Digest of Translated Russian Literature

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SOVIET PHYSICS-DOKLADY (*Doklady Akademii Nauk SSSR, Otdel. Fiziki*). Published by American Institute of Physics, New York.

Volume 5, number 6, May–June 1961.

Expansion of a Reactive Four-Terminal Network into a Chain of Simplest Four-Terminal Networks, M. S. Livshits and M. Sh. Flekser, pp. 1150–1152.

Principle of "Mobile Lockouts" in Designing Electronic Digital Computer Networks, M. A. Kartsev, pp. 1153–1156.

Together with a group of engineers, the author developed a system of potential semiconductor elements for networks, designed for use in electronic digital computers at a switching frequency of up to 5–7 Mc. Without dwelling on the engineering details, we shall merely note those characteristic features of this system of elements which are essential to our subsequent analysis.

Accurate Solution of the Three-Dimensional Equations for a Nonsteady Gas-Flow of the Double Wave Type, L. V. Komarovskii, pp. 1163–1165.

Stability of One Case of a Spherical Converging Shock Wave, R. M. Zaidel' and V. S. Lebedev, pp. 1166–1168.

Construction of Asymptotic Expansions for Weak Interaction from the Formal Thermodynamic Perturbation Theory in a Modified Formulation of the Problem of a Nonideal Bose-Einstein System, V. V. Tolmachev, pp. 1190–1193.

The following question arises naturally: To what kind of approximation does the summation of the special type of diagram arising in a statistical variation principle correspond? It seems to us that the fundamental value of such summation, reconstructing the formal perturbation theory, is in the fact that with its help one may construct asymptotic (for weak interactions) expansions of quantities of interest to us; i.e., it furnishes us with a method for constructing such a type of expansion.

Axiomatic Method and the Theory of Perturbations, B. V. Medvedev, pp. 1206–1209.

The usual approach to quantum field theory is by means of the formal Hamiltonian approach, which arises as a direct transference to field theory of the method that leads from classical mechanics to quantum mechanics. With this method, the theory is fixed when the form of the Lagrangian is assigned; an application of the variational method yields the equations of motion, and when quantization is carried out by known methods, these equations are transformed into the Heisenberg equations for the operational functions of the field. The theory can actually be formulated in this way only in the framework of perturbation theory, since not only the solution of the equations, but the equations themselves ("exclusion of infinity") can only be obtained in the form power series in the coupling constant.

Difficulties in the Hamiltonian method have led to the introduction of another approach—often called (not too suitably) the axiomatic method—in which the basis of the theory is taken to be certain general physical requirements which must be satisfied by *the solutions of the equations*, while these equations are not explicitly formulated. Interest in such a method of constructing a theory has grown recently in connection with the investigation of dispersion relations—the only exact result of quantum field theory.

The fundamentals of the axiomatic method can be formulated in various ways. Among these formulations of the basis of the theory can be included the requirement that at each point there exist Heisenberg fields that are commutative with any space-like hypersurface; this approach has been developed by Lehmann, Symanzik, and Zimmermann, and many others. On the other hand, we can start from a proposal made by Heisenberg, and limit our considerations to the scattering matrix. This latter method was used by N. N. Bogolyubov, M. K. Polivanov, and the author in connection with the theory of dispersion relations.

In all the variants of the axiomatic approach, there arise natural questions concerning the compatibility of the system of "axioms" introduced, and the sufficiency of these axioms (with what degree of arbitrariness?) in determining the theory. It is impossible at the present time to give any definite answer to the first of these questions, since the existence of a consistent quantum field theory has not yet been established. The aim of the present work is to investigate the second question. To be precise, we will show that, in the framework of perturbation theory, the formal expansion of the scattering matrix in powers of the coupling constant follows from the basic position of the axiomatic approach, supplemented by assumptions concerning the transformation properties of the fields considered, and the rates of growth on the matrix elements. The same degree of arbitrariness is obtained as in the usual theory.

Boundary Conditions in the Method of Sperical Harmonics V. S. Vladimirov, pp. 1210–1213.

Temperature Effects in the Plasma Vibrations of a High Density Fermi-Gas, I. V. Trosnikov, pp. 1214–1217.

The collective vibration spectrum of a high density electron gas is investigated. The method used allows one to examine simultaneously the cases of high and low temperature. The only difference arises in the calculation of the integral entering into the final expression for the energy of the collective vibrations. The value of this integral may be calculated by expanding the integrand in a series. For low temperatures one obtains a temperature correction vanishing at zero temperature. For high temperatures the correction is of a quantized character and vanishes in the classical limit.

Calculation of the Phase Trajectories of Charged Particles Taking into Account the Coulomb Interaction in the Input Resonator of a Linear Electronic Accelerator, S. P. Lomnev, pp. 1264–1266.

Because of the exceptional complexity of the dynamic equations for a great number of charged particles, we could not integrate the equations directly, and the multiple-particle problem was solved by means of physical statistics. Contemporary, rapid operating computing machines permit us to turn again to the direct method of solution of the multiple-particle problem which is formulated as Cauchy's problem with initial conditions.

In this paper, the latter method is illustrated in the computation of the longitudinal motion of an electron packed in a linear accelerator using the relativistic approximation and taking account of the interaction of the electrons in the packet. We wish to note that in earlier accelerator calculations charge interaction was not considered, even though it has a basic influence upon the bunching and capture of the particles during the operation of large current accelerators, as is shown.

Spectroscopic Investigation of the Propagation of Hypersonic Waves in Viscous Liquids, M. S. Pesin and I. L. Fabelinskii, pp. 1290–1292.

One Possible Mechanism for Capture of Charged Particles in a Magnetic Field, V. M. Vakhnin and G. A. Skuridin, pp. 1296–1299.

Generalized Hartree-Fok Methods, Ya. I. Vizbaraite, T. D. Strotskite, and A. P. Yutsis, pp. 1300–1302.

Phenomenon of Magnetic Pinch in a Free-Molecular Plasma Stream (the Theory Governing the Flow of Solar-Corpuscular Streams Past the Earth's Magnetic Dipole), V. N. Zhigulev, pp. 1306–1308.

We analyze the case of the flow of a free molecular plasma stream past bodies that have an intrinsic magnetic field when the basic linear interaction parameter is large compared with the thickness of the "returning" layer and greater than the dimensions of the body (i.e., the body is completely within the cavity S). The general problem of magnetic "pinch" is formulated for this case. The results of the study are applied to the problem involved in the flow of corpuscular solar streams past Earth's magnetic dipole in the case where these streams are free molecular.

Fluctuating Microfield and Multiple Collisions in a Gas of Charged (or Gravitating) Particles, V. I. Kogan, pp. 1316–1319.

Investigation of the Dynamic Stability of Plates Using an Electronic Digital Computer, A. Yu. Birkgan and A. S. Vol'mir, pp. 1364–1366.

