

# Space INTELLIGENCE NOTES

SPACE SYSTEMS INFORMATION BRANCH, GEORGE C. MARSHALL SPACE FLIGHT CENTER

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1962 SOVIET MOON PLANS REPORTED. A Reuters syndicated dispatch, dated Moscow, states "reliable sources" revealed plans for a manned Soviet spaceship to travel around the Moon and back to Earth early in 1962. The newspaper article also attributes to the same source a statement that Russia does not appear likely to try to land a man on the Moon until 1964.

Soviet scientists were said to have put off the manned around-the-Moon shot, probably until January, because of "an eruption on the Sun that contaminated space with unusual amounts of radiation."

THE WASHINGTON POST commented further:

"A spaceman-trainee has been named to make the half-million-mile round trip and a rocket ship is built and ready for blastoff at Baikunur, the Soviet launching area 100 miles east of the Aral Sea, the article said.

"The trip is designed to study the lunar surface for a future landing of an automatic laboratory that would report back a wealth of data. Two such laboratories reportedly have been built. One may be launched next fall.

"The manned lunar trip will involve use of an instrument to magnify the moon's surface, greatly aiding in research.

"The article also said the instrument was carried in the spaceship of Maj. Gherman Titov last August when he orbited earth for 25 hours, but its existence has apparently not been officially announced yet.

"The recent Soviet rocket tests in the Pacific were said to have tested the guidance device for the moon spaceship.

"The spaceman-designate according to this report is a bachelor, unlike Titov and Maj. Yuri Gagarin, the first man in space. About 15 spaceman-trainees have been studying at Zhukovski Aviation Academy in Moscow for several weeks in a course that winds up in about a week. Titov and Gagarin are reported to be among the instructors.

"The article discounted reports that Russian scientists were considering putting a three-spaceman rocket ship in orbit around the earth or launching a dog into space to pave the way for the moon probe." (Source: WASHINGTON POST, November 19, 1961)

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SPECULATION ON THE FUTURE COURSE OF MANNED SPACE FLIGHT. In an article appearing in PRAVDA, and written by USSR Academician N. Barabashov before the first manned space flight, interesting speculations on the future course of space exploration are given.

"After a manned flight around the Moon, there will doubtlessly be other travels in space--to the Moon, Venus and Mars. Man will land on the surface of the Moon and will personally check all the information which we have received about our natural satellite by means of observations from the Earth.

"In the future it may well be that special astronomical observatories will be built on the Moon for making observations deep into space. There on the Moon, man will probably establish intermediate spaceship landing sites at which huge spaceships will be assembled and sent on more distant travels. This is dictated by the fact that the force of gravity on the Moon is only one-sixth what it is on the Earth." (Source: PRAVDA, March 12, 1961)

IRON CURTAIN PUT ON OSCAR? The world's first home-made communications satellite, called Oscar, was orbited December 12 riding piggy back aboard a Discoverer 36 satellite. It automatically transmits four dots followed by two dots. But, so far, no confirmation has been received from Russian hams on whether they are monitoring the satellite's morse code greeting "Hi."

Otherwise, the unique experiment in amateur space communications is working fine according to project headquarters in Sunnyvale, California, nerve center for coordinating global efforts to track the 10-lb moonlet.

Oscar controllers in Sunnyvale have been in direct voice contact with Russian short-wave radio amateurs, and data was given the Soviets on when to tune in to signals from the satellite. Other amateurs on every continent have heard Oscar and written about it to Sunnyvale. (Source: SAN JOSE NEWS, December 1961)

RUSSIANS CONSIDER USING SEA WATER AS FUEL. In a discussion of possible future marine power plants by A. Presnyakov in the Russian newspaper EKONOMICHESKAYA GAZETA, the use of sea water as a fuel component in gas turbines is suggested. In this concept, concentrated sea water containing large amounts of minerals and single-celled plants would be mixed with salts, kerosene, and mazut (petroleum residue) to constitute a cheap "biometallo-hydrocarbon" fuel. The article also reports that concentrated Black Sea water has been successfully tested as an admixture to the fuel for a Pobeda automobile engine. Such news, if true, should be a boom to economy-minded motorists and precipitate record sales for American turbine autos such as the Dodge Turbo-Dart--unless the exhaust fumes turn out to be to "fishy." (Source: EKONOMICHESKAYA GAZETA, December 4, 1961, p. 44)

RUSSIAN ASTRONOMER BELIEVES THERE ARE PEOPLE ON MARS. In an article entitled "Are There Rational Beings on Mars?" astronomer Docent F. Zigel states, "In our times there is scarcely to be found a single Soviet astronomer who considers our Earth to be the only inhabited planet." Then, in reference to Mars, he quotes Academician Barabashov: "We have no basis for denying the existence of reasoning beings on a planet where there is evidently vegetation present." Similar feelings on the matter are attributed to Soviet scientists V. V. Sharonov and N. N. Sytinskays, and the work of G. A. Tikhov is credited with "demonstrating" that there is organic life on Mars.

The author continues to build a strongly worded case for the past or present existence of rational beings on Mars and concludes that if such life has now disappeared there would at least be traces of it left. The Martian canals, he feels, are clearly the work of rational beings. The fact that the Martian spring advances equatorward, instead of poleward as on Earth, is also evidence of the intervention of rational beings, according to Zigel. He says it is quite possible that there are settlements of major cities at the points where the canals intersect and reasons that the layout of the canals suggests that there are no national boundaries on Mars. He attributes a planet-wide unity and cooperation (apparently a form of Marxian Marsian society, Ed.) among its inhabitants to the severe natural conditions of the planet.

The author also says that the satellites of Mars are artificial and could not have been formed from the main body of the planet nor could they have been captured. "Everything (about the satellites) is explained," he continues, "very simply if we assume that Phobos and Deimos are artificial satellites created by Martians." He reasons that Phobos and Deimos move in the equatorial plane of Mars; and on its rotation around Mars, Phobos experiences a strange acceleration which can be explained if Phobos is a hemisphere, an impossible shape for a natural heavenly body.

The author further contends that Phobos and Deimos were created by the Martians between 1862 and 1877, that the system of irrigation canals is still in operation, and that the Martians are continuing to struggle with their harsh environment--that they have not disappeared, but continue to exist. (Source: ZHANIYESILA (Moscow), No. 2, 1961, p. 20)

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SOVIET MAGAZINE ARTICLES INDICATE CURRENT INTEREST IN MARS AS SPACE FLIGHT OBJECTIVE. Many articles concerning the planet Mars are currently appearing in Soviet magazines and newspapers. Some deal with the nature of Mars while others present problems associated with possible probes and spaceship voyages to that planet. The significance of such articles is that they present unconservative ideas for popular consumption in Russia. And it is obvious that they are designed to familiarize the ordinary reader with both the expected and unexpected implications of a major space flight project with a manned exploratory voyage to Mars as its eventual goal.

