SPACE JOURNAL

DEDICATED TO THE ASTRO-SCIENCES

the RUSSIAN challenge

SPECIAL THIS EDITION:

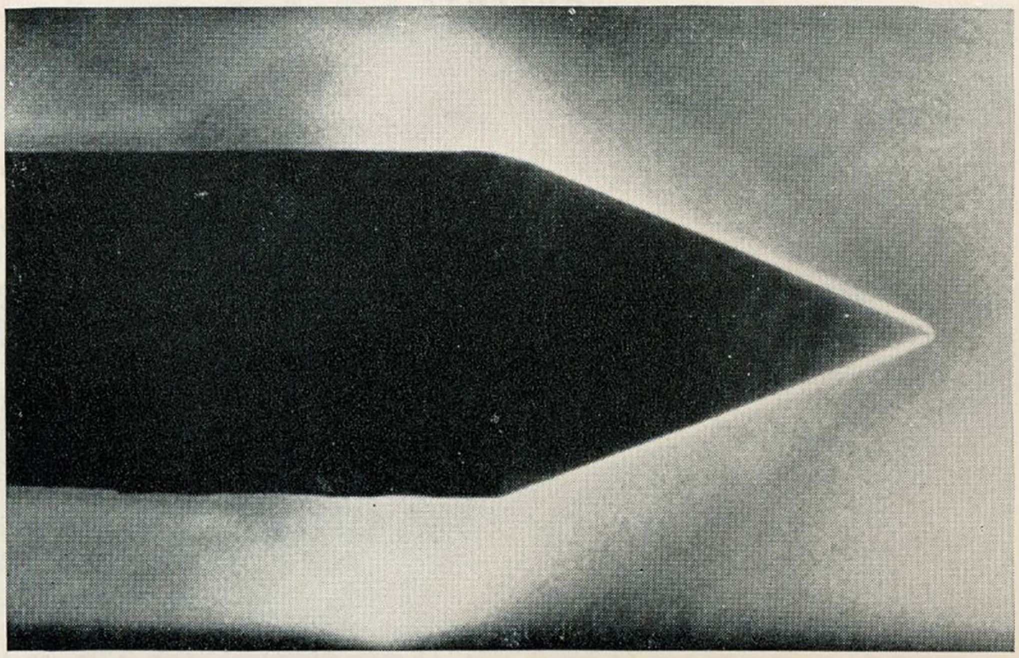
VILLAGE ON THE MOON

FALL 1958

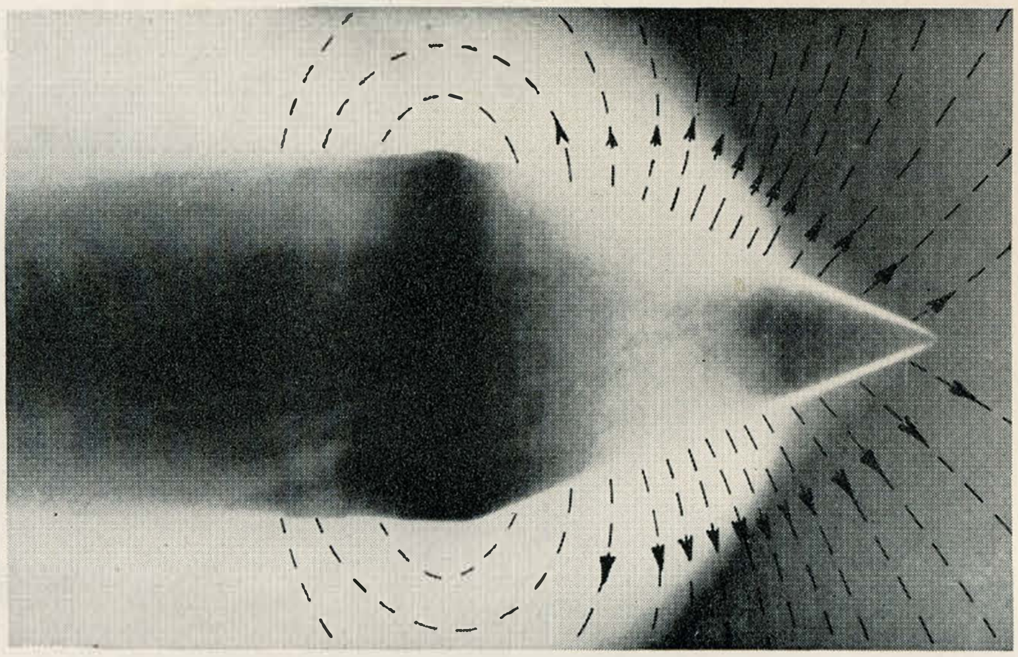
50¢

PROGRESS REPORT FROM AVCO RESEARCH LABORATORY

NEW LIGHT ON MHD*



NO MAGNETIC FIELD. This shock tube photograph, taken by emitted light only, shows the typical shock wave configuration formed by high-velocity gas flowing around a pointed cone.