The stability and critical behavior of plates subject to dynamic stress were investigated elsewhere by applying the Bubnov-Galerkin method; the approximate expression obtained for the deflection contained one parameter. In the present work, we give the results of a more accurate solution of this nonlinear problem, which were obtained by applying finite differences and using an electronic digital computer for the numerical calculations. We consider an initially deflected square plate hinged along the edges, which is subjected to dynamic compression forces in one direction. We assume that the edges remain straight during the deformation, but that the loaded edges can move freely toward each other. The variation with time of the deflection, and the stresses is to be determined.

Role of the Nervous System in Altering Free Histamine Level of Tissues Following Exposure to Ionizing Radiation, E. I. Krichevskaya, pp. 1369–1371.

The part played by the nervous system in altering the free histamine level of blood and tissues has been shown by many authors. The observed changes in level were usually linked with pain stimulation of the receptors, afferent nerve fibers or posterior roots of the spinal cord. In the radiation syndrome, despite the absence of the pain component, several investigators have also noted a definite increase in pathological impulses arising in the organs of the abdominal cavity. Their onset or intensification could be either a consequence or a cause of the production of certain humoral factors, particularly histamine.

In previous studies we established an increase in free histamine in various tissues of animals at early times after a single total-body exposure to a lethal dose of x rays. A study of the intimate biochemical mechanisms showed that these shifts were due to a change in the activity of the histidine decarboxylase-histaminase enzyme system and the reduction of the histamine-binding capacity of the tissues.

In the light of these ideas the aim of the present study was to find out if the increase in free, i.e., biologically active, histamine in various organs was a result of the direct action of radiation or if it was a reflex effect, like several other radiation effects. To clarify this question we studied the effect of ionizing radiation on the free histamine content of tissues when the receptor apparatus was excluded.

Volume 6, number 1, July 1961.

Complexity of Superpositions in Bases That Contain Nontrivial Linear Formulas with Zero Weights, É. I. Nechiporuk, pp. 6–9.

Statistical Dynamics of an Incompressible Turbulent Fluid, B. I. Davydov, pp. 10–12.

In the modern theory of turbulence the fluid flow is usually described in terms of two-point statistical moments, that is, in terms of correlations between hydrodynamic quantities referring to two points separated by a finite distance. This rather complicated description limits one to the more straightforward case of homogeneous turbulence; such restriction, however, has not proved completely successful. In view of this one may expect that the theory of inhomogeneous turbulence base on two-point moments would provide the means to solve fully actual problems. This has caused us to turn to one-point moments and try to obtain for them a closed system of differential equations.

In a previous paper by the author a turbulent flow was described in terms of the following quantities: the average velocity $U_i = \bar{u}_i$ at each point (at a given moment of time), then by the second moments $R_{ij} = \overline{v_i v_j}$ and the third moments $S_{ijk} = \overline{v_i v_j v_k}$ of the fluctuating velocities $v_i = u_i - U_i$, and finally by the energy dissipation at the given point $Q = \nu\overline{(dv_i/dx_k)^2}$, where ν denotes viscosity.

When one derives from the Navier-Stokes equation the statistical differential equations for the fundamental quantities, other moments also appear in them; we express them approximately in terms of the fundamental ones. Thus, the fourth moments of the fluctuating velocities are, in the known way, expressed by the second moments. As regards the moments in which the pressure fluctuation $q = p - P$ (where $P = \bar{p}$) occurs, these can be expressed in terms of fundamental moments, by using a close analogy to the corresponding terms in the Boltzmann kinetic equation for an ideal gas.

Effect of Bubbles in Shock Detonation in a Liquid, R. I. Soloukhin, pp. 16–17.

In experiments on the shock detonation of liquid explosives, it was found that the sensitivity to detonation depended to a large degree on the presence of gas bubbles in the liquid. The sharp increase in external pressure leads to the adiabatic collapse of a bubble, and this leads in turn to the formation of a detonation nucleus in the gas medium. It is impossible, however, to use the adiabatic compression formula in the calculation of the maximum temperature of the gas for the excess pressure in the liquid, because of the inertial forces that act during the collapse of the bubble. The time for the collapse can also be of the same order as the time for the change in pressure through the shock wave producing the compression. This causes more difficulty in calculating the compression. Below we consider the results of experiments on the shock detonation of an explosive gas mixture in the form of underwater gas bubbles.

Diffusion Irradiation in a Medium with Mirror Reflecting Boundaries, V. V. Sobolev, pp. 21–23.

In a note the author discussed the problem of diffuse irradiation in a semi-infinite medium which consisted of plane-parallel layers limited by a mirror surface with a coefficient of internal reflection equal to unity. This problem was reduced to the equation

$$B(\tau) = \frac{\lambda}{2}\int_0^\infty [Ei|\tau - t| + Ei(\tau + t)]B(t)dt + g(\tau) \quad [1]$$

where $B(\tau)$ is the ratio of the radiation coefficient to the absorption coefficient (at optical intensity τ); $g(\tau)$ the ratio of the radiation coefficient, immediately at the radiation source, to the absorption coefficient; λ the probability of survival of a quantum during the primary act of dispersion.

Eq. [1] may be solved by using the Fourier transformation. However, in the note mentioned another method (suggested earlier by another author) was used for solving this equation. In the present note this method is used to solve an equation having the general form of Eq. [1].

Theory of the Mössbauer Effect, I. P. Dzyub and A. F. Lubchenko, pp. 33–35.

The study of the emission and absorption of γ quanta by nuclei that are part of a crystal lattice is of interest both to nuclear and solid state physics. The interpretation of the experimental data presented in a reference given was based on the work of Lamb. In view of the fact that experimentally it is possible to detect very small changes (10^{-7} ev) in the position of the maxima in the γ ray emission (or absorption) cross section and also to investigate the shape of the reabsorption curve, it is of considerable interest to be able to take into account the changes in the equilibrium positions and the normal frequencies of lattice vibrations as a function of the nuclear state. The problems of the factors governing the shape of the intensity curve in emission (or absorption) and whether or not an undisplaced Mössbauer line is present in the spectrum are very important. This aspect of the phenomenon is considered in the present paper.

Theory of Discrete Space Time V. G Kadyshevskii, pp. 36–38.

Some Properties of Cesium Plasma in a Thermoelectronic Energy Converter, N. D. Morgulis and Yu. P. Korchevoi, pp. 71–73.

Devices for the direct conversion of thermal energy into electrical by means of thermionic emission (reviews of this subject are given elsewhere) are almost always filled with cesium vapor at a suitable pressure p. The aim of this is to neutralize the electronic space charge at the cathode by the Cs ions and to create a contact potential difference V_c between the converter electrodes. Cs vapor usually produces interelectrode plasma and can have a significant influence on the physical properties of the converter, for example, analogous to that discussed theoretically in another paper. Some workers have considered that the plasma plays a dominant role in such a "plasma converter." The aim of the present work has been to obtain information about the properties of this type of plasma.

Stability of Wing Panels Under Heating, L. M. Kurshin, pp. 77–79.

Plasma Effects in Semiconductors and Biological Effect of Radiowaves, D. A. Frank-Kamenetskii, pp. 91–93.

Relation Between Communication Capacity of Vision and Brightness, V. D. Glezer, I. I. Tsukkerman, and T. M. Tsykunova, p. 93.

