and gastric ulcers; they are also engaged in experimentation with and production of new vitamin products. These new medicines [the vitamins] overcome mental and nervous disorders and also delay aging of the organism.

In the Kobanya Medicine Factory (Kobanyai Gyogyszerarugyar) they are producing [or will produce] isotope preparations and medicines for protection against radioactive radiation as well as vitamin B-12, insulin, and various hormone preparations.

[For additional information on radiology, see Item No 10.]

VII. METALLURGY

65. Effect of Niobium on Temper Brittleness of Chrome-Nickel Steel

"Effect of Niobium on Temper Brittleness of Chrome-Nickel Steel," by M. P. Braun, Doctor of Technical Sciences, and Engineers B. B. Vinokur and A. I. Kondrashev; Stalinsk, Izvestiya Vysshikh Uchebnykh Zavedeniy—Chernaya Metallurgiya, No 8, Aug 58, pp 113-118

Specimens of chrome-nickel steel 30KhN with niobium content ranging from zero to 0.90% were tested by the Academy of Agricultural Sciences Ukrainian SSR and the Novo-Kramatorskiy Machine Building Plant to determine the effect of niobium on temper brittleness and toughness. The various heat-treating methods are described and results are given for impact strength tests at temperatures from -200°C to 300°C.

The most effective content of niobium is in the 0.30-0.40% range. Optimum heat-treatment for this type of steel consists of quenching at 850-900°C and tempering at 580-650°C. Long holding at 650°C results in a sharp increase in toughness. Increase of toughness is more rapid when applying multiple cyclic tempering with alternating cooling (in water and in a furnace). Final cooling speed has no effect on toughness.

VIII. PHYSICS

Nuclear Physics

66. USSR Developments in the Field of Nuclear Energy

"Nuclear Energy in the National Economy," by Yu. Klimov; Moscow, Promyshlenno-Ekonomicheskaya Gazeta, Vol 3, No 137 (437), 19 Nov 58, p 4

In 1959-1965 a number of new nuclear power-generating plants will be put into operation. These plants will be equipped with different types of reactors.

The building of powerful nuclear energy electric power plants will not only supply some parts of the country with electric power, but also free a large quantity of coal and petroleum for use as raw material in the chemical industry. A nuclear energy electric power plant has been in operation in the USSR for more than 3 years without any difficulty or interruption. Recently, the first section of a nuclear electric power plant was started the nominal capacity of which is 600,000 kw.

However, the construction of power reactors in the USSR is still on an experimental basis. The reason is that reactors of a great variety of designs can be used for the generation of heat which is then transformed into electric power. The type of reactor selected depends on the nuclear fuel used, the disposition of the fuel within the reactor, the energy of the neutrons which bring about nuclear fission, and the nature of the substances used to bring about the physical processes which take place in the reactor. The most careful calculations and detailed comparative analysis of the designs of nuclear power plants have not yet given an answer to the question as to what type of reactor is most convenient and economical.

A nuclear reactor is a very complex device. One cannot foretell in advance all characteristics of its operation and all its advantages and shortcomings. The answer can be given only on the basis of actual operation of power reactors of different types, so that all data can be compared. However, one must already use discrimination at this stage in deciding for what capacities the nuclear energy electric power plants will be designed. Those power reactors which have been investigated most thoroughly and the advantages of which are most apparent should be designed for high capacities. On the other hand, reactors in regard to which doubts and moot points exist, and the advantages of which are less apparent, should be designed for lower capacities.

However, the electric power capacity of the reactors must be sufficiently high (i.e., of the order of tens or hundreds of thousands of kilowatts) to carry out experimental operation under conditions as close as possible to those encountered in connection with the industrial utilization of nuclear energy.

The program for the building of power reactors in the USSR is often referred to as a large-scale industrial experiment carried out by the Soviet Union. Under this program, a number of nuclear energy electric power plants of different capacities are being constructed in the USSR. The capacities of these plants range from tens of thousands to several hundreds of thousands of kilowatts.

The question is often asked whether one cannot select the most thoroughly tested reactor design as a prototype and on the basis of this design begin extensive construction of nuclear power plants. In connection with this, the example of the development of nuclear power in Great Britain is mentioned, where for all practical purposes only one type of reactor (gas-cooled, graphite-moderated, and employing natural uranium as fuel) is used.