WITH MAGNETIC FIELD. Here is shown the magnetohydrodynamic displacement of the shock wave. The magnetic field is caused by electric current flowing through a coil of wire within the cone. This experiment qualitatively demonstrates the interaction of a high-temperature gas with a magnetic field. This effect would be expected to produce drag and reduce heat transfer to the body.

The Avco Research Laboratory was founded a little more than three years ago for the purpose of examining high-temperature gas problems associated with ICBM re-entry. The success of this research led to the birth of a new corporate enterprise, Avco's Research and Advanced Development Division.

The Research Laboratory, now established as a separate Avco division, has expanded to embrace all aspects of physical gas dynamics. We are currently gravid with several embryonic projects which we anticipate will likewise grow into new corporate enterprises. Our work in the physics, aerodynamics and chemistry of high-temperature gases is growing in the following areas:

Magnetohydrodynamics—
Flight and industrial power-generation applications

Space flight—
Manned satellites
Electromagnetic propulsion

These developments have created a number of openings for physicists, aerodynamicists and physical chemists. If your background qualifies you to work in any of these areas, we would be pleased to hear from you.

Arthur Kantrowitz

Dr. Arthur Kantrowitz, Director
Avco Research Laboratory

P. S. A listing of laboratory research reports indicative of the scope and depth of our activities is available. Address your request: *Attention: Librarian, Avco Research Laboratory, 2385 Revere Beach Parkway, Everett, Massachusetts.*

***Magnetohydrodynamics**, the study of the dynamics of electrically conducting fluids interacting with magnetic fields.

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SPACE JOURNAL OF THE ASTRO-SCIENCES

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Earthman's First Moon Landing as rendered in oil by Con Pederson. Layout of cover by Dave Christensen and Bill Isbell.

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Projecting With Space Journal

Our Problem--Yours and Mine

Wernher von Braun

Two bright six-year-olds were out on the playground at recess. They were closely examining a spider crawling on a brick. "Don't touch it!" exclaimed one first-grader. "It's a poisonous *Latrodectus mactans!*" he added. "How do you know it's a black widow?" asked the second. "Whether or not it's a black widow," replied moppet number one, "the markings indicate that it is definitely of the genus *Latrodectus.*" At this point, the school bell rang. "Let's go back to class," said one of the youngsters. "We've got to finish stringing those darned beads."

This, of course, is an apocryphal story. I tell it here merely to point out an obvious fact: **To neglect our children with precocious talents is nothing short of criminal waste of our human resources. Adlai Stevenson once summed up this problem in his eloquent prose: "We must not let indifference or unwillingness cause us to fail to see the problem of education in human terms—in terms of boys and girls with abilities and aspirations, children who may either be held down and defeated by a poor educational system or be given new possibilities and new goals by a good one. When we neglect education in an age of global conflict, we risk the very safety of our nation and the future of freedom in the world."**

No one with any compassion or common sense has ever, to my knowledge, presumed to suggest that bright students should be accorded attention at the expense of the average student or the slow student. What has been suggested is that the bright student in some instances has been *penalized* because of his brightness. In this regard, I hope and believe that elementary teachers are playing a vital role in developing and keeping alive the specialized interests of gifted children.

We all can agree with Mr. Stevenson that education is the passport to a better society. It may stick in the craws of some, but it is a fact of life in 1958 that the race is to the swift, and the battle is to the strong. The day is past when a student can expect, in his bland innocence, to "get by."