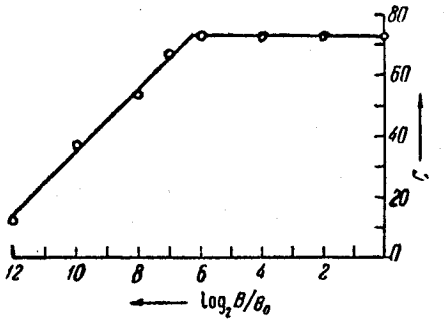

Fig. 1

The communication capacity of vision is the maximum amount of information which can be perceived by the brain through the visual system in unit time. Its value in optimal conditions of seeing is of the order of several tens of bits of information per second.

The aim of this work was to study the relation between communication capacity and brightness. The brightness was varied by means of neutral filters. Otherwise the method was the same as that used in Sziklai's work, where the speed of visual perception was measured by means of a television apparatus. The subjects were trained to identify eight simple, large (about 2–4 degrees) objects with a contrast of about 80%, presented in random order. The communication capacity was measured as $C = (H/T)$bits/sec, where T is the time required for correct identification of one object, and $H = \log_2 B = 3$ bits is the amount of information obtained.

Fig. 1 (mean of four subjects) shows C as a function of the logarithm of the ratio of B to B_0—the initial brightness (about 100 apostilb in white). At low levels of brightness the communication capacity increases linearly with increase in the brightness logarithm, just as the capacity of an ideal communication system would increase with the power of the useful signal. A two-fold increase in brightness in this region leads to an increase of approximately 10 bits per sec in the communication capacity.

Comparing the linear dependence of C on $\log_2 B$ with the linear dependence of visual acuity on $\log B$, we can surmise that the change in volume of the visual channel underlies the mechanism of the increase of communication capacity in this region.

With further increase in brightness in the conditions of the experiment the visual acuity no longer restricted the identification of objects and maximum speed of perception was attained.

Literature Cited:

1 Sziklai, G. S., Trans Inst. Radio Engrs., IT-2, no. 3, 125 (1956).

2 Shannon, C., *Information Theory and Its Applications* (Russian translation) (Moscow, 1959), p. 82.

3 Glezer, V. D., and Tsukkerman, I. I., Biofizika 4, 55 (1959).

Volume 6, number 2, August 1961.

Possibility of Observation of Gas Nebulae in the Lyman Alpha Line, G. A. Gurzadyan, pp. 95–97.

Improving the Quality of Extremum Control of Objects with Inertia in the Presence of Interference, V. V. Kazakevich and A. P. Yurkevich, pp. 104–106.

In order to solve the problem of extremum control of objects with inertia in the presence of external low frequency interference it is necessary to use some special systems. When using ordinary controllers such as those memorizing the extremum, the reduction in the speed of search is unavoidable due to inertia of the object; this reduction in turn lowers the noise stability of the system.

In another article a method of extremum control was presented and was so substantiated that it enabled one, in principle, to avoid the harmful effect exercised by the inertia of an object of any order in the absence of the object's dynamic members below the extremum of the characteristic. It is a special feature of the indicated system that a specific combination, in the general case a nonlinear one, of signals from the derivatives of the regulated quantity is fed to the input of the controller; also the effect due to the varying of the function is introduced with the aid of the nonlinear member.

These systems give a better performance as regards the quality of the control processes in objects with inertia in the presence of low frequency interference even when compared with the control of an inertialess object; this is due, to some extent, to the effect of the low frequency interference being filtered out. In the presence, however, of strong interference such that the level of the maximum varies rapidly, and when the readjustment of the regulating unit is not unduly rapid, the losses due to search may become quite considerable.

We shall concern ourselves with the frequency occurring case of the extremum control of an object of the first order.

Method of Determining Transfer Matrix Functions in Multicircuit Automatic Systems, P. I. Chinaev, pp. 112–114.

The actual elaboration of complex systems of automatic control necessitates an extensive application of the analysis and synthesis methods of multicircuit automatic systems. One begins with matrix differential equations which provide a mathematical description of the processes taking place in the system and their interrelations.

The transfer function approach introduced by A. V. Mikhailov is at present considered to be a fundamental one when forming the equations of motion of a single-circuit system. For a system with a number of coordinates under control, however, it is customary to use only an algebraic formulation; not only are the computations more involved in this case but errors are also more likely to occur.

A method is presented in the sequel whereby a matrix transfer function is determined in the case of a complex multicircuit automatic system.

A Class of Progressive Motion in an Ultrarelativistic Gas, V. A. Skripkin, pp. 115–117.

Self-Similar Solutions of the Laminar Boundary Layer Equations in Magnetic Hydrodynamics, N. I. Pol'skii and Academician I. T. Shvets, pp. 121–124.

Recently there have appeared numerous papers devoted to finding self-similar solutions of the equations for the laminar flow of a viscous, electrical conducting liquid or gas in the presence of a magnetic field. In the majority of them the flow past a plate or in the vicinity of a stagnation point of a blunt body is investigated subject to some kind of limitations—not considering, for example, the interaction of the magnetic field with the viscous flow, omitting the terms characterizing the viscous and Joulean dissipation in the energy equation, and not considering the change of the magnetic field intensity B along and transverse to the flow. Other self-similar solutions were obtained elsewhere for the case in which the velocity outside the boundary layer and the magnetic field intensity are related by a power law along the body in appropriately chosen variables (and not in the initial "physical" plane). In another paper it was shown that the value of B in the vicinity of the stagnation point decreases along the normal in inverse proportion to the cube of the distance, and the effect of the magnetic field on the nonviscous flow was established. This gave occasion to investigate, in a reference given, the effect

of the indicated change of the value of B on the heat transfer. In this case, the self-similar equations given elsewhere, in which the value of B was also taken to be constant, equal to its mean value between the stagnation point and the shock wave, were used.

However, it is not difficult to obtain self-similar solutions also when B changes according to a power law both along the body and along the normal. In addition, certain other self-similar solutions of the equations of the laminar boundary layer in magnetic hydrodynamics are implied here, and they in some sense exhaust all the possible cases of obtaining such solutions. The present paper is devoted to these questions. The case of an incompressible fluid and of a gas are both investigated.

Variation of the Cathode Sputtering Coefficient as a Function of the Angle of Incidence of Ions on a Target, V. A. Molchanov and V. G. Tel'kovskii, pp. 137–138.

At the present time, there is no single well-constructed theory of cathode sputtering. In order to explain the nature of this complex phenomenon it is important to know the angular dependence of the process of target disintegration. However, the effect of the angle of incidence of the ions on the magnitude of the cathode sputtering is not well known. For low energy ions, qualitative results have been given. Quantitative measurements of sputtering under the action of ions with an energy of tens of kiloelectron-volts are reported only in two papers. But they were carried out for a relatively small angular interval (from 0 to 50°), and the authors attribute their lack of success to the large convergence of the ion beam. For glancing angles of incidence (close to 90°) no measurements of the cathode sputtering coefficient were made.