The development of nuclear power in England along the lines indicated is due to the very rapid depletion of coal in that country and the increasing expense of imported crude petroleum. Under the circumstances Great Britain cannot wait until the most economical type of reactor has been developed and selected: to prevent a shortage of power in the near future, it is necessary to concentrate on the development of a single type of reactor there, even if this reactor is not of the best possible type. The situation is different in the USSR and the US, because these countries have a sufficient supply of conventional fuel for the next few decades. Therefore, both in the USSR and the US reactors of different types rather than a single type are being constructed. Apparently, a score or more years will elapse before it will be decided which reactor type is the most economical.

What types of reactors are used at USSR nuclear energy electric power plants that are in operation or are being built at present? First of all, one must mention the so-called water-water type of reactor, in which water is used both as a coolant and a moderator. In reactors of this type, the nuclear fuel is cooled by water pumped through the reactor. In order that the water assume the highest possible temperature, it is kept under a pressure of 100 atmospheres. This water transmits heat to steam generators forming a part of a second curcuit and then returns to the reactor. Steam under a pressure of 20 atmospheres is formed in the steam generators. This steam is fed into turbogenerators.

A nuclear power plant with reactors of this type is being built in Voronezhskaya Oblast. Another nuclear power plant of the same type will be erected in Leningradskaya Oblast.

In Ul'yanovskaya Oblast a reactor of the water-water type is also being constructed. However, this reactor will have a simpler system of steam generation: the water will boil in the reactor itself. The steam generated in the reactor is fed directly into the turbine. Reactors of this type are considered very promising. In them fuel elements of the same type will be used as those applied at the Voronezh and Leningrad nuclear power plants.

The construction of reactors of this type was delayed because of the high radioactivity of the steam that is fed into the turbines. It has been demostrated, however, that this radioactivity can be lowered to a level which makes it possible for the personnel to stay in the vicinity of the turbine for a definite length of time sufficient to complete the necessary work. At the plant being built in the Urals reactors of another type are used. A prototype of these reactors is that used at the first USSR nuclear power electric energy plant that is in operation in the vicinity of Moscow. In the graphite-moderated reactor of the Ural Plant, ordinary water under high pressure will be used as the heat-transfer agent. In the reactor of this design, the graphite acting as moderator is perforated by many vertical ducts containing nuclear fuel. The heat-transfer agent flows through these ducts. The steam will have a higher pressure and temperature than those of the first nuclear energy electric power plant (the pressure of the steam will amount to 90 atmospheres and its temperature will be 480-500°). In an experiment carried out at the first USSR nuclear energy electric power plant, the majority of the steam ducts were operated at the boiling point. The experiment was successful. At present, the reactor of this electric power plant operates under new, more advantageous conditions. Superheating of the steam in the steam ducts of the reactor itself will also be applied at the Ural Plant.

In the reactor of the nuclear power-generating plant which will be constructed on the Volga, liquid sodium is used as the heat-transfer agent and graphite as the moderator. Sodium is of advantage as a heat-transfer agent, because it can be heated to a very high temperature without a substantial increase of pressure in the heat-transfer circuit. Because of this, it will be possible to bring the temperature of the steam generated in the boilers to 500° at a pressure of the steam amounting to 90 atmospheres.

A fast breeder reactor has been planned for construction on the Volga. The start of the operation of the first section of a new and very powerful nuclear energy electric power plant was reported in a Tass dispatch

recently. In the reactor of this power plant, graphite is used as the moderator, water as the heat-transfer agent, and natural uranium as fuel. A motion picture on the subject of this nuclear power plant was shown recently at the Second International Conference on the Peaceful Uses of Nuclear Energy (Geneva, September 1958).

Mobile power reactors and reactors for transportation purposes are also being developed in the USSR.

The reactor for the icebreaker Lenin has operational characteristics which cannot conceivably be achieved with the use of ordinary sources of power. The icebreaker, which will soon be in operation is distinguished by a high degree of self-sufficiency (it can stay at sea for one year), high speed, and a high capacity for cutting through ice. As far as its characteristics are concerned, this vessel is far superior to the most powerful existing icebreakers both in the USSR and outside the USSR.

Soviet scientists are also making a large contribution to the study of controlled thermonuclear reactions.

67. Construction of a Nuclear Reactor in Georgian SSR

"From Every End of the Country" (unsigned article); Moscow, Pravda, 26 Nov 58

"The construction of a nuclear reactor in Georgia is drawing to an end. Laboratories are being equipped in which scientists of the Soviet republics of Transcaucasia will conduct scientific research."