A good example of the educational nature of such articles may be gleaned from a recent article by V. Bronshteen entitled "A Stroll Around Mars." The author takes the reader on a "mental excursion" around Mars; briefly passing over the subjects which are best known--the continents, seas, polar caps, and canals.

The article concludes with a report on the Soviet discovery of a bright white spot on Mars in August 1956. This was followed a week later by severe dust storms and two huge, yellowish dust clouds were formed. The south polar region was hidden from view for two weeks. The dust clouds moved at great velocity in an easterly direction and dispersed in a few days. The article suggests that these great disturbances in the Martian atmosphere are associated with an increase in solar activity. (Source: TEKHINKA-MOLODEZHI (Moscow), No. 1, 1961, p. 33)

CANADIAN SPACE RESEARCH PRODUCES UNIQUE SPACECRAFT DEVICE. Compact satellite antenna erection units that can extend and retract long tubular elements have been developed by Special Products Div., de Havilland Aircraft of Canada, Ltd., Downsview, Ont., from an invention by George J. Klein, of Canada's National Research Council. The design's key element is a preformed spring-steel (or beryllium copper) tape that is coiled in a flat cross-section on a storage spool but unreels into tubular form through a guide sleeve. The extensible tubular element, formed as the curling tape edges overlap some 180 deg, is nearly as strong as a seamless tube of equal diameter and wall thickness. It is even stronger if several elements are nested. The maximum bending moment occurs when about 8-10 ft of tubing have been payed out, so virtually the only limit on length is set by the amount of tape you can store on the spool. The length of elements can be "tuned" to different frequencies by precise servo control. De Havilland has built 37- and 75-ft units for the Canadian Topside Sounder satellite and 30-ft antennas for NRL's Lofti and a Javelin experiment.

The erection unit shown in Fig. 1 is a self-contained package complete with power supply for extending the antenna length to the automatic power cutoff point. Advanced design being worked on by de Havilland extends four antenna elements from a single, centrally mounted storage drum.

Other possible applications for the key element of this device include the following:

1. As an instrument boom in a satellite or moon-landing vehicle the extendable elements could be used to remove instruments to a remote location from the vehicle, make measurements, and then retract.

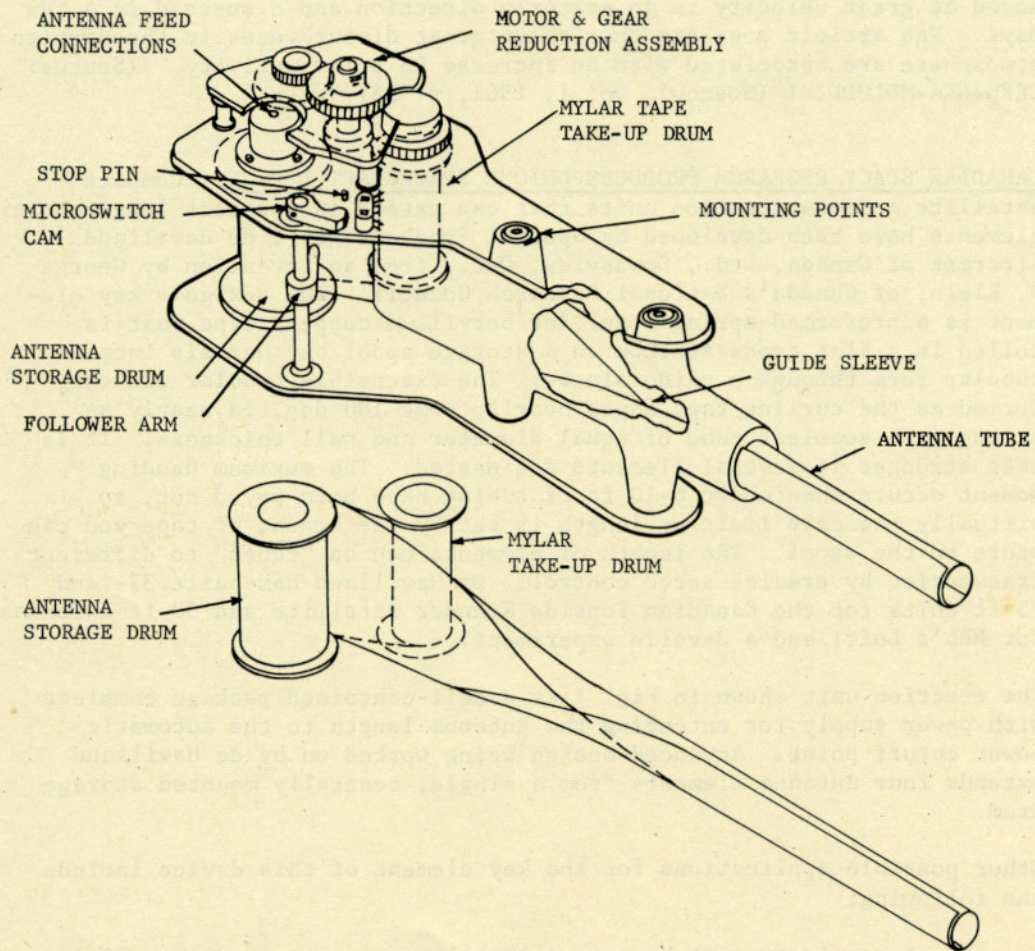


FIG. 1. The compact satellite antenna unit shown in the two sketches above illustrate one application of an automatic tube-forming and retracting device.

2. In a space station structure extensible elements could easily be stored in a launch vehicle. In the desired orbital position station structures could be erected in various configurations using precisely metered extensions with suitable end couplings.
3. In satellite orientation by extending very long tubes from opposite sides of the vehicle to produce an elongated mass distribution, an erection torque can be set up that tends to align the principal axis of least inertia with the local vertical.
4. Compactness makes this design attractive for use as an actuator when there is not enough room in the vehicle for long-travel hydraulic rams.
5. For an aircraft antenna, advantages are precise servo control of the tube lengths for different frequencies and drag minimization by full retraction.
6. For an Earth-vehicle antenna, quick retraction would be useful in such obvious applications as whip antennas on tanks and submarines.

(Source: SPACE/AERONAUTICS, June 1961, p. 125)

RUSSIAN DISCUSSES PROBLEMS OF PROBING VENUS. An article recently appearing in the Soviet publication OGONEK deals with three aspects of the Venus space probe: (1) imparting the necessary velocity to the automatic station so it would reach Venus; (2) putting it into a precise trajectory and maintaining it; and (3) the collection of scientific data and their transmission to Earth.