In this article we present the results of a study of cathode sputtering for polycrystalline samples of copper by 27-kev argon ions for a broad interval of angles of incidence of the beam (from 0 to 84°).

Heat Exchange during Liquid Metal Flow in the Laminar and Transition Regions, B. S. Petukhov and A. Ya. Yushin, pp. 159–161.

Most investigations dealing with the question of heat exchange during liquid metal flow in tubes have considered the heat exchange in the case of turbulent flow, and only a few authors have dealt with flow in laminar and transition regions. In accordance with other papers the heat exchange under conditions of laminar flow of liquid metals increases with increase in the Péclet number (Pe). This contradicts the theory according to which the Nusselt number (Nu) is a constant equal to 4.36 (under conditions of thermal stabilization with a constant thermal flow density at the wall). The existing data concerning heat exchange in the transition region show considerable divergence (by a factor of 2 or more).

In view of the foregoing, we have carried out an experimental investigation of heat transfer for the case of forced flow of mercury in a circular tube in the laminar and transition regions with constant thermal flow density at the wall. The heat exchange was under conditions of hydrodynamic and thermal flow stabilization.

Experimental Observation of Mach Reflection of Detonation Waves in a Solid Explosive, E. A. Feoktistova, pp. 162–163.

The experiments described below were carried out in connection with the solution of a problem concerning oblique impact of detonation waves performed by Gandel'man (this problem was recently discussed elsewhere). The solution obtained by him was not entirely accurate (the analyzed equation of state of the detonation products was inaccurate, and the solution was not obtained over a narrow incident angle range where the analytical solution is ambiguous); the critical value of the angle α_{cr} separating the regular and Mach reflection regimes was determined only as the interval 40–44°.

It therefore appeared to be of interest to observe experimentally the "third" Mach wave, measure its propagation velocity and also determine the value of α_{cr}.

Volume 6, number 3, September 1961.

Principle of Nonlocal Search in Automatic Optimization Systems, I. M. Gelfand and M. L. Tsetlin, pp. 192–194.

In many problems of practical nature it is necessary to make use of complex control systems, with many degrees of freedom. The study of control processes in many physiological mechanisms also leads to this kind of problem (formation of movement, analysis, of afferency, etc.). Attempts to solve these problems with the aid of classical mathematics have often proved futile. Moreover, even if an algorithm can be formed without any difficulty with the aid of which the problem could be solved in each particular case, the implementation of the algorithm does not prove possible due to the limitations of electronic computers and also due to the time which would be involved in solving the problem.

In such a case a solution could be reached by applying organization which, to some extent, is always characteristic of problems encountered in practical human activities as well as those in physiology. In other words, a solution is found by ignoring the most effort-demanding (chaotic) situations. It should be noted that in a large number of cases these disadvantageous (chaotic) possibilities appear to be also most difficult in the formal mathematical sense.

The present note is an attempt to solve one of the problems in the theory of automatic control, that is the automatic optimization in the case of many working parameters.

Some Exact Solutions of the Equations of Nonsteady Motion in Magnetohydrodynamics, Yu. P. Ladikov, pp. 198–201.

We consider a wider class of types of motion than those investigated elsewhere, in which the radial velocity was assumed to be a linear function of the radius.

Two-Dimensional Supersonic Flow, I. A. Charnyi, D. S. Vil'ker, B. I. Mitel'man, and G. D. Rozenberg, p. 205.

As is known, the temperature of a wall, parallel to which there is a supersonic gas flow with $Pr \approx 1$, does not differ greatly from the static temperature. It might be conjectured, however, that if we introduce a liquid into the supersonic gas flow, and this liquid has a freezing temperature much higher than the gas temperature, then a two-phase flow would be obtained consisting of the gas and particles of the frozen liquid. The temperature of a wall adjacent to such a flow could be considerably lower than the static temperature.

In order to verify this conjecture, experiments were carried out in the hydromechanics laboratory of the M. V. Lomonosov Moscow State University. Water was introduced into the supersonic air flow in a Laval nozzle ($M = 1.2$ and $M = 3.0$). The static air-temperature and the temperature of the water were 15°. The air and water mass-flows were respectively, 0.12 and 0.02 $kg \cdot sec^{-1}$. After the flow had continued for 8–12 sec, a steel rod located in the flow was covered with a layer of ice strongly attached to the rod. The rate of formation of the ice layer, its thickness, and the firmness of its attachment to the surface of the rod increased for increasing flow velocity.

This phenomenon could obviously be used in practice to obtain cooling effects at high pressure gas wells and mainline gas conduits, and it could also be used for cooling surfaces by using gas flows.

Canonical Operator Transformation in Representation of Secondary Quantization, F. A. Berezin, pp. 212–215.

Possibility of Reducing the Magnitude of the Ionization Fluctuation in Gases, A. A. Vorob'ev, A. P. Komar, and V. A. Korolev, pp. 219–221.

It is known that the fluctuations of the ionization produced by ionizing particles sets an upper limit to the resolving power obtainable in ionization measurements of nuclear particles. Fano has derived the following expression for δ_N, the rms fluctuation in the number N of ion pairs produced by ionizing particles of a given energy producing N_0 ion pairs on the average:

$$\delta_N^2 = \frac{\overline{(N - N_0)^2}}{N_0^2} = \frac{F}{N_0} \qquad [1]$$

An analytical expression for the coefficient F will be given below. According to Fano's estimate, $F = 0.3$–0.5 in the case of ionization in gases. Recent measurements made by us of the magnitude of the ionization fluctuations in argon have shown that $F = 0.22$. This means that, for example, the limiting value of the α-line half width in an ionization α-spectrometer is 14 kev at the α-particle energy $E_\alpha = 6.0$ Mev.

An analysis of the results of Fano's calculations shows that the magnitude of the ionization fluctuations is mainly determined by the redistribution of the numbers of ionized and excited atoms. Their total number appears to fluctuate considerably less. This

leads to the idea of the registration of the total number of ionized and excited atoms which can be realized in the following manner. It is known that the lowest excited level of the noble gases is metastable and that in the collision of such excited atoms with impurity molecules whose ionization potential is lower than the energy of the metastable state, the latter molecules become ionized (additional ionization). It is clear that if the probability for additional ionization is high, then the magnitude of the total ionization registered in the spectrometer will be proportional to the total number of the primary ionized and excited atoms.

Destruction of the Eye as a Sequel to Intraocular Operations Performed after Heavy Radiation Exposure, V. V. Popov, pp. 265–268.

The principal result in the present paper is in the nature of a chance discovery which we made during the course of our many years of experiments on the inversion of the round lens in the eye of lower vertebrates during their postembryonic development. In these experiments we have recently been using x ray as a technique, and this led us to establish a completely new concept—the "surgical after-effect" of relatively strong ionizing radiation in the case of operative interference with the eyeball. A brief substantiation of this concept is the main topic of our paper.

Volume 6, number 4, October 1961.

Algorithmic Solvability of Isomorphism Problems for Automata, Yu. I. Sorkin, pp. 294–295.

Structure of Slow Magnetohydrodynamic Shock Waves in the Barotropic Case, A. G. Kulikovskii, pp. 302–304.