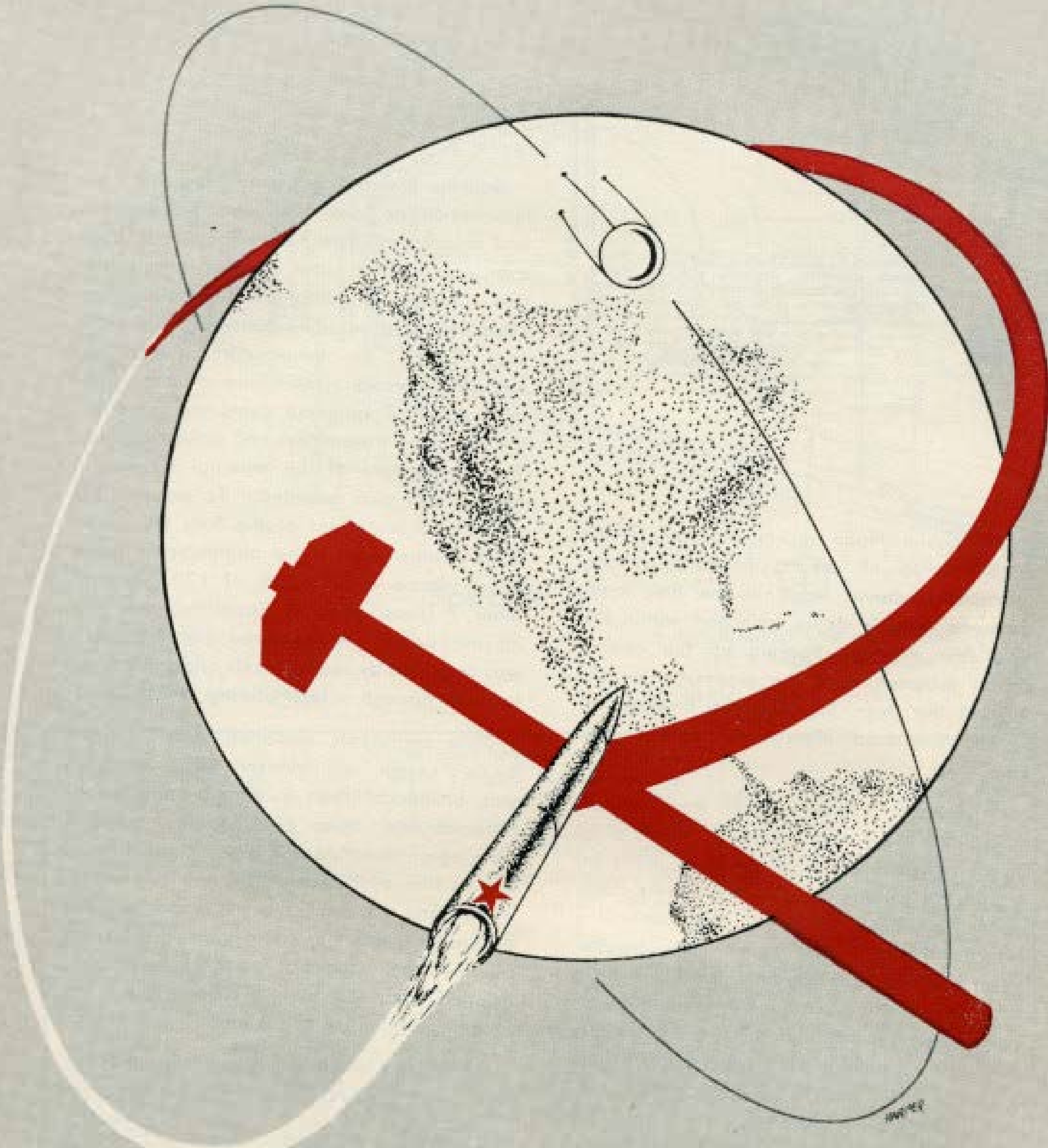
When we compare ourselves to other countries, we sometimes find that we have been weighed in the balance and found wanting. The New York *Herald Tribune* reported recently that Prince Charles, heir to the throne of Great Britain, at the age of eight is studying French grammar, world geography, long division, and multiplication, and getting "advanced drill in reading, writing, and spelling." This of course is the Blue Plate Special for a future monarch, but it shows what some youngsters are capable of digesting. The Gymnasium which I attended as a boy started its students out with a stiff course in the classics at the age of ten and Cornelius Nepos at twelve. I have never regretted my good fortune in being exposed to such a diet. This same preoccupation with education is true of the rest of Europe and of the British Commonwealth of Nations.