The article discusses general problems of multistage rockets and the launching of the station from a satellite. With regard to the trajectory, it points out that a number of factors could not be precisely evaluated, such as the gravitational attraction of Venus. The third problem is also discussed in rather general terms. The author supplies no information not available earlier and in greater detail.

There is no indication whether the station has any provisions for the correction of its trajectory. It is said that the station will pass by Venus at a distance of 180,000 km from the center of the planet. At that time the station will be 70 million km from Earth, although it will already have travelled 270 million km. (Source: Abstract from Office of Technical Services, Dept. of Commerce, "After 100 Days," by Yu. Krylov. Candidate of Technical Sciences, OGONEK, Moscow, No. 10, March 1961, p. 2)

SOLUTION OF BOUNDARY LAYER EQUATIONS. It is noted that one of the most important and difficult problems in calculating hypersonic flow around a solid body is the determination of the heat transfer at a stagnation point in a blunt body. The high temperatures which usually develop in the flow zone behind the shock wave require consideration of various chemical reactions occurring not only inside the boundary layer but also on the solid surface. A numerical solution of equations of the boundary layer at a stagnation point of a blunt body in the flow of a ternary gas mixture consisting of O, N<sub>2</sub>, and SiO<sub>2</sub> was obtained at the computer center of Moscow State University with the digital computer "Setun." For purposes of simplification, the calculations were performed for the case where the surface of the body was assumed to remain solid. The results indicate that the use of a single diffusion coefficient for all mixture components introduces a considerable error. The L<sub>i</sub> numbers which indicate the relationship between the energy and concentration ( $L_i = \rho D_i c_p \lambda$ , where  $\rho$  = density;  $D_i$  = coefficient of binary diffusion;  $c_p$  = heat capacity; and  $\lambda$  = thermal conductivity) were found to vary sharply along the thickness of the boundary layer. Further study is urged of the problem of selected constant values of L<sub>i</sub> numbers in order to simplify boundary layer equations. (Source: A.I.D. Press, No. 617, January 5, 1961, p. 1; translation of article in MEKHANIKA I MASHINOSTROYENIYE, No. 6, November-December, 1961, p. 3)

PROBABILITY THEORY IN CELESTIAL MECHANICS. The application of the theory of random processes to celestial mechanics is considered in terms of the motion of celestial bodies when initial conditions and certain parameters (primarily body mass) are random variables and the solution of corresponding differential equations of the motion is a random process, the probability distribution of which must be determined. The two-body problem is considered on the basis of the method presented by M. Born (Zeitschrift für Physik, 153, 1958, 372). Under the assumption that the probabilities of the initial data are distributed according to the normal distribution law, a critical value is established of the time  $t_c$ , i.e., the time interval in which the prediction of angular variables and consequently of elliptic motion is possible. The estimate obtained of the critical value  $t_c$  indicates the degree of reliability of the elements used. Simple formulas expressed in terms of Keplerian elements and the mean anomaly are derived for calculation of the probability distribution of  $\omega_k$  and  $I_k$ , which represent angular and force variables, respectively, in an elliptical two-body problem. In considering the motion of a planet in the gravitational field of the sun under the action of a random force, formulas are derived for the probability distribution of the deviations of coordinates and velocities from the coordinates and velocities of the Keplerian motion in the case where the probabilities of initial coordinates and velocities are distributed according to normal law. The formulas obtained can be applied to the study of the motion of satellites and space vehicles but are valid only in a finite time interval, when



the deviation probabilities of coordinates and velocities from the Keplerian motion are sufficiently small. The results are extended to the n-body problem. (Source: A.I.D. Press, No. 593, November 30, 1961; translation of article in ASTRONOMICHESKIY ZHURNAL, Vol. 38, No. 4, 1961, p. 738)

EXISTENCE OF SUPER-GALACTIC SYSTEM PROPOUNDED. The existence of super-galactic systems has been the subject of discussion and controversy among astronomers for many years. Appearing in *Tudomány es Technika* was an article dealing with research on this subject.

The article states that our galactic system includes about 120 billion stars and is similar to a spiral nebula having a diameter of about 72,000 light-years. Our sun is located in the central galactic plane at a distance of nearly 24,000 light-years from the center of the system. The sun moves toward the constellation of Lyra at a velocity of 20 km/sec, and revolves around the galactic center in 225 million years. By means of smaller telescopes, several galactic systems have been detected at a distance of 1 million light-years. At a distance of 10 million light-years, there are more than a thousand galactic systems. Upon using large telescopes, several 100 million systems have been found, such as the nebula in the constellation of Andromeda located 680,000 light-years away and the Magellanic Clouds located 530,000 light-years from the earth.

Soviet astronomer A. Ambartsumyan, President of the Armenian Academy of Sciences and Director of the Astronomic Institute of Byurakan, stated in the course of the International Congress in Brussels in 1958, that the nebulae disintegrate, that new systems are forming, and that galactic systems collide, as in the case of the NGC 5128 galactic system.

The theories of G. O. Abell and F. Zwicky concerning the existence of additional galactic systems called Super-Galaxies are described. A graph shows the northern galactic hemisphere, the outer curved line indicates the northern limit of the galaxy. Located in the center, a galactic agglomeration of 3,000 known members is shown in the constellation of Virgo, the central part of which fills up a space of about 7 degrees in diameter. The agglomeration's total extent amounts to about 15 x 40 degrees. A similar galactic system exists in the southern hemisphere. These systems apparently form a large circle representing the equator of a giant super-system. An additional phenomenon confirming the theory of existing super-galactic systems is the galactic noise in the 1.2 and 1.9 m wave bands established by J. D. Kraus, H. C. Ko, and others in 1953 and 1954. According to Sklovskiy, this phenomenon represents a synchrotron radiation. E. R. Hill and J. R. Shakeshaft repeated these observations in the 3.5 and 1.9 m wave length and stated that there was no radiation found corresponding to the conditions prevailing in the super-galactic area.