The question of the structure of oblique magnetohydrodynamic shock waves has been examined in previous articles. The problem of the structure of magnetohydrodynamic shock waves reduces to resolving the questions: Which of the singular points of the system of ordinary differential equations describing the one-dimensional steady motion of a conducting gas may be joined together by integral curves; is such a joining unique; and does it depend on the magnitude of the dissipative coefficients. In another paper the problem of the structure of shock waves was examined in the presence of all the dissipative coefficients: viscosity, thermal conductivity, and magnetic viscosity. It was shown that there are not more than four singular points S_1, S_2, S_3, S_4 (in order of increasing density at the point) of the system of four ordinary differential equations describing the one-dimensional flow; and the character of the integral curves in the neighborhood of these singular points was elucidated. It was shown that there always exists a unique integral curve effecting the transition $S_1 \rightarrow S_2$, which corresponds to a rapid shock wave in the sense shown elsewhere. For not all relations among the dissipative coefficients may the pairs $S_1 \rightarrow S_3$, $S_1 \rightarrow S_4$, and $S_2 \rightarrow S_3$ be joined by integral curves. These transitions correspond to shock waves which are unstable in the sense given in another paper.

The question of the structure of slow shock waves ($S_3 \rightarrow S_4$) for all dissipative coefficients remained open. This is apparently connected with the mathematical difficulty of investigating integral curves in four-dimensional space, and also with the fact that an example had been constructed in which the points S_3 and S_4 are not joined by an integral curve. However, the construction of this example was in error, as shown in another paper.

Elsewhere the structure of magnetohydrodynamic shock waves was investigated for the case when only the magnetic viscosity and the second kinematic viscosity differ from zero among the dissipative coefficient. In that paper it was shown that within the framework of the setting indicated, there always exists a unique integral curve joining the points S_3 and S_4, and representing structure of slow shock waves; the character of the joining of the remaining pairs of singular points was also clarified.

Below, under the assumption of barotropy, it will be shown that slow shock waves always possess a structure, i.e., the points S_3 and S_4 are joined by a unique integral curve for any dissipative coefficients. The barotropy assumption is convenient in that it reduces the problem to the study of integral curves in three-dimensional space; however, certain peculiarities of the four-dimensional nonbarotropic case are retained in this still (compare the character of the singular points in a reference given and in the present paper).

Model of a Cavitating Liquid, B. S. Kogarko, pp. 305–306.

It should be noted that there is not yet a sufficiently satisfactory mathematical model to describe the flow of a liquid with cavitation bubbles inside it. The work of Ackeret, who assumed that the bubbles existing in the liquid are compressed adiabatically, and the pressure in the water is the same as the pressure inside the bubbles, was one of the first steps in the construction of such a model. A certain modification of these ideas was obtained elsewhere, where a diffusion model of a cavitating liquid was considered. However, in these theories, the dynamics of the individual bubbles was not taken into account.

In the present note, a model of a medium is proposed which, in a certain approximation, can be considered a cavitating liquid and in which the expansion of compression of the bubbles is subject to the ordinary equations of hydrodynamics. The origin of cavitation depends essentially on the presence of the liquid of foreign particles—"cavitation nuclei" (of dimensions 10^{-3} to 10^{-5} cm), around which cavitation bubbles form and grow.

Motion of a Body of Variable Mass with Constant Expenditure of Power in a Gravitational Field, G. L. Grodzovskii, Yu. N. Ivanov, and V. V. Tokarev, pp. 310–313.

The general case of the optimization of the reactive motion of a body of variable mass in a gravitational field of two centers with constant expenditure of power $N = \text{const}$ is investigated in the present paper, and the corresponding variational problem is examined.

Regarding Some Singularities in the Transverse Propagation of High Frequency Waves in Magnetoactive Plasmas, B. N. Gershman, pp. 314–316.

In this paper we study some of the singularities in the propagation of high frequency waves in a homogenous plasma that is located in a constant magnetic field $\mathbf{H}_0$. These singularities are associated with the presence of thermal motion of the electrons and are only noticeable in the direction which is perpendicular to or nearly perpendicular to that of the field $\mathbf{H}_0$ (transverse propagation). In the remainder of the paper we will assume that the propagation is strictly transverse.

Violation of the Boltzmann Distribution during Thermal Dissociation of Molecules, A. I. Osipov, pp. 323–314.

As has been shown, the process of thermal dissociation of molecules leads to a considerable violation of the Boltzmann distribution in the upper vibrational levels. This is caused by the fact that thermal dissociation occurs as a result of the transition of the molecules from the upper vibrational levels into the continuous spectrum, and the rate of molecular transitions into the continuous spectrum in greater than the rate of excitation of molecules into the upper levels. Elsewhere a system was discussed which consisted of a monatomic gas containing a small admixture of dissociating diatomic molecules. The distribution of vibrational energies in an isolated system of dissociating diatomic molecules is also of interest. In calculating distribution functions for vibrational energies in this case, it is necessary to take into account the transmission processes for vibrational quanta as well as the transformation of translational energy into vibrational energy during molecular collisions. The present paper is devoted to elucidating the part played by the former process in setting up a quasi-stationary distribution of vibrational energy during dissociation.

Broadening of the Hydrogen Lines from Arc Plasma and Shock Tubes, V. F. Kitaeva and N. N. Sobolev, pp. 328–331.

The present communication is devoted to a comparison of experimentally obtained profiles of H_α and H_β lines with the theoretical line profiles computed by the G. K. Sh. theory (Gruiem, Kolb, and Shen).

Contact Image Intensifier for Red Region of Spectrum, I. V. Volkov, V. F. Esipov, and P. V. Shcheglov, pp. 349–350.

Volume 6, number 5, November 1961.

Surfaces of Discontinuity with Release or Absorption of Energy in Magnetic Hydrodynamics, A. A. Barmin, pp. 374–376.

One Exact Solution of the Equations of One-Dimensional Relativistic Hydrodynamics with Discontinuity in the Transformation of the Residual Mass of the Material, V. A. Skripkin, pp. 377–379.

Properties of the Solution of the Problem of a Point Explosion in Compressible Media, N. N. Kochina and N. S. Mel'nikova, pp. 380–383.

The problem of a strong explosion in an ideal gas was solved by L. I. Sedov. The non-selfsimilar problem of a point explosion in an ideal gas has been examined by a number of authors. The problem of a strong point explosion in an ideal compressible medium was examined by N. N. Kochina and N. S. Mel'nikova and also by Yu. L. Yakimov, the non-selfsimilar problem of a point explosion by N. N. Kochina. It is of interest to investigate the dependence of the solution of the problem of an explosion in an ideal two-parameter medium on the energy of the explosion E_0, on the initial pressure p_1, and on the initial density ρ_1, and it is important to qualify the various cases in which one can convert a solution found for certain values of the parameters E_0, p_1, ρ_1, to other values of the energy of the explosion E_0 and other initial parameters p and ρ_1. The present paper is devoted to this question and to the asymptotic behavior of the solutions.