Dr. Lawrence G. Derthick, U.S. Commissioner of Education, returned recently from a trip abroad accompanied by ten U.S. educators. They were sobered by what they saw. In Leningrad they noted a striking fact which pointed up what they described as Russia's "total commitment" to education: biology, chemistry, physics, and astronomy are required of all pupils, regardless of their individual aspirations. Language studies begin in the second grade.

The Soviet race for military supremacy is no more of a challenge than their race for supremacy in education. We cannot meet this challenge by leaving the problem to educators or to politicians alone. It is a people's problem. It is *our* problem.

*Reprinted from the September 1958 "Instructor."

space symposium



the russian space challenge to the free world

soviet technical progress

By Ronald C. Wakeford

Ronald C. Wakeford graduated from Southampton University, England, with the Higher National Certificate in Aeronautical Engineering. His post graduate study was conducted at the same university. His professional career has included engineering and business experience in three countries, England, Canada, and the US. He is the author of numerous reports and articles dealing with rocketry and astronautics. He is Director of Research at National Research and Development Corporation.

The Soviet Moon rocket program, which according to all reports is daily gaining momentum, should result in the first interplanetary vehicle being launched within the next few months. Backing up the current Soviet program were the successful launchings of the three Sputniks, the first two of which re-entered dense atmosphere and burned up.

Scientifically informed circles were not surprised that the Russians were far ahead of us in the astronautical field since, at many international meetings and in their press, forecasts had been made of the impending satellite firings. The tremendous booster thrust required to place Sputniks II and III in orbit is indicative of the strides the Soviets have made in creating large rocket motors and new propellant fuels, advancing in the guidance field, and in developing high altitude biological laboratories.

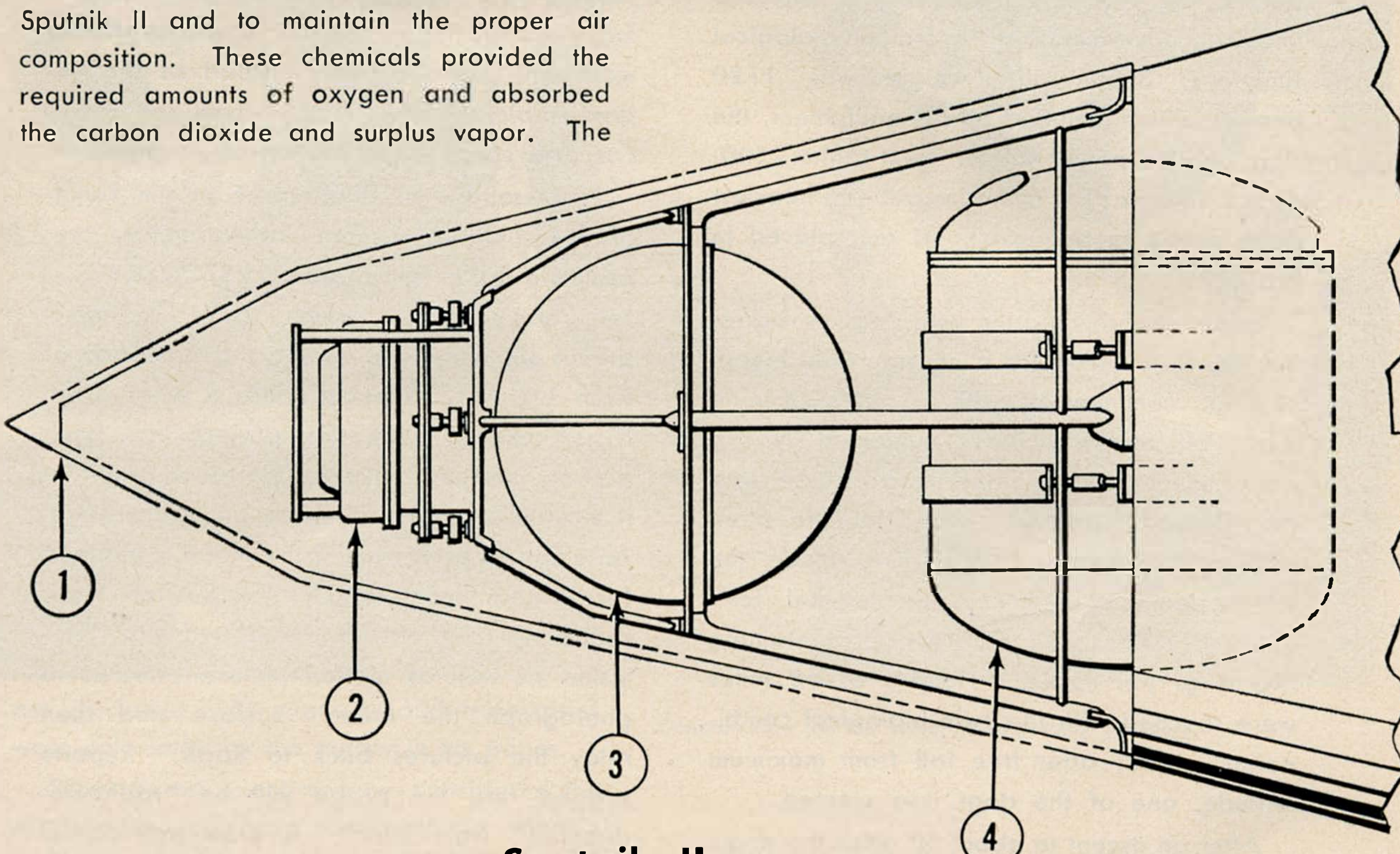
It has been reported that the three-stage booster vehicle which carried the second Soviet satellite into orbit developed a take-off thrust of approximately 660,000 lbs. This figure resulted in an apogee altitude of close to 1,000 miles.