Included with the article are 2 photographs and 1 graph. (Source: Dept. of Commerce, Office of Technical Services, English Abstracts, No. 11, 1961, p. 1)

PARAMETRIC SUBHARMONIC OSCILLATORS AS ELEMENTS IN ULTRA-HIGH-SPEED DIGITAL COMPUTERS. This survey paper, prepared by S. A. Akhramov and A. S. Roshal<sup>1</sup>, is devoted to methods of achieving an appreciable increase in the speed of response of electronic digital computers. These methods are associated with the transition to UHF techniques. Special emphasis is given to the method based on using parametric subharmonic oscillators. Methods are studied for displaying and processing information in systems with a carrier, and the corresponding logic networks are analyzed. Theoretical and experimental data are cited that characterizes the various properties of parametric subharmonic oscillators. These data are essentially applicable to the use of subharmonic parametric oscillators in digital machines. (Source: AUTOMATION EXPRESS, Vol. III, No. 10, 1961)

A METHOD FOR DESIGNING UNITS WHICH STORE AND SELECT SINES AND COSINES. Engineers G. G. Menshikov and L. M. Rakhovick in a report to Izvestia V. U. Z. outline a method developed for designing special units for data processing equipment. The report discusses various devices used for obtaining the values of sines and cosines both according to the tabular method and according to the method where the successive values of the functions are computed. Their particular method, however, is applicable for designing units of the tabular type that are used in digital analog harmonic analyzers and synthesizers. (Source: AUTOMATION EXPRESS, Vol. III, No. 10, 1961, p. 27)

VISUAL ULTRASONIC FLAW DETECTOR. A new variant of ultrasonic flaw detection equipment has recently been developed by the Zeiss works of Jena, East Germany. This instrument is called "Sonovisor 2." It produces a 2-dimensional picture of defects found in a tested specimen. The instrument operates in three ways: 1. cylindrical specimen (rolls, shafts, and tubes with walls over 3 mm thick) are inspected by the "rotary-sectioning" method. 2. flat specimens are inspected by the "scanning-sectioning" method. 3. the standard echo method can be used when desired.

Fig. 2 shows the principle of the "rotary-sectioning" method. The testpiece and the electron-optical system of the oscilloscope tube rotate synchronized. In this way, the echo of the ultrasonic pulse traces a contour of any flaw on the screen. A "section after section" inspection is performed by moving the probe along the testpiece.

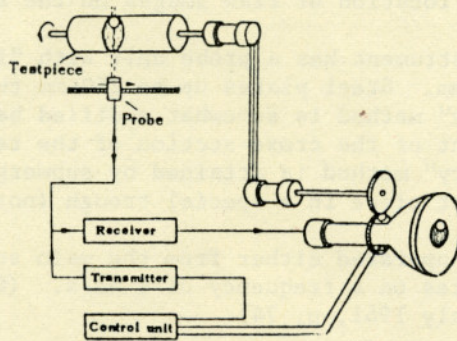


FIG. 2

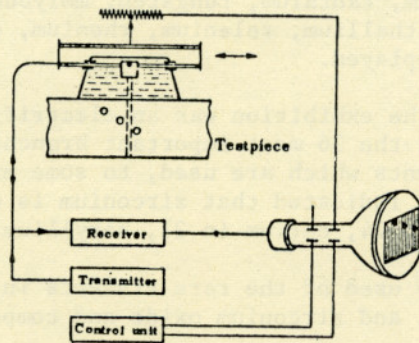


FIG. 3

The "scanning-sectioning" method is shown in Fig. 3. The probe moves with a slider and is surrounded by liquid in an "inverted tank" for better acoustic contact with the testpiece. Position of the probe is indicated by the amount of voltage coming from the potentiometer. This voltage controls the location of flaw images on the screen.

The "Sonovisor 2" instrument has a probe unit with "inverted tank"; probe travel is 120 mm. Steel plates up to 250 mm thick can be inspected. The "rotary" method is somewhat modified because the screen image is a development of the cross-section of the testpiece. Acoustic contact in the "rotary" method is attained by submerging the probe and lower part of the test piece in a special trough (not shown in Fig. 2).

"Sonovisor 2" can be operated either from the main supply or with 12-volt batteries. It operates on a frequency of 4 Mc/s. (Source: SOVIET TECHNOLOGY DIGEST, July 1961, p. 74)

THE USES OF RARE ELEMENTS IN RUSSIAN INDUSTRY. The use of rare elements is rather wide spread throughout Russian industry today according to K. F. Klubnichkin, a candidate of Technical Sciences at Giredmet Institute.

At an Exhibit of the Achievements of the USSR's National Economy in 1960, a special exhibition was prepared by the State Research and Planning Institute for the Rare Metals Industry at Giredmet to demonstrate many of the uses of these elements. Specimens of semi-manufactured products and articles containing rare elements such as zirconium, lithium, strontium, niobium, tantalum, tungsten, molybdenum, titanium, beryllium, germanium, thallium, selenium, rhenium, cerium, lanthanum, and neodymium were displayed.

The central point of the exhibition was an electrified stand on which was given the names of the 36 most important branches of Russian industry and the rare elements which are used, to some extent, in each branch. For example, the stand indicated that zirconium is used in 33 branches, niobium and tantalum in 24, cerium in 21, beryllium in 20, etc.

Today, the most widely used of the rare elements in Russian industry are zircon, zirconium, and zirconium oxide and compounds.

Zirconium is now in standard use in the casting industry for counter-pickup dyeing. A de-ionized zirconium concentrate, in the form of a mixture or paste, has replaced dyes made of silica sand, marshalite, and other materials. Savings of 100 to 200 rubles (\$10 to \$20 - 1961 rate) per casting ton have been reported from machine construction plants now using this new method of dyeing. Zirconium materials are presently being used in plants located in Kiev, Kharkov, Dnepropetrovsk, Zhdanov, Berdyansk, Riga, and other cities.

Zirconium is also being widely used in the steel industry in the form of ferrosilicozirconium. In structural steel for example, zirconium causes a reduction in grain size which results in a reduction of cycles necessary for forging and hot stamping of parts. In addition, the use of zirconium in steels helps simplify thermal processing, increases hardness, improves flowability, and raises the scaliness and corrosion resistance in water.

Zirconium steels have been tested at the largest machine construction plants, mining and oil equipment plants, at TET's, and elsewhere in manufacturing automobile parts, metal cutting machines, coal combines, cracking units, and steam pipes.

Apart from metallurgy, zirconium materials are being used in the production of electrovacuum units in the form of sprays on various parts of lamps and getters, and also in the production of high-bolt condensers. A notable feature of the titano-zirconium condensers is their ability to keep high-current loads although very small in size.

Certain zirconium compounds: borides, carbides, and the oxide - are being applied in the manufacture of various refractory articles, particularly thermocouples. One type of thermocouple makes possible the continuous measurement of molten steel and pig iron for 100 hours. In comparison, platinum-platinorhodium thermocouples can be submerged only briefly in these molten metals without damage. Another type of thermocouple, using zirconium carbide, can measure temperatures up to 2600°C in neutral mediums and in a vacuum.