68. New Soviet Book on Nuclear Engineering

Yadernyye Energeticheskiye Ustanovki (Nuclear Power Installations), by P. A. Petrov, State Power-Engineering Publishing House (Gosenergoizdat,) Moscow/Leningrad, 1958, 256 pp

The book is based on a course given by the author at Moscow Power Engineering Institute. The principles of physical and thermal calculations for thermal reactors are presented and a sample calculation for a power installation is given. The various fission materials and economic problems are considered. All descriptions of actual reactors are based on non-Soviet literature. The book is intended for nuclear engineering students.

69. Reasons Protective Shells Are Used in Reactors Outside USSR Examined

Zashchitnyye Obolochki Yadernykh Reaktorov (Protective Shells for Nuclear Reactors), by A. N. Komarovskiy, Publishing House of the Main Administration for the Utilization of Atomic Energy Under the Council of Ministers USSR (Atomizdat), Moscow, 1958, 68 pp

The use of protective shells in reactors outside the USSR is the subject of the book. The reasons given in the literature for the use of these shells despite their high cost are examined. Protective shells have not been used in the USSR nor are they included in reactors now under construction or projected. Various aspects of the design, construction, and testing of shells are covered.

70. Physical and Engineering Problems in Reactor Design

"Physical and Engineering Problems in Small-Size Protective Shield Design," by V. I. Kukhtevich and S. G. Tsypin; Moscow Atomnaya Energiya, Vol 5, No 4, Oct 58, pp 393-402

The designing of small protective shields of nuclear reactors is reviewed for facilitating the construction of mobile units. Physical problems arising in the design of a small shielding are discussed. The radiation of the nuclear reactor, gamma rays and neutrons penetrating the shielding layers, the formation and passage of capture gamma rays, and sector shielding are treated. Engineering problems such as Compton scattering of the shield, the choice of materials and the best arrangement of shielding layers are also discussed. The design of such reactors is considered so complex that thorough testing and experimental corrections are suggested.

71. Automation of Reactors

"Complex Automation for Reactor Control," by P. Kovanits and M. Kulka, Institute of Nuclear Physics of the Czechoslovak Academy of Sciences, Prague; Moscow, Atomnaya Energiya, Vol 5, No 4, Oct 58, pp 403-411

Two types of follow-up systems suitable for automatic control of nuclear reactors are analyzed. In the first system a detector follows the deviation of a certain point, e.g., the specified constant neutron flux. This system is suitable for combining the functions of measuring and signaling the period, the power, and subcritical state of the reactor, and for emergency protection of the reactor. In the second

system the power of the reactor follows the deviation of the detector. Such a system can combine the operation of automatic control of the subcritical state, the period, and the power of the reactor. The design of follow-up systems of both types would give two different methods for the complex automation of reactor control. The first version is easier to introduce into the existing equipment. The second and improved version will probably find application in new installations. The suggested schemes have the advantage of consisting of standard parts, of providing autocontrol, and of ensuring constant operating conditions of the detector and the apparatus.

72. New Measuring Instrument Developed

"Short Communications" (unsigned article); Moscow, Atomnaya Energiya, Vol 5, No 4, Oct 58 p 487

A magnetometer for accelerators -- The Physics Institute of the Academy of Sciences USSR devised a magnetometer with a permalloy dial for measuring the static and dynamic magnetic fields in accelerators. The measuring range of the apparatus is 0 to 60 oersted; its sensitivity is $(2-3)\cdot10^{-3}$ oersted. In measuring nonuniform magnetic fields variable in time, the design of the equipment automatically eliminates the error connected with the hysteresis of the permalloy and the relation of eddy currents of the field to the velocity of field variation.

73. Nuclear Transitions

"Electromagnetic Transitions in Isomeric Nuclei," by L. I. Rusinov and D. A. Varshalovich; Moscow, Atomnaya Energiya, Vol 5, No 4, Oct 58, pp 432-445

Electromagnetic transitions in isomeric nuclei are analyzed. The probabilities of gamma radiation of isomeric nuclei are compared with theoretical evaluations. The comparison is carried out for permitted as well as forbidden j- and l-transitions in spherical nuclei and for transitions between levels of one rotational band, single-particle and K-forbidden transitions in deformed nuclei. Experimental data on electromagnetic emission and quantum characteristics of isomeric nuclei concur with modern representations of the structure of the atomic nucleus.