Sputniks I and II gathered much valuable information on ultraviolet and X-radiations, and cosmic ray intensities. Sputnik III, however, carries much more complex instrumentation. Sputnik II contained thermal control equipment and sensitive elements to register such effects as temperature fluctuations and the internal temperature of the orbiting vehicle. A spherical container contained the two radio transmitters and power supplies. The temperature of the external surface of Sputnik was also recorded. To measure the short wave radiations of the Sun, the Soviet Earth probes used three photoelectric multipliers placed at an angle of 120° to each other. These received radiation, and the electric signal generated by the multipliers was amplified by radio circuits and transmitted to Earth through a telemetering device.

Data on cosmic radiation were supplied by two cosmic ray counters. After a signal was broadcast that a definite number of particles had been counted, the particles were again recorded with a new signal broadcast as soon as the same number was reached. By dividing the number of recorded particles by the time taken to count them, the Soviets obtained the number of particles the counter trapped each second. In other words, they found the intensity of radiation.

As for the biological experiment, the dog Laika was the first living organism to travel several days in cosmic space. Important scientific data on reactions to the gravity free, weightless, condition were obtained from this revolutionary biological experiment. In addition, pulse beat, respiration, arterial blood pressure, cario-biopotentials, temperature and pressure in the animal's cabin were recorded and telemetered to receiving stations.

Highly active chemical compounds were used to regenerate the air in the cabin of Sputnik II and to maintain the proper air composition. These chemicals provided the required amounts of oxygen and absorbed the carbon dioxide and surplus vapor. The amount of compounds in chemical reactions was controlled automatically, and the cabin was equipped with apparatus to feed the dog and eliminate wastes. The dog was



Sputnik II

1. JETTISONABLE NOSE CONE
2. INSTRUMENT FOR MEASURING ULTRAVIOLET AND X-RADIATION FROM THE SUN
3. RADIO TRANSMITTER
4. HERMETICALLY SEALED CHAMBER FOR LAIKA

SATELLITE LAUNCHING VEHICLES

Type	Designation	Length (ft)	Diameter (max. ft)	Weight	Stages	1st Stage Thrust	2nd Stage Thrust	3rd Stage Thrust	Exhaust Speed f.p.s.	Warhead	Status
Sputnik	CH-9	125.6	16.24	211,000	3	451,000	264,000	77,000	9850		
Sputnik	CH-10	112.8	16.24		3	517,000	268,000	78,100			
	SOVIET INTERCONTINENTAL AND INTERMEDIATE RANGE BALLISTIC MISSILES										
ICBM	T-3 (M-104)	88.5	11.5	160,000	3	484,000	268,000	78,100		Thermo Nuclear	Operational
ICBM	T-3 Second Version	108	16	350,000	3						
ICBM	T-3A	91.5	12	176,000	3	517,000	268,000	78,000	9840	Thermo Nuclear	Operational
ICBM	T-3A Second Version	101.5	16	396,000	3						
IRBM	T-4-A	122	10.2	231,000	3	264,000	264,000	77,000	9380		Experimental
IRBM	T-2	65.5	8.5	100,000	2	268,000	78,100		8365	Atomic	Operational
IRBM	T-4 (M-102)	56.1	7.2	70,850	2	170,400	52,800		10,000		Experimental
IRBM	Golem 2	57	7.2	74,800	2	242,000	71,500		7900		Experimental
IRBM	CH-18	42.3	5.9	41,300	1	99,000			7550		Production
IRBM	T-1	62	5.64	37,850	1	78,100			6525		Operational