Resolvent of the Schroedinger Operator for a System of Three Particles Interacting in Pairs, L. D. Fadeev, pp. 384–386.

The energy operator for a system of N particles with masses $m_1, \ldots, m_N$ interacting in pairs has the form

$$H_N = -\sum_{i=1}^{N} \frac{1}{2m_i} \nabla_i^2 + \sum_{i<j}^{N} v_{ij}(r_i - r_j) \qquad [1]$$

Here r_i is the radius vector of the ith particle, and ∇_i^2 is the three-dimensional Laplace operator for the variable r_i in the theory of scattering all potentials $v_{ij}(r)$ decrease as $[r] \to \infty$.

Up to the present time only the operator H_2 has been studied in detail. A. Ya. Povzner has studied the eigenvalue spectrum of this operator with $v_{12}(r)$ satisfying definite conditions and has established the theorem of expansion in terms of its eigenfunctions. These results were extended by Kato and Ikebe. The basis of A. Ya. Povzner's approach is the study of the resolvent of the operator H_2 in the complex plane, particularly in the vicinity of the real axis. The method used by him cannot be directly extended to the case $N > 2$.

In a physical paper, the author has recently proposed new integral equations for the investigation of three-particle systems. The present paper presents some of the results obtained with the help of these equations on the behavior of the resolvent of the operator H_3 in the complex plane. The principal result has been presented in the form of a theorem.

Time-Dependent Problem in Magnetohydrodynamics, D. V. Sharikadze, pp. 387–390.

In this article the unsteady flow of a viscous incompressible fluid with finite electrical conductivity past a plane plate is examined. An external constant magnetic field with inductance $\mathbf{B}_0$ acts perpendicularly to the plane of the plate. We consider the magnetic field induced in the fluid to be negligibly small in comparison with the external field.

Virial Theorem in the Classical Problem of the Scattering of Particles by a Center of Force, Yu. N. Demkov, pp. 393–395.

The virial theorem was initially proved in classical mechanics in the case of finite motions, i.e., those motions in which the coordinates and momenta of the mass points forming a system are bounded. The theorem has also been proved in quantum mechanics for the stationary states with a discrete spectrum, i.e., for bound states, which correspond to finite motions in classical mechanics.

V. A. Fok has shown that the virial theorem follows naturally from the variational principle and a variation of the scale of length. The corresponding equations were derived for classical mechanics, the Shroedinger equation, the Dirac equation, the Thomas-Fermi method, etc. However, all of these derivatives referred to bound states or finite motions. An analogous virial theorem in the case of an energy operator with a continuous spectrum was first derived by the present author for the problem of the scattering of particles by a center of force. The theorem was then generalized to more complex problems of the scattering theory—inelastic charge exchange, and other processes, to the Dirac equation, and quantum field theory. At the same time, the corresponding generalization has not been made in classical mechanics.

Three-Dimensional Relativistic Schroedinger Equation for the Three-Body Problem, Yu. A. Gol'fand, pp. 402–403.

The aim of the present work is the relativistic generalization of the Schroedinger equation without an increase in the number of independent variables, which is the main difference between the equation obtained here and the well-known Bethe-Salpeter Eq. [1].

Certain Integral Relations in the Acoustics of a Moving Medium, L. M. Lyamshev, pp. 410–412.

It has been noted that the principle of reciprocity in acoustics can be formulated mathematically in the form of a number of integral relations connecting the solutions of two self-adjoint boundary value problems. In the acoustics of a moving medium relations analogous in a certain sense to the reciprocity relations can be obtained, although, as is well known, the principle of reciprocity does not hold in a moving medium. These relations connect the solutions of two adjoint boundary value problems and establish a connection between the volume sources, certain surface forces acting on elastic thin bodies in the moving medium, and the sound fields specified by the sources and the oscillations of the elastic bodies.

Instability of a Nonuniform Rarefied Plasma in a Strong Magnetic Field, L. I. Rudakov and R. Z. Sagdeev, pp. 415–417.

Experimental investigations into the Joule heating of plasma by a current flowing along a strong magnetic field show that instabilities develop in the plasma which cannot be explained within the framework of ideal magnetohydrodynamics. Elsewhere these phenomena are interpreted on the basis of kinetic theory as forced oscillations induced by electrons carried along the magnetic field. These oscillations have been called "ionic acoustic" waves. This type of instability, however, can only arise in a strongly nonisothermal plasma in which electrons are considerably hotter than the ions

$$T_2 \gg T_i$$

(T is the temperature.)

A mechanism for the instability is proposed in another paper within the framework of hydrodynamics with finite conductivity. The importance of this instability decreases when the electron mean free path is comparable with the characteristic dimensions of the experimental equipment.

In what follows we consider a mechanism for the instability which does not depend on the condition that the plasma be nonisothermal and which does not require the presence of a longitudinal electric current.

We adopt the following assumptions: 1) The plasma pressure is small in comparison with the magnetic pressure $p \gg H^2/8\pi$; 2) the instability develops in a time which is shorter than the collision time; 3) the frequency of the induced oscillations is considerably smaller than the cyclotron frequency of the ions, $\omega \ll eH/Mc$, whereas the wavelength of the resulting disturbance λ is considerably larger than the Larmor radius of the ions, $\lambda \gg r_H$; 4) $H^2/8\pi \ll nMc^2$.

Physical Properties of Titanium Nitride in the Region of Homogeneity, G. V. Samsonov and T. S. Verkhoglyadova, pp. 429–430.

Titanium nitride TiN, a typical insterstitial phase, has a wide range of homogeneity extending from 30 to 50 atom % nitrogen. Within the limits of this region changes can be expected in the character of the chemical bond and, consequently, changes in the physical properties.

In the present work studies were made of the microhardness and electrical resistance of alloys of titanium with nitrogen in the region of homogeneity of the TiN phase. The microhardness was measured on powders of alloys which were prepared by nitriding titanium powder (99.8% Ti, 0.1% Ca, 0.09% Fe, 0.02% H) according to the method given elsewhere preventing the possibility of simultaneous oxidation. The powders contained from 35.6 to 49.8 atom % N ($TiN_{0.56}$–$TiN_{0.98}$). The specimens for the electrical resistance measurements were prepared by sintering briquets of titanium powder pressed at a pressure of 2–4 ton/cm² in an atmosphere of nitrogen for 2–4 hr at temperatures of 900–1300°. The obtained specimen contains from 34.7 to 49.8 atom % nitrogen ($TiN_{0.53}$–$TiN_{0.98}$) and for each composition there were several values of porosity to provide reliable graphic and calculated extrapolation of the electrical resistance to zero porosity.

General Method of Determining the Optimum Distributions for Linear Antennas, V. L. Pokrovskii, pp. 435–436.

The problem of the optimum directivity pattern has been solved only for a very small group of linear antennas with equidistant radiators and variable currents. The control of the current amplitude and phase constitutes a very complicated technical problem. Antennas with equidistant radiators are unstable with respect to changes in current and frequency, and therefore the beam vacillation in such antennas constitutes a difficult problem. Finally, the striving to secure a better antenna directivity with a minimum number of radiators is quite understandable. This can be achieved by simultaneously varying the currents and the distances between the radiators. In order to answer the question of what can be achieved by using this approach, it is necessary to solve the corresponding optimum problem.