74. Pickup Reactions of Uranium

"Cross Section of the U-238 (n, 2n) U-237 Reaction for 15-Mev Neutrons," by G. P. Antropov, Yu. A. Zysin, A. A. Kovizhnykh, and A. A. Lbov; Moscow, Atomnaya Energiya. Vol 5, No 4, Oct 58, pp 456-457

After cross sections of reactions U-238 (n, 2n) U-237 on 6- to 10 Mev neutrons were published by D. D. Knight and others (Bull. Amer. Phys. Soc., serv. II, v. 2, 198, 1957) the authors carried out experiments of the same type of reaction on 15-Mev neutrons in their laboratory.

The cross section $\sigma_{n,2n}$ was found to be 1.5 ± 0.2 barns. This result agrees with data of the above reference work and with statistical theory.

75. Gamma-Ray Energy Measurements

"Calorimetric Measurement of the Gamma-Ray Energy Flow From a Synchrotron," by S. P. Kruglov; Moscow, Zhurnal Tekhnicheskoy Fiziki, Vol 28, No 10, Oct 58, pp 2310-2323

A new calorimeter design is suggested for obtaining higher accuracy in measurement of the energy flow of gamma radiation at a spectrum up to 500 Mev. Construction and operation of the apparatus are described. The calibration of the calorimeter was carried out by means of heating elements fixed in absorbing lead cylinders. A cylinder design is suggested which provides good thermal contact of the heater with the mass. The maximum errors of calibration did not exceed 1%. The results of measurements of the energy flow at 45, 65, and 85 Mev of gamma ray Bremsstrahlung from a synchrotron are presented. Measurements with cylinders 4 or 11 cm long showed the same accuracy within the error tolerance.

Experimental research on gamma-ray Bremsstrahlung energy absorption in various materials by means of a calorimeter is under way for comparison with ionization measurements.

The work was performed using the synchrotron of the Leningrad Physicotechnical Institute. The author expresses appreciation to the synchrotron group headed by N. N. Chernov.

76. Excitation of Hydrogen Atoms by Slow Electrons Considered

"Collisions of Slow Electrons With Hydrogen Atoms," by V. I. Ochkur; Vestnik Leningradskogo Universiteta, Seriya Fiziki i Khimii, No 4, 1958, pp 53-68

Low-energy collisions between electrons and hydrogen atoms are considered. The following background to the problem is given:

"Information on the probability of the excitation of atoms by electron impact is necessary for an understanding of many processes studied in the physics of gas discharges, astrophysics, and the physics of the atmosphere.

"At high collision energies, a general solution can be given to the problem by the methods of perturbation theory. This makes it possible to establish a number of laws governing the behavior of the cross section.

"At low collision energies, details of the atomic structure take on an important role. Any kind of a general theory is therefore impossible and the actual calculations become considerably more complex. Difficulties also increase in the region in an experimental approach to the problem. Nevertheless, the low-energy region is particularly important for application.

"The first theoretical work on slow collisions was done in the early 1930s, but the considerable mathematical difficulties encountered prevented any progress of note and only in recent years, with the introduction of variation methods, has work begun again in this field. A survey of the results of this work shows, however, the problem is essentially so complex mathematically that one can hardly hope to find a sufficiently effective procedure for obtaining excitation functions in an analytical form without a huge expenditure of labor. Until recently, the difficulty was connected with the methods for numerical integration. The advent of electronic computers opened new possibilities in this area. An attempt to utilize these is made in the present work.

"Collisions between electrons and atomic hydrogen are considered since this problem is the most simple and the greatest part of recent work on the theory of slow collisions has been in connection with this problem, thus affording the opportunity for a comparison of results. A disadvantage of this choice is the lack of sufficiently reliable experimental data."

The excitation of the hydrogen atoms by slow electrons is considered. The equations describing the excitation are obtained from the variational principle and are solved numerically for excitation to the 2s, 2p, 3s, 3p, 3d, 4s, and 4f, states for the energy range from 13.5 to 65 ev. The results show that the shape of the excitation function for this energy range may differ considerably from the usual shape. This is attributed to the effect of the exchange terms taken into account in the equations.

S-phases for elastic scattering are calculated for the atom in the ground state and excited states. It is shown that the higher the excitation of the state considered, the smaller is the role of exchange terms in the calculation of elastic scattering.