Many diverse articles are being manufactured from refractory compounds of rare metals, including zirconium. One article, believed to have great prospect by Mr. Klubnichkin, is the use of zirconium dioxide in the production of high-refractory linings for glass and metallurgical production. According to certain literary data (no further definition of data), lining steel casting ladles with zirconium brick extends the period between repair of ladles by 15 to 20 times.

Zirconium dioxide has been used for some time as an ingredient in enamel, lacquer, and special glass. It raises the refraction index of white enamels and is therefore a good damper. In the process of boiling enamel, the zirconium dioxide is not reduced or burned and is also a good substitute for antimony and tin oxides. Lacquers with zirconium compounds have an increased whiteness and resistance at high temperatures.

In recent years, Russian industry has begun the wide introduction of rare earth elements. The greatest application of these elements is in production of nonferrous and special glass and refractory articles, as well as in the production of highly strong iron.

Cerium dioxide contributes to the coloring of glass from yellow to brick; neodymium oxide for lilac; and a mixture of neodymium and praseodymium for dove. Glass made with praseodymium oxide is used for protection against ultraviolet rays; glass made with cerium dioxide and lithium oxide is sensitive to the rays.

Refractory crucibles and other related articles are manufactured from cerium dioxides and sulfides. Additions of lanthanum and lithium oxides to the glass makes it possible to produce chemically stable glass articles for the measurement of hydrogen ion concentrations over a range of pH1 to pH14.

In iron metallurgy, a long known method for increasing the strength and elastic characteristics of iron is to spheroidize the carbon in it. One method of modifying iron has been with magnesium but considerable pyro-effects limits the method for mass use. "A rare earth magnesium modifier without pyroeffect has been developed by the Giredmet Institute, and this modifier makes it possible to obtain an iron with a spheroidized form of graphite." The manufactured alloy consists of 40 to 50 percent cerium, 20 to 25 percent lanthanum, 15 to 20 percent of other rare earth elements, 4 to 7 percent magnesium, and up to 10 percent iron. "The highly strong iron approximates steel in its properties."

The field of radio and electronics is also using rare elements in the production of extra-pure semi-conductor materials. Such components as diodes, microwave detectors, high-frequency triodes, and rectifiers are being manufactured from a variety of materials including germanium, silicon and indium alloys with arsenic, and antimony.

High anti-corrosion qualities of many rare elements and their capability to impart special properties to ordinary metals have led to the discovery of many new alloys. Tantalum-tungsten, tungsten-rhenium, and tantalum-niobium alloys, for example, are now being used in the electric stamping industry. New light alloys composed of aluminum, magnesium, and rare elements as well as titanium alloys with additions of niobium, tantalum, rhenium, zirconium, and beryllium are in various stages of development.

Although Russian industry is apparently making progress in the use of rare elements, there are evidently weaknesses also. The following comments by Mr. Klubnichkin give some indication of these weaknesses:

"In conclusion, it should be noted that the Exhibition was weak in reflecting the role of rare elements in light industry, medicine, and those technical divisions such as x-ray, light, and photo-techniques. It could have been possible to show more broadly the use of rare elements in silicate and refractory industries, in the technique of chemical protection, and in vacuum technique. In 1961, the rare elements division should be considerably enriched with new exhibits and data on the technico-economic efficiency of using rare elements in the national economy.

"The most cursory investigation of the use of rare elements shows that in the future a considerable increase will be needed in the volume of their production. It is especially important to direct resources toward finding economically the raw material resources of rare elements, the valuable properties of which could already have been used in the most diverse forms of production. The broad introduction to nonferrous metallurgy of the side recovery of rare elements rhenium, scandium, gallium, germanium, etc., not only provides the needs of the national economy, but it also can help improve the economics of many nonferrous metallurgical enterprises." (Source: THE SOVIET JOURNAL OF NONFERROUS METALS, January 1961, p. 63)

BORONIZING HIGH ALLOYED STEELS. Soviet metallurgists Yu. M. Lakhtin and M. A. Pchelkina are the authors of the report abstracted for this article.

The work covered by their report deals with boronizing high alloyed chrome nickel steels of the stainless and heat-resistant variety, with a view to improving the surface hardness, wear and corrosion resistance, and resistance to scoring at high temperatures. The boronizing treatment was carried out in a mixture of diborane and hydrogen ( $B_2H_6 : H_2 = 1:25$ ) at temperatures around  $950^\circ C$ . All specimens were soaked at the boronizing temperature for several hours.

It was found that all the steels could be boronized though not to the same extent. In all cases the boronized layer comprised two regions, a relatively thin one made up of borides only and underneath, a thicker layer of boride-containing steel.

Steel compositions and boronizing results are given in the table.

The effects of chrome, nickel, and other elements on boronizing were studied and it was found that a chrome content above 8 percent and a nickel content above 5 percent reduced somewhat the depth (and in the case of nickel, also the hardness) of the boride layer. However, the effect was not very serious. Much more detrimental were the effects of titanium and niobium, though only if their content was over 2 percent titanium or 1 percent niobium.

It was concluded that high alloy steels of the types mentioned can be successfully boronized and will attain a protective layer of great hardness and wear resistance. (Source: SOVIET TECHNOLOGY DIGEST, July 1961, p. 41)

MACHINE THREADING. The Moscow City Sovnarkhoz recommends for use a lead screw rpm counter with four transmission ratios (5:3, 5:5, 5:7, 10:11) which makes possible the threading of any metric standard pitch thread

TABLE I

STEEL	Boronizing Conditions		Depth of Layer (microns)		Surface Micro-hardness (kg/mm <sup>2</sup> )
	Temperature (°C)	Duration (hr)	Boride	Total	
18 Cr + 9 Ni + Ti	950	6	25	100	2200
	1100	2	20	120	2200
18 Cr + 12 Ni + 3 Mo + Ti	900	4	20	100	2290
	900	4	25	115	2290
18 Cr + 25 Ni + 2 Si	1100	2	70	150	2200
	950	6	15	130	2190
23 Cr + 18 Ni	1100	2	20	130	2190
	950	6	15	70	1890
25 Cr + 20 Ni + 2 Si	950	6	12	130	2090
	850	2	15	60	2190
25 Cr + 25 Ni + Ti	850	4	25	75	2190
	850	6	30	125	2190
	850	10	45	160	2190
	950	2	30	80	2190
15 Cr + 37 Ni + 3 w + Ti	1050	2	50	120	2190



without reverse motion of the lathe spindle. It permits the thread to be cut directly to the step, threading to begin from the groove, and the lathe carriage to be engaged or disengaged without damaging the thread. Threading productivity is doubled or even tripled when threading large components. (Korman, K. E. Mashinostroitel', No. 11, November 1961, p. 14)