It should also be emphasized that individual radiators were considered as isotropic elsewhere. If the directivity of individual radiators is not neglected, more convenient optimum directivity patterns can be obtained.

The aim of the present article is to find a general method for determining linear antenna parameters, by means of which the problem of finding the optimum distribution of these parameters could be theoretically reduced to numerical calculations. If the problem is stated in this way, we can consider not only discrete, but also continuous current distributions, which do not have singularities if they are given in the form of finite Fourier sums.

Hypoxia as the Cause of the Increase in Radiation Resistance Produced by Hypothermia, M. M. Konstantinova, pp. 439–441.

Volume 6, number 6, December 1961.

Flow of a Rarified Gas into a Vacuum from a Point Source, A. Ya. Pressman, pp. 451–453.

The propagation of particles of a sufficiently rarified gas into a vacuum from a point source located on the plane $z = 0$ is considered from the point of view of solving an equation of the Einstein-Fokker type with "diffusion coefficient" depending on time under the boundary conditions corresponding to different types of interaction between the gas particles and the plane $z = 0$.

Boundary-Value Problem of the Propagation of Electromagnetic Waves in a Spherically Stratified Anisotropic Dissipative Medium, P. E. Krasnushkin, pp. 466–469.

A method of normal waves has been published previously. The formulation of this method was based on the spectral theory of self-adjoint linear operators, so that the method can be applied to the solution of a comparatively narrow class of boundary-value problems on the propagation of waves in stratified media without losses. The spectral theory of linear non-self-adjoint operators that has been developed in recent decades enables us to extend the application of the method of normal waves to stratified media with losses and to take into account the emission of radiation in a natural way. We consider here a rather general case of such a medium, with a direct relation to the problem of a spherical semiconducting earth surrounded by a magnetically anisotropic ionosphere. The case includes the problem of Watson and its analogues in acoustics and seismology.

Motion of a Medium of Finite Conductivity in the Presence of a Plane Magnetic Field, D. V. Sharikadze, pp. 470–471.

In the study of the flow of an electrically conducting medium between solid boundaries it has been assumed that all of the parameters that characterize the flow of the medium remain constant along the direction of the flow. As has been shown previously, it is possible to find plane magnetic fields of the form $\mathbf{H} = [a(y) - bx]\mathbf{i} + (by + b_0)\mathbf{j}$, in which there can be a motion of the medium with the velocity $v_x = u(y)$, $v_y = v_z = 0$. In this way a new exact solution of the equation of magnetohydrodynamics was found: Lin's work was based on formal requirements on the structure of the vectors $\mathbf{v}$, $\mathbf{H}$, $\nabla p'$, and the work of Regirer on the stationary flow of a viscous incompressible conducting medium.

In the present work we look for magnetic fields such that it is possible to have: 1) nonstationary flow of a compressible conducting medium; 2) stationary flow of a compressible conducting medium; 3) nonstationary flow of a viscous incompressible conducting medium; and 4) nonstationary flow of a viscous compressible conducting medium.

In the third case when the flow becomes stationary one gets the result of Regier. As in other papers, the solutions obtained here will be new exact solutions of magnetohydrodynamics.

Behavior of Imperturbable Systems in Inertial Space, V. A. Bodner and V. P. Seleznev, pp. 476–479.

Imperturbable systems in three-dimensional inertial space, used as navigation systems, contain three accelerometers fastened onto a gyroscopic stabilizer and oriented along the axes of the inertial coordinate system. Accelerometer signals are integrated twice for location fixing. Since the accelerometers do not measure gravitational acceleration, three channels for self-compensation of gravitational accelerations are desirable. Such systems have selectivity with regard to acceleration of the center of mass of a body moving in space and may be used to determine linear velocities and position coordinates. Imperturbable systems with three self-compensation channels, as distinguished from systems with two such, have many interesting and important peculiarities. Certain questions in the theory of these systems will be expounded here.

We consider the behavior of imperturbable (inertial) navigational systems in three-dimensional inertial space. As coordinate system we choose the ecliptic system $x_0y_0z_0$, with origin at the center of the sun, and two of the axes, x_0 and y_0, in the plane of the ecliptic. The third axis is perpendicular to this plane. One of the axes x_0 or y_0 may be directed toward the star Spica. The position of an object in such a system will be determined by the rectangular coordinates x, y, z.

Angular Distribution of Sputtered Particles on Irradiation of a Single Crystal by an Ion Beam, V. A. Molchanov, V. G. Tel'kovskii, and V. M. Chickerov, pp. 486–487.

In cathodic sputtering of single crystals, a preferential emission of atoms along certain crystallographic axes of the target occurs and the sputtered material forms a characteristic pattern ("Wehner Spots") on the collector, the shape of which depends on both the type and orientation of the crystal as well as on the energy of the ions. This phenomenon was investigated by Wehner and by other authors after him. The angular distribution of sputtered material was studied only in one reference. The authors of that paper concluded on the basis of indirect measurements that this distribution conforms to a cosine law within the confines of each Wehner spot. Meanwhile, it was shown elsewhere that another quantity which characterizes the sputtering—the sputtering coefficient of single crystals—displays a considerably stronger angular dependence. On account of this it seemed interesting to carry out a direct measurement of the spatial distribution of the particles which leave the target during its irradiation by an ion beam. The main results of the work are presented here.

Electrostatic Effects in a Rarefield Plasma Moving in a Nonuniform Magnetic Field, Yu. S. Sigov, pp. 497–499.

A nonuniform magnetic field $\mathbf{H}(\mathbf{r})$ affects the electronic and ionic components of a plasma moving through it to a different extent; this leads to separation of the electric charges in zones whose dimensions are determined by the extent of nonuniformity L of the magnetic field. Formation of volume charges extended in space in the plasma leads to jumps of the electrostatic potential, and the magnitude of these potential jumps is dependent upon the physical properties of the flowing plasma, as well as the degree of nonuniformity of the applied field $\mathbf{H}$. This nonlinear effect is examined in the present paper for the case when $\mathbf{H} = \mathbf{H}(x)$.

Increasing the Strength of Thin Glass, I. A. Boguslavskii, F. F. Vitman, and V. P. Pukh, pp. 502–504.

The best results for the hardening of silicate glass have achieved recently in two ways: hardening and chemical etching.

Each of these methods can increase the strength of glass severalfold. Later it was possible to achieve a still greater increase in the strength of glass by combining strengthening with subsequent treatment of the glass first by hardening and then by etching. The last operation was intended to remove both defects of the original glass and also those defects which were generated in it or developed during hardening. For glasses which readily receive hardening in an air stream, treatment by both methods makes it possible to increase the mean values of strength to 70–80 kg/cm^2.