thoroughly trained prior to making the flight; it was gradually accustomed to protracted stays in the small, hermetically sealed chamber, to the space suit, and to the attached impulse converters that record physiological functions. Sputnik II's weight was 1120 pounds, which included all the equipment, the dog, and the power source. Next to the 2500-pound Sputnik III, it is the largest and heaviest Earth probe to be developed and placed in orbit.

Soviet experimentation with dogs in rockets has been going on for a considerable length of time, commencing with a series of nine dogs, all of which were subjected to the environment of our upper atmosphere and the fringe of Space. Of these initial nine, three (Albina, Kozavka and Malyshka) made the ascent more than once. Subsequent tests utilized 12 dogs with many rockets containing two dogs per rocket. Heights of 68 miles were reached with this twin biological combination; shortly after free fall from maximum altitude, one of the dogs was ejected.

After an ascent to about 50 miles the dog's parachute equipment was activated; taking place three seconds after ejection. The second dog was ejected at altitudes of between 23 and 28 miles; its parachute opening was timed to inflate at a height of approximately two and one/half miles. Professor Pokrovskii, director of the Institute of Experimental Aviation Medicine of the Academy of Sciences of the USSR, stated that all dogs used in the experiments were recovered successfully.

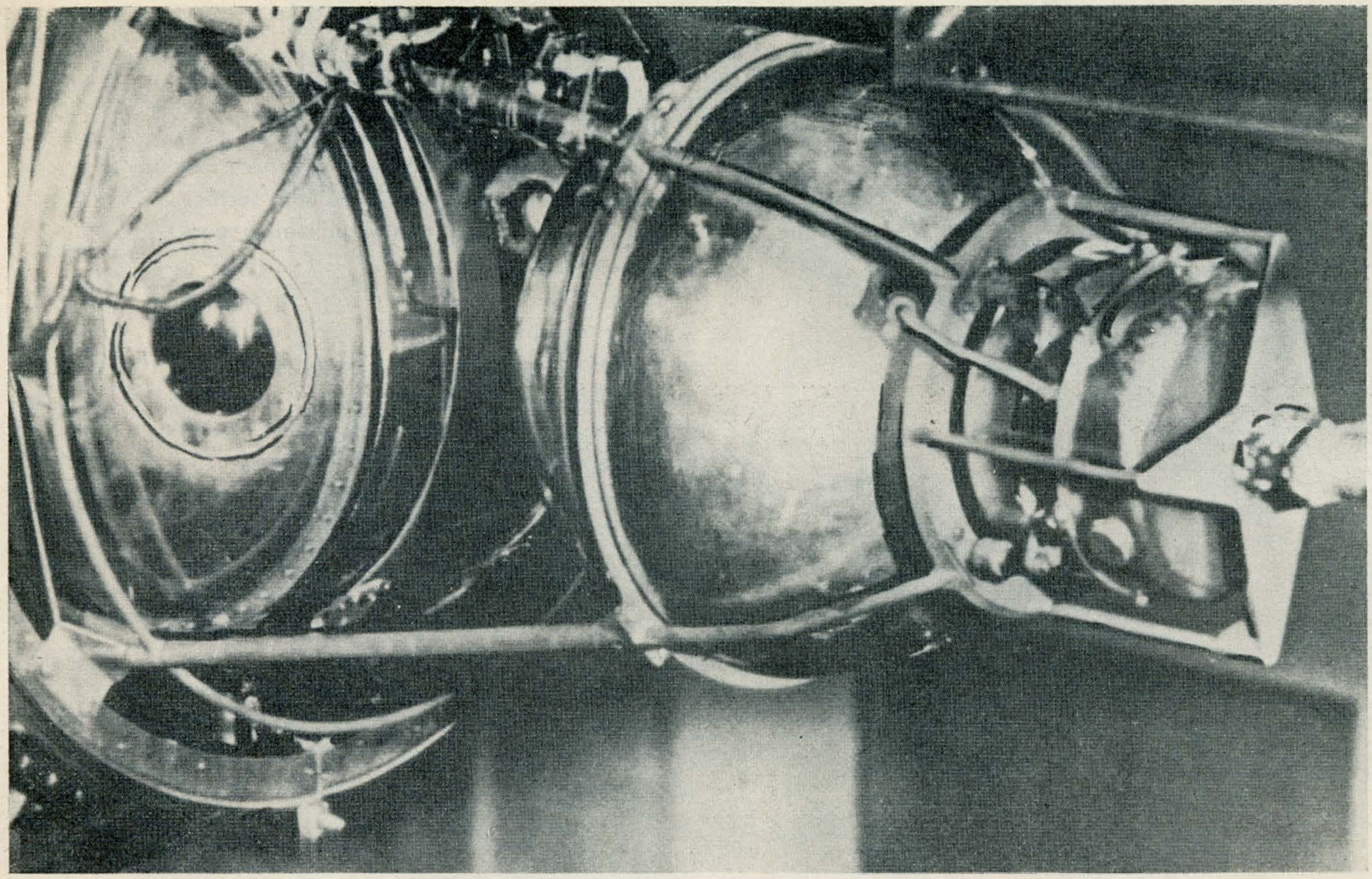
The dogs were trained to endure strain and to resist vibration; the Soviets stated that the dogs behaved normally when ejected and that they bore up well under the weightless state which followed. The data recorded indicate that the condition of the animals was satisfactory throughout the experiment.