77. Sound Velocity Dispersion in Liquids Measured

"Sound Velocity Dispersion and Hypersound Propagation in Liquids," by M. S. Pesin and I. L. Fabelinskiy, Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, and Voronezh Agricultural Institute; Moscow, Doklady Akademii Nauk SSSR, Vol 122, No 4, Oct 58, pp 575-577

Sound velocity dispersion in liquids at frequencies of 10^{10} cps is investigated by determining hypersound velocity in certain liquids on the basis of the structure of Rayleigh lines and comparing the results with supersound velocities in these same liquids under the same conditions. Methylene chloride and methylene bromide were the liquids used in the experiment. The observed dispersion is attributed entirely to a relaxation mechanism.

Thermodynamics

78. Modeling of a Thermal Field

"Conditions for Electrical Modeling of a Thermal Field With Internal Sources of Heat," by V. P. Mashovets and M. A. Korobov; Moscow, Zhurnal Tekhnicheskoy Fiziki, Vol 28, No 10, Oct 58, pp 2124-2129

A thermal field is successfully modeled by analogy with an electric field. A value called "formfactor" was introduced by A. N. Lozhkin, Yu. V. Golevinskiy, and Z. Z. Alperovich (ZhTF, 6, 7, 1936; Teplovyye Seti

[Thermal Networks], 1936; and Problemy Teplofikatsii [Heating Problems] No 11, 1936 as an analogy criterion between electric and thermal fields. But this analogy method was valid for a Laplace field only, where internal heat sources are missing. In this work the criterion equation for the internal region is derived, as well as for the boundary conditions of the electric field modeling a thermal field with internal heat sources.

Electrodynamics

79. Spatial Dispersion Considered in Calculation of Electron Energy Loss

"Energy Losses of an Electron in a Medium With Spatial Dispersion," by V. M. Agranovich and A. A. Rukhadze; Moscow, Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, Vol 35, No 5 (11), Nov 58, pp 1171-1174

A general formula for the energy loss of an electron moving in an arbitrary anisotropic medium with spatial dispersion is given. It is shown for the nonrelativistic case that the total energy loss in an isotropic medium does not change on consideration of the spatial dispersion of the medium, while losses to the excitation of longitudinal waves do in general change. It is shown that Cherenkov radiation of a given frequency is distributed over the surface of several cones, if the spatial dispersion of the medium is taken into account. The intensity of this radiation is calculated.

80. Low-Frequency Oscillations in a Plasma Studied

"Low-Frequency Oscillations of a Plasma in a Magnetic Field," by K. N. Stepanov, Physicotechnical Institute, Academy of Sciences Ukrainian SSR; Moscow, Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, Vol 35, No 5 (11), Nov 58, pp 1155-1160

Low-frequency oscillations which occur along with high-frequency electron oscillations in a plasma and in which both electrons and ions participate are considered. Low-frequency longitudinal oscillations in a plasma consisting of electrons and singly charged ions and located in a constant homogeneous magnetic field are studied. The dispersion equations and their solutions for certain limiting cases are given.

81. Certain Properties of Supersonic Flows Deduced

"On Certain Properties of Axially Symmetric Supersonic Gas Flows," by Yu. D. Shmyglevskiy, Computer Center, Academy of Sciences USSR; Moscow, Doklady Akademii Nauk SSSR, Vol 122, No 5, Oct 58, pp 782-784

The equations for the axially symmetrical gas flow, defined by the characteristic of the first family, around a body of revolution with a given shape are considered. The equations were formulated by A. A. Dorodnitsyn (Sbornik Teoreticheskikh Rabot po Aerodinamike [Collection of Theoretical Work on Aerodynamics], Moscow, 1957).

Two properties were deduced on the basis of an analysis of the equations. In the axially symmetrical supersonic flow around a body of revolution, an increase in the radius of curvature of the generating curve AB of the body at a point A on the body produces a decrease in the derivatives at a given characteristic AC of the first family $d\alpha/ds$ and $d\theta/ds$, where α is the Mach angle, s is distance measured along the line of constant characteristic of the second family, and θ is the angle of inclination of the velocity to the axis of flow. One consequence of this property is that when the curvature of AB at the point A is equal to -oo, the derivatives $d\alpha/ds$ and $d\theta/ds$ are a minimum.