A threading head with electromagnetic coupling for threading dead-end holes has been designed and built at the Experimental Scientific Research Institute of Forging and Pressing Machinery. Prior to threading, the head is set up for specific depth. When at the end of the threading operation the stop hits the microswitch, the latter "orders" the electromagnetic coupling to reverse the tap motion. At speeds from 47.5 to 300 rpm, the time required for reversal is 0.12 to 0.32 second; precision of threaded depth is 0.01 to 0.05 mm. (Source: A.I.D. Press, No. 608, January 3, 1962, p. 2; translation of article in MASHINOSTROITEL', No. 11, November 1961, p. 15)

VERNIER-CALIPER CENTER PUNCH. The vernier-caliper center punch shown in

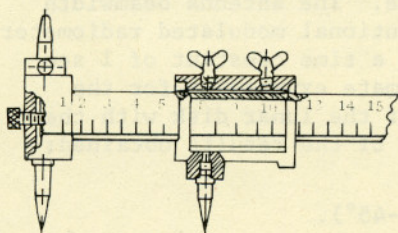


FIG. 4

Fig. 5, designed by K. Yefremov at the Rybinsk Machine-Building Plant, is to be used for laying-out operations. The punch can be set to the desired distance with a precision of 0.02 mm. (Source: A.I.D. Press, No. 616, January 4, 1962, p. 1; translation of article in MASHINOSTROITEL', No. 11, November 1961, p. 15)

HOT MACHINING (BULGARIA). A method for improving machinability and raising the metal-removal rates in the machining of hardened steel and other metals and alloys which are hard to machine has been developed at

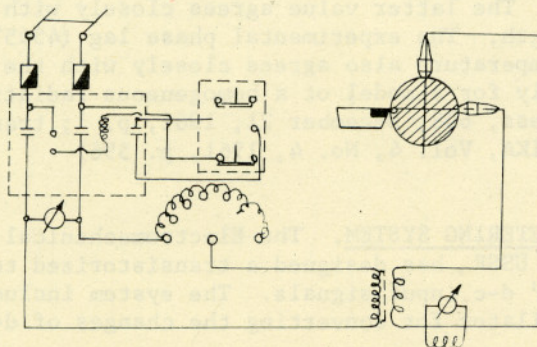


FIG. 5

the Scientific Research Institute of Machinery and Metalworking in Sophia. In an order method developed in the USSR by Professor Larin, the workpiece is resistance heated by an electric current passing from the cutting tool through the workpiece; by the new method the current enters the workpiece from a special terminal (see Fig. 5). This method has the following advantages: (1) cutting-tool temperature is decreased and the life of the tool increased by 30 to 50 percent; (2) parts with irregular surfaces or blowholes can be machined; (3) breaking of the tool tip or the occurrence of welding to the workpiece during stoppages of rotation are eliminated; (4) a smaller tool-nose radius can be used; (5) the cutting tool need not be insulated; and (6) the precision of the machining process is improved. (Bekjarov, E. Strojirenska vyroba, Vol. 9, No. 11, 1961, p. 552) (Source: A.I.D. Press, No. 608, January 8, 1962, p. 6; translation of article in STROJIRENSKA VYROBA (CZECH.), Vol. 9, No. 11, 1961, p. 552)

LUNAR RADIO EMISSION ON THE 3.2-CM WAVELENGTH. The Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR, has measured the two-dimensional distribution of lunar radio brightness on the 3.2-cm wavelength with the aid of a 22-m radio telescope. The antenna beamwidth at the 3-db level was 6.3' ( $\pm 0.2'$ ). A conventional modulated radiometer whose threshold sensitivity was 3 to 4° with a time constant of 1 sec served as a receiver. The following approximate expression for the variation of the temperature at the center of the lunar disk with the phase of the moon  $\phi$  was derived on the basis of the results obtained:

$$T = 223 - 17 \cos (\phi - 45^\circ).$$

The relative error in temperature measurement was  $\pm 5$  percent, while the absolute error resulting from an approximate determination of antenna parameters was  $\pm 15$  percent. The error in determining the lag between the radio phase and the optical lunar phase was  $\pm 5$  percent. The temperature deviation from the average value was determined to be  $\pm 7.5$  percent and the depth of penetration of radio and thermal waves for the 3.2-cm wavelength, 6.1 cm. The latter value agrees closely with that obtained on the 2-cm wavelength. The experimental phase lag ( $45 \pm 5^\circ$ ) in the expression for the temperature also agrees closely with the value of  $41^\circ$  obtained analytically for a model of a homogeneous radiating layer. (Source: A.I.D. Press, 608, December 21, 1961, p. 1; translation of article in RADIOFIZIKA, Vol. 4, No. 4, 1961, p. 596)

LOW-FREQUENCY TELEMETERING SYSTEM. The Electromechanical Institute, Academy of Sciences USSR, has designed a transistorized telemetering system for "unified" d-c input signals. The system includes a transmitter with an LR oscillator for converting the changes of d-c signals

(up to 3.9 v) into frequency variations (range 27 to 44 cps), and a receiver whose output current reaches 1.3 ma at a 600-ohm load. The receiver is a modified noncompensated transformer-type frequency meter similar to the TH4 -3 manufactured by the "Elektropul't" Plant. For high stability the transmitter has negative feedback effected by a modified transformer-type frequency meter. For increased input resistance (900 ohm), a cascade of two transistors is used in the first transmitter stage. Additional transmitter data: coefficient of nonlinearity not exceeding +0.6 percent; parasitic amplitude modulation of the output voltage,  $\pm 3$  percent; errors caused by the variation ( $\pm 15$  percent) in voltage supply,  $\pm 1.2$  percent; and error caused by the ambient temperature deviations from 20°C by  $\pm 10^\circ\text{C}$ ,  $\pm 1.18$  percent. The formula derived for the dynamic characteristics of the system shows good agreement with experimental results. The transient time for frequency stabilization and that for output current stabilization are 0.23 second and 0.44 second, respectively. (Source: A.I.D. Press, No. 615, January 3, 1962, p. 1; translation of article in PRIBOROSTROYENIYE, Vol. 4, No. 5, 1961, p. 51)

ON BOOKS. The following book reviews have been selected from various publications as noted:

n.a., Sciences in Communist China. Edited by S. H. Gould (A.A.A.S.) Washington: Bailey and Swinfen, London, 872 p.

"This weighty volume, the result of a symposium held in Washington nearly a year ago, is an attempt to appraise the vast scientific and technological upsurge which has occurred in China during the past 12 years. In principle, it will be very useful to world science, for the organizational details of Chinese scientific and engineering institutions are not to be found in the current reference books, and even if the current Chinese journals were more freely available than they are, the gulf between the ideographic and alphabetical languages greatly hinders communication.