The Russian biological achievements are only forerunners of many experiments that must be conducted. Man is one of the next steps in their program, and it is extremely likely that Soviet scientists will have man in Space shortly. Bio-satellite experimentation with human occupants represents the next great probe into the third dimension. For many years the biological approach of Soviet medical scientists has been to utilize dogs as test subjects. This research has paid off, and many authorities in the US would prefer to work with these animals instead of the unpredictable rhesus monkeys which spearhead our own space flight biological programs.

Professor G. A. Chebotarez of the Leningrad Institute of Theoretical Astronomy presented a paper in February 1957 titled "Cosmic Boomerang," which gave technical details on a method of placing payloads of from 110 to 220 pounds into a lunar orbit. It is believed that this project has been actively pursued since its inception and that it is currently approaching the hardware stage. An elliptical orbit around the Moon is planned for Project Boomerang. The Russian lunar probe will probably be equipped with television as well as motion picture cameras to photograph the Moon's surface and then relay the pictures back to Earth. Reports suggest that the probe will be "radiotele-directed" from Earth. A prominent Soviet scientist, I. S. Hlebtsevich, is in charge of this particular aspect of the program.

One study in which the Soviets are particularly interested is the determination of what causes the appearance and disappearance of craters on the Moon. Astronomer S. Y. Ziggel also wants to investigate the white cloud phenoma which are to be found in certain areas of the Moon. The question he raises is: "Do Moon quakes occur; and, if so, do such catastrophes cause crater changes and the mysterious clouds?"