The second property given is that, in axially symmetrical flow around a body of rotation, an increase in the radius of curvature of AB at the point A produces an increase in the radius of curvature of the shock wave at point C, if the points A and C are connected by a characteristic of the first family. A consequence of this property is that the curvature of the shock wave at the point C is a minimum when the curvature of AB at the point A is equal to -oo.

82. Solution to Equations for Two-Dimensional Compressible Flows Given

"Approximate Analytical Representation of Plane Supersonic Gas Flows," by O. S. Vorob'yev; Moscow, Doklady Akademii Nauk SSSR, Vol 122, No 5, Oct 58, pp 778-781

The solution to the equations for the supersonic flows of a compressible gas is given on the basis of certain approximations. Four boundary-value problems for these equations are also treated.

Mechanics

83. The Rotation of a Heavy Body About a Fixed Point Investigated

"Concerning the Integration of the Equations of Rotation of a Heavy Solid Body About a Stationary Point in the General Case of Goryachev-Chaplygin," by V. A. Toporova, Institute of Mathematics and Mechanics imeni V. I. Romanovsky, Academy of Sciences Uzbek SSR; Tashkent, Izvestiya Akademii Nauk, Uzbekskoy SSR, No 2, 1958, pp 77-85

As is known, D. N. Goryachev developed the particular case of complete integrability of the equations of rotation of a heavy rigid body about a stationary point (see Lektsii po integrirovaniyu uravneniy dvizheniya tyazhelogo tverdogo tela okolo nepodvizhnoy tochki [Lectures on the Integrability of the Equations of Motion a Heavy Solid Body About a Stationary Point], Gostekhizdat, M., 1953). In addition, S. A. Chapliyagin proved that this case may be investigated completely on the basis of conversion of hyperelliptic integrals. In order to indicate how this result of Goryachev-Chaplygin is utilized for a general investigation, the differential equations of the problem are considered under the conditions that the coordinates of the center of the load satisfy the conditions

$$y_o = z_o = 0,$$

and that the moments of inertia satisfy the condition

$$A = B = 4C.$$

84. Fast Method of Determining Electron Density Distribution in Crystals

"On the Investigation of Electron Density Distribution in a Crystal," by Yu. N. Shuvalov; Leningrad, Vestnik Leningradskogo Universiteta, Seriya Fiziki i Khimii, No 4, 1958, pp 36-44

A graphical method of determining slight changes in the electron density distribution in a crystal is described. The method obviates the necessity of extensive calculations, in which the accumulated error may exceed the effect under study. It was applied in a study of the redistribution of electron density in cadmium sulfide connected with the increase in its electrical conductivity.

85. Ionic Emission From Metals

"Theory of Ion-Electron Emission From Metals. I. Comparison With Experiment," by S. V. Izmaylov; Moscow, Zhurnal Tekhnicheskoy Fiziki, Vol 28, No 10, Oct 58, pp 2209-2216

Experimental data and "radiative" theory of kicking out electrons from the metal by means of fast positive ions are compared. The theory is found to concur satisfactorily with observations. For further details a complex study of the secondary electron emission is considered imperative.

86. Secondary Electron Emission

"Electron Reflection and Secondary Emission From Metallic Surfaces in the Region of Small Energies of Primary Electrons, I.," by I. M. Bronshteyn and V. V. Roshchin; Moscow, Zhurnal Tekhnicheskoy Fiziki, Vol 28, No 10, Oct 58, pp 2200-2208

An attempt is made to devise a convenient method for measuring the coefficients of secondary emission from a nickel surface and the reflection coefficient of electrons from a metallic surface at a primary energy range from 0.2 or 0.4 ev to 30 ev. Experimental results of measurements with a nickel surface are plotted in graphs.

87. Dielectric Losses in Crystals

"Dielectric Losses in Feldspars," by V. A. Ioffe and I. S. Yanchevskaya; Moscow, Zhurnal Tekhicheskoy Fiziki. Vol 28, No 10, Oct 58, pp 2154-2164

The temperature and the frequency relations of the angle of dielectric losses and of permittivity of a number of natural single crystals of feldspars at a temperature range of 20-500°K and at a frequency range of 5.10^2-5.10^6 cycles are studied. A resonance absorption and an anomalous permittivity dispersion were revealed at a 5.10^5-cycle frequency in all tested feldspars. It was established that at a temperature range of 200-500°K the permittivity in feldspars depends on the resonance phenomenon. Resonance occurs at thermal excitation. The low and uniform resonance frequancy for all tested feldspars indicates that the observed resonance should be connected to electronic processes. It is suggested that resonance occurs during electron transition from one oxygen atom to another in the negatively charged aluminum-oxygen tetrahedron.