However, this result can be achieved readily only for thick glasses, for which by hardening to a degree of 4–5 N/cm, it is possible to create in their surface layer compressive stresses of about 25–30 kg/mm^2. Thin glasses (of thickness 5 mm and less) are not very receptive to air hardening: in the best case in glasses of 5 mm thickness degrees of hardening of only about 1–2 N/cm can be obtained, the hardening compressive stresses only reaching about 6–10 kg/cm^2. For glasses of thickness 1.5–3 mm it is not generally possible to count on a noticeable strengthening by the method of hardening in an air medium.

The strengthening of thin glasses (of thickness 1.5–3 mm) by etching in a solution of hydrofluoric acid can increase their mean strength to 50–60 kg/mm^2—much less than that which is achieved for thick glasses. When seeking a further increase in the strength of thin glasses, of considerable interest is the recently developed thermochemical method for strengthening glass, which consists of cooling the glass from temperatures above the vitrification temperature is heated silicone liquids This method of strengthening glass leads to a very noticeable increase in strength of thin glass and its heat resistance which, with a uniform degree of hardening (evaluated from the difference in travel of beams in polarized light), with this method of treatment is much higher than for glasses hardened by the ordinary methods.

It was shown earlier that the higher the level of strength of the initial glass, the greater the strength which can be obtained after hardening by etching. Thus, glass with a natural surface acquired in the process of hot drawing, having a higher strength compared with mechanically polished glass, after etching becomes stronger than polished glass. In exactly the same way the higher the degree of hardening of the glass the higher the strength of the glass after its etching. From this it would be expected that the high strength of thin glass obtained due to thermochemical treatment will permit a much greater strengthening after additional treatment by etching than was achieved by other methods. In this connection we performed the following experiments. Specimens of vertically drawn glasses measuring 80 × 80 mm^2, of thickness, 1.5, 3.0, and 5.0 mm with natural and mechanically polished surface were strengthened: a) by the method of thermochemical strengthening; b) by the method of etching in a solution of hydrofluoric acid; and c) by both methods successively.

Experimental Analysis of the Effect of Radiation on Cellular Nuclei in the Culture of Embryonal Human Tissues, N. P. Dubinin, Yu. Ya. Kerkis, and L. I. Lebedeva, pp. 538–540.

Volume 6, number 7, January 1962.

Power of Networks of Functional Elements, M. N. Vaintsvaig, pp. 545–547.

One of the basic problems of cybernetics is the problem of the synthesis of control systems. The specifics of this problem depend in an essential way on the class of control systems chosen, and also on the methods for estimating their complexity. In the present paper, as an example of a class of control systems, we take up the class of networks of functional elements. Selected as an index of simplicity of such a circuit is some quantity characterizing the functioning of the network. In particular, this may be the mean power of the circuit, the maximum number of simultaneously excited elements, etc. Proceeding from this index there is introduced in the usual manner the Shannon function. It has been shown that these functions, for changes of the finite basis, vary between the limits of $C_1 n$ to $C_2 2n/n$ where C_1 and C_2 are certain constants which depend on the basis. It is established that these tolerances are exact.

Generalizing the Invariance Principle to Linear Automatic Systems with Variable Parameters, V. A. Vasilenko, pp. 548–549.

In the well-known papers of N. N. Luzin and P. I. Kuznetsov the foundation was laid for a mathematical theory showing that a coordinate of a linear dynamic system is independent of an external excitation. The subsequent development of these concepts by V. S. Kulebakin enabled us to establish a new trend in the theory of automatic control and to formulate fundamental rules for complex automated systems.

The invariance principle, however, which was worked out for systems with constant parameters, has been found difficult to apply to many electrical systems, as the parameters of the system elements have not remained constant in the course of the exploitation time; this may also be true in the short run because of variations in temperature, humidity, etc. Similar phenomena likewise take place in other physical devices and this necessitates the use of special complex correcting devices in systems with variable parameters in order to tune the network parameters after perturbation in accordance with the variations of the characteristics of the regulator and of the controlled object.

The main results of the invariance theory can be extended to varying-parameter systems, if one considers perturbations not only as external excitations applied to a linear dynamic system but also as internal ones caused by a variation in time of system parameters or by a discrepancy between the nominal and the required values. In such cases the invariance theory enables one to find the optimum linear systems (according to some criterion) of automatic control. To this end it is sufficient to know the required (optimal) linear characteristic of the controlled object and to treat the deviations in an actual system as external perturbations with regard to which it is necessary to comply with the requirement of the independence of the input (controlled) coordinate.

Integration of Potential-Pulse Forms, V. G. Lazarev and E. I. Piil', pp. 550–552.

Transforming the Programs for the Solution of Complex Logic Problems to Optimal Form, S. N. Razumovskii, pp. 555–557.

In solving large logic problems on computers we use complex programs which assure the analysis of the logic linkages characteristic for the problem being solved and the selection of a solution method as a function of the results obtained by such an analysis. The complexity of these programs and the difficulty in formulating them are such that they require the automization of the programming process. However, an analysis of existing programs, including programs formulated automatically, demonstrate that they are not optimal in the sense of the most effective utilization of the possibilities for optaining information from the logic conditions of the problem.

We can attempt to transform the structure of the problem in such a way as to increase the quantity of information obtained from the logic functions. The transformations may consist of rational analysis or synthesis of the logic fractions, in changing their order, etc. We shall present ideas on the transformation of the structure of problems to a certain more effective form.

Vortex and Circulation Conservation in Magnetohydrodynamics, M. N. Kogan, pp. 565–566.

In classical hydrodynamics the Thompson theorem is valid, which asserts that the circulation of the velocity about any closed "fluid" contour remains constant during the flow, or that vortices move with the particles of the fluid. It is easy to verify that this theorem is no longer valid in magnetohydrodynamics. Here, however, there is a result that plays to a certain extent the same role as the Thompson theorem. The object of the present article is to prove this result.

Boundary of the Region of Existence of Optimal Nozzles Free of Shock Waves, L. E. Sternin, pp. 574–575.

Motion of a Gyroscope in a Cardan Suspension When There is a Moment with Respect to the Axis of Natural Rotation, S. A. Kharlamov, pp. 580–582.

The moment of resistance of natural rotation of a gyroscope considerably exceeds the frictional moment in the axes of the inner and outer gimbal rings; therefore the integral of natural rotation does not occur. In order that the natural kinetic moment of the gyroscope not vary, artificial rotational moments are generated to balance the moment of resistance. If the suspension gimbal ring is not perpendicular, the rotational moment shows a damping influence on the nutation range of the gyroscope, leading to a systematic drift.

One Version of the Regular Precession of a Solid with a Liquid-Filled Cavity, M. P. Gulyaev, pp. 583–584.

Anisotropic Electron Scattering by Ionized Impurities, A. G. Samoilovich, I. Ya. Korenblit, and I. V. Dakhovskii, pp. 606–608.

The anisotropy of electron scattering by ionized impurities can be explained by the anisotropy of the electron energy spectrum and by the anisotropy of the scattering potential itself. The latter occurs in noncubic crystals, in which the dielectric constant is anisotropic. We shall assume a scalar dielectric constant. In principle, generalization to the case of a tensor dielectric constant gives rise to no difficulty.