"Twenty-six articles are offered by 29 contributors, of whom 20 are Chinese emigrés living in America and only 9 Westerners. Among the former, there are several well-known names, such as Lin K'o Shêng (Robert Lim, formerly Surgeon-General of the Chinese Army); Wang Ching-Hsi, the physiologist; Li Hui-Lin, the botanist; and Hsü Lang-Kuang, the ethnologist. There is no doubt that anyone interested in what is happening in pure and applied science in China will find a wealth of illuminating insights in the material here collected, not always in conformity with the interpretations of the readers themselves.

"A general survey of the book reveals a spectrum of variation. The articles on such subjects as engineering or electronics is favorable and congratulatory, that on mining and metallurgy even enthusiastic,

while those on physics, chemistry, and geology are quite objective; but when we come to the biological sciences, with the controversies over genetics and the value to be placed upon traditional Chinese medicine, the wind of the cold war blows in upon the proceedings, and some of the reviews are as much political as scientific. However, the writers differ among themselves; for instance, the much-criticized program of "back-yard blast furnaces" is strongly defended by Li and Wu as an effective educational process. Similarly, while Lin and Wang make a bitter attack upon the study and practice of traditional Chinese medicine, their colleagues Wei and Ch'en reach balanced or even not unfavorable conclusions. The long review of progress in the agricultural science by Phillips and Kuo seems particularly fair. Standing by itself is J. Tuzo Wilson's article, the work of the only Western contributor to the symposium who has himself travelled and studied in People's China during the last few years. He describes the great progress which has been made in geophysics and regrets that international politics have interfered with Chinese participation in international scientific organizations.

"The specific articles are preceded by a group of three having a more general character. Lindbeck's survey of the structure of Chinese science and technology, primarily factual in content, is all the more welcome as information is very scarce abroad about the great expansion of scientific institutes under the National Academy, the various ministries, and the universities. The contribution of Orleans on education and scientific manpower is also mainly objective and presents a good deal of statistical material, forming a resume' of his recent book "Professional Man-Power and Education in Communist China" (National Science Foundation, Washington, 1961). The same cannot be said of the paper by Ch'en Hsi-En on scientists and politics. It quotes, to be sure, from many original Chinese sources, but it does so in the manner of a prosecuting counsel on the staff of Life or Time magazines, making no attempt to see the problems in the round, or as they would appear to the Communist scientists themselves, and citing, without interrupting, the "jargon" of a quite different social system.

"Some misunderstandings arise, Ch'en believes, for lack of a sound historical perspective. For instance, the emphasis on "t'u fa" (traditional methods) as often more suitable than "yang fa" (foreign methods), means nothing to the Westerner or the Westernized Chinese who is ignorant of the history of Chinese technology. The history of science before our own time is but touched upon here and there in the book. When we consider the great and splendid past of Chinese culture, with all its contributions to the arts and sciences, it seems a rather hazardous thing to attempt to evaluate its position today with a background which commenced yesterday.

"The editing of the volume has suffered from what is perhaps the same disease. Uniformization of the alphabetical versions of personal and place names has been done in a half-hearted way, so that the book is an antheop of misprints and garblings of names. Only by one chance remark could the reviewer know that the article already mentioned was by Li and Wu rather than Yoo and Wei. Clean and precise conventions established and adhered to will alone familiarize Western scientists with the work, so often excellent, of their Chinese colleagues.

"No praise can be too high for the very large amount of work which this book has brought together, and for the rich bibliographies which it contains. The reader must be warned, however, that it is far from exhaustive. There is no mention, for instance, of China's most eminent protein biochemist, and one could list a good many of the recent decennial review articles which have been ignored."

This article was reviewed by Dr. J. Needham F. R. S. (Source: DISCOVERY, December 1961, p. 558)

Ernst, B. R. and T. J. De Vries, Atlas of the Universe. Nelson: London, 226 p.

"This lavishly illustrated encyclopedia of the universe and the methods of astronomy must be among the most comprehensive and informative introductions to the subject yet published. It opens with 103 pages of plates and captions showing nearly all the important objects to be seen in the heavens together with an excellent series of diagrams summarizing such topics as solar radiation, stellar spectroscopy and the evolution of the solar system, stars, galaxies and the universe as a whole. The last half of the book is set out as an encyclopedia and contains, besides the text, about 200 explanatory diagrams." (Source: DISCOVERY, November 1961, p. 509)

Catch, John R., Carbon-14 Compounds. Butterworths; London, 128 p.

"Now that radio isotope tracers are so widely used in so many fields, this guide to the literature and use of carbon-14 compounds should be of great value. The author has done a thorough job in summarizing the techniques and pitfalls of carbon-14 as a tracer and has included full bibliographies. Chapters deal with the production of the isotope, chemical synthesis, biological methods of labeling, peculiar features of carbon-14 compounds, analysis, measurement, and precautions." (Source: DISCOVERY, December 1961, p. 564)

Burgess, Eric, Long-Range Ballistic Missiles. Chapman and Hall, London, 1961 (English; 255 pages; 128 illust.)

"During recent years, long-range ballistic missiles have become outstandingly important in both East and West, and basically, each of these missiles represents but a part of a comprehensive system. It is therefore hardly surprising that even very interested laymen are unable to find their way through the maze of development. For those who want the whole picture, here is, then, a book which is easy to understand, but at the same time comprehensive. The author begins by going over historical development and then proceeds to give an account of the main American types, flight trajectories, construction of missiles and their airborne systems, particularly reentry bodies, and ground organization. One chapter deals with defense against long-range ballistic missiles. The final chapter "Ploughshares", concerned with ICBMs as carrier rockets for satellites and space probes, demonstrates how the money, effort, and brainpower invested in these weapons will also redound to the benefit of peaceful uses. This well-illustrated book is completed by a concise bibliography and an index." (Source: INTERAVIA, XVI, No. 12, 1961, p. 1711)

ON SELECTED BIBLIOGRAPHIES. The following translations were selected from the U. S. Department of Commerce, Office of Technical Services, Technical Translations, Volume 6, Number 11, dated December 12, 1961. Persons within MSFC desiring information on ordering and cost of translations should contact M-MS-IPL, telephone 876-8386.

#### ELECTRICAL AND ELECTRONIC ENGINEERING

Kitov, A. I. and Krinitskii, N. A., Electronic Computers, tr. ed. by A. D. Booth, 1961, approx. 120 p.

Trapeznikov, V. A., Tyrnka, Z. and others, Automatic Control and Man, September 15, 1961, 7 p.