88. Photoconductivity of CdS Crystals

"Investigation of the Spectral Distribution of Photoconductivity in CdS Single Crystals at 77 and 20°K," by V. L. Broude, V. V. Yeremenko, and M. K. Sheynkman; Moscow, Zhurnal Tekhnicheskoy Fiziki, Vol 28, No 10, Oct 58, pp 2142-2151

The fine structure of photoconductivity curves of CdS single crystals was studied at temperatures of 77 and 20°K and compared with absorption spectra at various wavelengths. The ratio of spectral distribution of the photocurrent to the lifetime of current carriers did not exhibit a simple relation to the coefficient of light absorption at the boundary of self-absorption. Therefore, the ratio of photosensitivity of the absorption coefficient depends on the wavelength of the absorbed light.

89. Inelastic Electron Scattering

"Theory of Inelastic Electron Scattering in Metals, I.," by A. Ya. Vyatskin; Moscow, Zhurnal Tekhnicheskoy Fiziki Vol 28, No 10, Oct 58, pp 2217-2227

The problem of inelastic scattering of high-energy nonrelativistic electrons in metals due to their Coulomb interaction with the lattice electrons is analyzed. A solution is obtained by the method of successive weak bond single electron approximation for lattice electrons.

Theoretical Physics

90. Statistical Matrix for Relativistic Electron Gas Obtained

"A Method for Calculating the Statistical Matrix," by A. B. Tulub; Leningrad, Vestnik Leningradskogo Universiteta, Seriya Fiziki i Khimii, No 4, 1958, pp 23-29

The problem of calculating a statistical matrix is reduced to the solution of the Heisenberg equations of motion in which the time is replaced by the quantity $s = -i(1/kt)$, where k is the Boltzman constant and T is the absolute temperature.

The method is used to obtain an integral representation of the statistical matrix for a relativistic electron gas. The advantage over a calculation based on energy considerations is that the difficulties due to the complexities of the Dirac wave functions in the presence of a magnetic field are avoided.

The collaboration of V. A. Fok is acknowledged.

Miscellaneous

91. New Institute of Physics of High Pressures Organized in the Academy of Sciences USSR

"Institute of Physics of High Pressures," (unsigned article); Moscow, Priroda, Vol 47, No 10, Oct 58, p 112

"The physics of high pressures is a relatively new field of science which is acquiring increased significance in many fields of science and practical application. The development of research on the compressibility of matter in its three states -- solid, liquid, and gas -- has led to the discovery of new relationships pertaining to the structure and properties of matter. Taking into consideration the importance of further development of research in this field, the Presidium of the Academy of Sciences has decided to reorganize the Laboratory of the Physics of Superhigh Pressures, Academy of Sciences USSR, into the Institute of the Physics of High Pressures. The principal lines of research pursued at the new institute will be concerned with the effect of pressure on the plastico-elastic properties of solids; the fine structure of energy levels, the strength of bonds between atoms, interactions between electrons, and phase transformations in solids; the physical properties of substances under pressures of the order of one million atmospheres; the physical properties of liquids under superhigh pressures; etc.

"The new institute consists of five laboratories, viz., those of the structure of matter, physicomechanical properties, electric and galvanomagnetic phenomena, dynamic methods, and research on the liquid state.

"Prof L. F. Vereshchagin has been appointed director of the new institute."

XI. MISCELLANEOUS

92. Conference on Electron Microscopy

"The Biological Section of the All-Union Conference on Electron Microscopy," by S. B. Stefanov; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Biologicheskaya, No 6, Nov/Dec 58, pp 756-758

The Second All-Union Conference on Electron Microscopy was held in Moscow during the early part of May 1958. One of the largest sections of the conference was the biological which presented 35 reports on the use of electron microscopy in virology, microbiology, histology, and cytology.

Among the virological reports, three concerned the influenza virus. S. B. Stefanov, of the Laboratory of Electron Microscopy, Department of Biological Seiences (OBN -- Otdeleniye Biologicheskikh Nauk), Academy of Sciences USSR, reported on the abrupt morphological changes in the influenza virus as a result of washing the virus with distilled water before electron microscopy. He also reported new methods of washing. As As a result of these methods, he discovered new morphological elements in the influenza virus cultures. V. D. Lotte (Institute of Virology, Academy of Medical Sciences USSR) confirmed some of the facts described by Stefanov. V. A. Zuyev (Institute imeni Mechnikov in Moscow) presented some information on phagocytosis of the influenza virus.

Gao Tyan' Syan' (Institute of Virology, Academy of Medical Sciences USSR) presented the first photographs of consecutive sections of the virus of lymphogranulomatosis inside cells.

A. S. Shubin (Insitute of Cancer Pathology and Therapy, Academy of Medical Sciences USSR) reported the presence of viruslike particles in extracts of a series of malignant tumors after many passages of the tumor material through tissue explants.

K. S. Sukhov (Institute of Genetics, Academy of Sciences USSR), who for a long time has fruitfully used electron microscopy in his experimental work, reported new findings as a result of his studies of the tobacco mosaic virus. V. A. Smirnova (Laboratory of Electron Microscopy, Department of Biological Sciences, Academy of Sciences USSR) presented the results of her observations on the morphology of the formation of particles in the tobacco mosaic virus. Ye. I. Skalinskiy (State Scientific Control Institute for Veterinary Preparations, Ministry of Agriculture USSR) presented interesting new details concerning the structure and configuration of the particles in the fowl pox virus.

I. Ya. Ageyev (Ukrainian Experimental Vetrinary Institute) attained great successes in studying the hog cholera virus. There is no information in the literature concerning the morphology of this virus, and its artificial culturing has definitely never been accomplished. After studying the erythrocytes of some infected animals, Agayev believes that the small granules on the surface of the eyrthrocytes are the hog cholera vectors. N. K. Oleynik, of the same institute, reported on his work involving the morphology of the vector of infections equine anemia, something which had never been investigated before.

V. I. Biryuzovaya (Laboratory of Electron Microscopy, Department of Biological Sciences, Academy of Sciences USSR) reported on her investigations of the fine structure of bacterial cells with the aid of superthin sections. She presented information concerning nucleus-like formations in bacteria, and new, earlier unknown details of the structure of the protoplasm -- small canals, permeating it in various directions. The author considers these canals analogous to the ergastoplasm of higher cells.

Ye. I. Skalinskiy and N. M. Nikiforova (State Scientific Control Institute for Veterinary Preparations) described distinct morphological differences between pathogenic and nonpathogenic strains of pasturella. This work, as far as is known, is the first instance in which electron microscopy has been used to study pasturella.

Several reports described changes in bacterial cells caused by the effect of chemical therapeutic substances and antibiotics.

In the reports concerning bacteriophages, A. S. Tikhonenko (Laboratory of Electron Microscopy, Department of Biological Sciences, Academy of Sciences USSR) described the results of treating bacteriophage particles with a detergent and quaternary ammonium bases, causing the head to disintegrate into fine grains with a diameter of 15-25 millimicrons. The study of bacteriophage morphology and its interaction with bacterial cells, it was reported, has begun in certain institutes of the Academy of Medical Sciences USSR. N. N. Solv'yev showed some beautiful photographs of various phages.

Reports were also presented in the fields of histology, cytology, and histogenesis, all involving the use of electron microscopy.

The work of the Biological Section of the conference indicates blatant insufficiencies in the development of electron microscopy research involving biological objects. The fact that electron microscopy is not being utilized to the fullest degree was obviously demonstrated. The medical biological establishments of the USSR are equipped with more

than 50 electron microscopes. However, more than 50% of the published works appearing in the Soviet literature involving electron microscopy of biological objects was accomplished primarily at the Laboratory of Electron Microscopy, Department of Biological Sciences, Academy of Sciences USSR, which at present has three microscopes. Of the 35 reports given at the section meeting, 7 were completed by members of this laboratory, 5 by other institutes of the Department of Biological Sciences, and 8 by institutes of the Academy of Medical Sciences. This means that many laboratories which possess electron microscopes did not present reports in the various sections of the conference. Therefore, it is suggested the centralized laboratories of electron microscopy be established in the affiliates of the Academy of Sciences USSR, the republic and associate academies, larger universities, and scientific centers.

It was reported at the conference that two new microscopes, the UEMB-100 with a resolution of 10-12 angstroms and the EM-5 with a resolution of 20-25 angstroms, will be produced this year.

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