Impressions of the activities of the First Congress of the International Federation on Automatic Control that was held in the Soviet Union from June 27 to July 7 are presented by 4 persons.

Zubov, V. I., Mathematical Methods of Investigating Automatic Regulation Systems, September 1961, 336 p. 68 refs.

Trans. of mono. Matematicheskie Metody Issledovaniya Sistem Avtomaticheskogo Regulirovaniya, Leningrad, 1959, 324 p.

Contents:

General theorems on the stability of motion  
Investigations of transients in linear systems with variable coefficients  
Estimate of behavior of transients in nonlinear systems  
Construction of solutions of nonlinear systems of differential equations  
in the vicinity of a singular point of the regular type  
Estimate of the effect of constantly acting disturbances on transients  
in a non-stationary system  
Investigation of the stability in doubtful cases  
Periodic and almost periodic oscillations in nonlinear systems  
Application of electronic computers for the analysis and synthesis of  
automatic control systems  
Append. I, Methods of approximating families of solutions of differential  
equations  
Append. II, On the theory of linear stationary systems with delayed  
argument  
Append. III, Correlation functions of stochastic solutions  
Append. IV, Description of the program  
Append. V, Self-oscillations and convergence  
Bibliography.

MECHANICAL ENGINEERING

Prokof'ev, K. A. and Vidyakin, Yu. A., Device for Damping Vibrations of  
Turbine Blades, 1961, 3 p. 1 ref.

Testing of blades connected by steel cable showed that the use of the  
cable, first, excludes the possibility of occurrence of tangential vi-  
brations of the blades (as with wire connexion) owing to the large  
frictional forces set up between the cable and the blades when rotating;  
and second, that occurrence of a continuous spectrum of bending-twisting  
vibrations of the packet is impeded owing to the low rigidity of the  
connexion. The investigation allows the recommendation of flexible  
connexion in turbine building. (Extract)

ORDNANCE, MISSILES, AND SATELLITE VEHICLES

n.a., First Flight of Man into Space (Some Details on Preparations for  
the Flight and the Flight Itself on the Satellite "Vostok"), July 27,  
1961, 11 p.

n.a., The First Manned Space Flight, July 27, 1961, 26 p.

n.a., The Second Flight of a Man in Cosmic Space, September 29, 1961,  
38 p.

General information is given concerning Titov's 25-hr flight in Vostok-2 launched from the cosmodrome Baykonur on August 6, 1961, which landed on August 7 near the settlement of Krasnyy Kut, Saratov Oblast'.

n.a., The Second Spaceship, August 8, 1961, 5 p.

The role of radio electronics and automation in the launching of August 19, 1960 (the launching containing the dogs Belka and Strelka) is discussed in "popular" terminology.

Blagonravov, A. A., Preparation for Man's Flight into Cosmic Space, August 29, 1961, 16 p.

A general review is given of some of the problems that were solved prior to flight of April 12, 1961 of Yu. A. Gagarin.

Kosyrev, E., Infrared Direction Finders: Heat Direction Finding: Means of Reconnaissance (Teploelengatsiya; Sredstvo Razvedki), February 5, 1960, 5 p.

Oparin, A. I., Is There Life on Other Planets?, August 31, 1961, 13 p.

Romanov, N., On Rocket Aircraft into Space, August 1, 1961, 13 p.

Sisakyan, N., Man and Space (Pt. I), July 27, 1961, 7 p.

#### ENGINES AND PROPULSION SYSTEMS

Dumov, V. I. and Peshkin, M. A., On Two Features of Cavitation Qualities of a Centrifugal Pump with Feather Type Vane and Partial Discharge of Liquid, June 29, 1961, 10 p. 1 ref.

The sharp pressure drop, produced by feather type vane, annular collector and partial discharge, at an increase in delivery is explained by the appearance of cavitation at the input section of diffuser duct, for which the maximum attainable delivery appears to be critical. Cavitation phenomena in the diffuser lead to severe destruction of the input rims of the duct. The unstable operation of the pump and the sharp pressure pulsations in the pressure feeding pipe line with subpressures at input are connected with cavitation in the feather vane and can be liquidated by increasing the pressure at the intake into the pump.  
(Author)



Gukasova, E. A. Zhukovskii, M. I. and others, Aerodynamic Improvement of the Steam and Gas Turbine Blade Apparatus, Chaps. 4, Sec. 4-1; 8 and 11, August 22, 1961, 161 p.

Contents:

Principles of model analysis of aerodynamic processes in turbine blading  
Experimental investigations of flat screens at high subsonic and supersonic velocities  
Turbine stage losses and methods for the computation of their basic characteristics.

Kalodorskii, Ya. Yu. and Rovinskii, E. V., Aircraft Nuclear Power Plants, May 1, 1961, 6 p.

A general discussion is presented of the specific structural, technological and operational difficulties (these, however, are being eliminated successfully) which occur during the utilization of a nuclear reaction in aircraft engines.

Ovsiyannikov, B. V., Theory and Design of Pumps for Liquid-Fuel Rocket Engines, 321 p. 28 refs.

The book is a textbook for the section "Theory and the Design of Pumps" of the course in "Bladed Machines in Liquid-Fuel Rocket Engines". The book has been based on the synopsis of lectures read by the author, as well as on materials published in the press in our own country and abroad. The book sets forth the theory and design of pumps for liquid-fuel rocket engines, examines the distinctive features of such pumps and the specifications they must meet in terms of the fuels (propellants) for which data has been published in the foreign press. Design parameters are given for pump systems of known foreign liquid-fuel rocket engines. In his presentation of a number of questions, the author has made wide use of the experience of industrial pump construction in our own country, which has had its most complete presentation in a monograph by Prof. A. A. Lomakin. (Author)

#### MANUFACTURING EQUIPMENT AND PROCESSES

Chaykin, F., Computer Equipment in Industry, September 15, 1961, 6 p.

Ol'shanskii, N. A., Mordvintseva, A. V., and Krumbol'dt, M. N., Seam and Spot Welding by Ultrasonic Vibrations, September 1961, 1800 words.

CERAMICS AND REFRACTORIES

Sil'vestrovich, S. I. and Boguslavskii, I. A., Strengthening Glass by Treatment with Organosilicon Compounds, 1961, 4 p. 8 refs.

An overall increase of the strength of glass was obtained by combined chemical and thermal treatment. Chemical treatment of the surface of the glass was accomplished by organosilicon compounds in conjunction with different methods of heat treatment. The values achieved for the bending strength of glass (55 to 57 kg/sq mm) exceed the strength of widely used steels (marks ST2, ST3, Kh14).