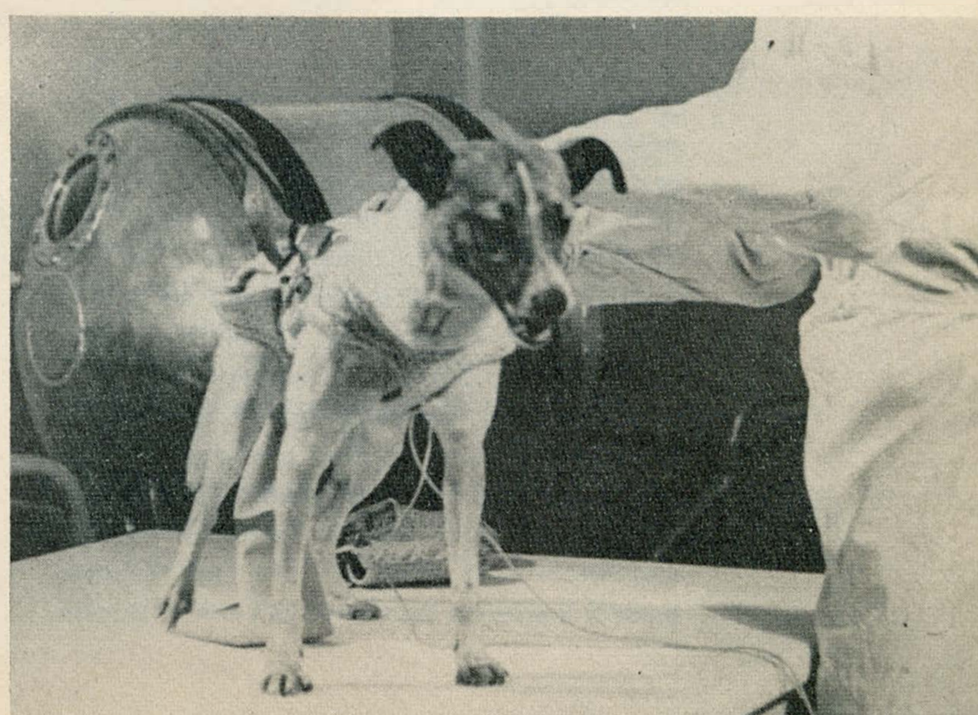
Russian scientist Egerov's paper entitled "Some Questions on the Dynamics of Flights to the Moon" gives some idea of how closely the Russians are studying the subject. In this paper he reviews the many fundamental questions and theories of flight to the Moon. The classification of unpowered trajectories, circumlunar flights, and the possibility of periodic circumflight of the Moon and Earth are examined. The question of impacting on the Moon and also the important question of the dispersion of instrumentation upon impact



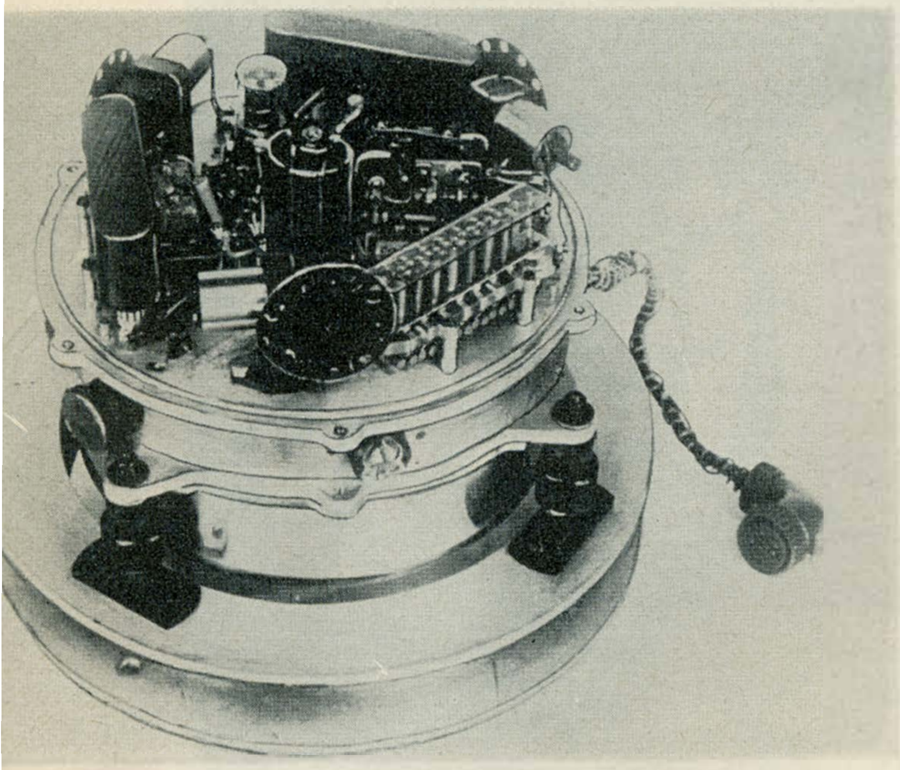
General view of the scientific apparatus in Sputnik II.

are discussed. As many as 600 trajectories were calculated by the author in his paper.

Other Soviet scientists have considered the establishment of base camps on the Moon's surface in the light of all the difficulties which will beset such a program. They have considered the need of frequently sending rocket ships to that body to support a base. The clothing and space suits for participants in such a venture have been designed; their space suits being (according to the press and photographic releases) developed, as in the United States, from high-altitude aircraft suits, and experimentation in pressure chambers.



"Laika" is shown before being installed inside Sputnik II (A still from the film, "First Soviet Earth Satellites").



Apparatus to study solar radiation, installed in Sputnik II.

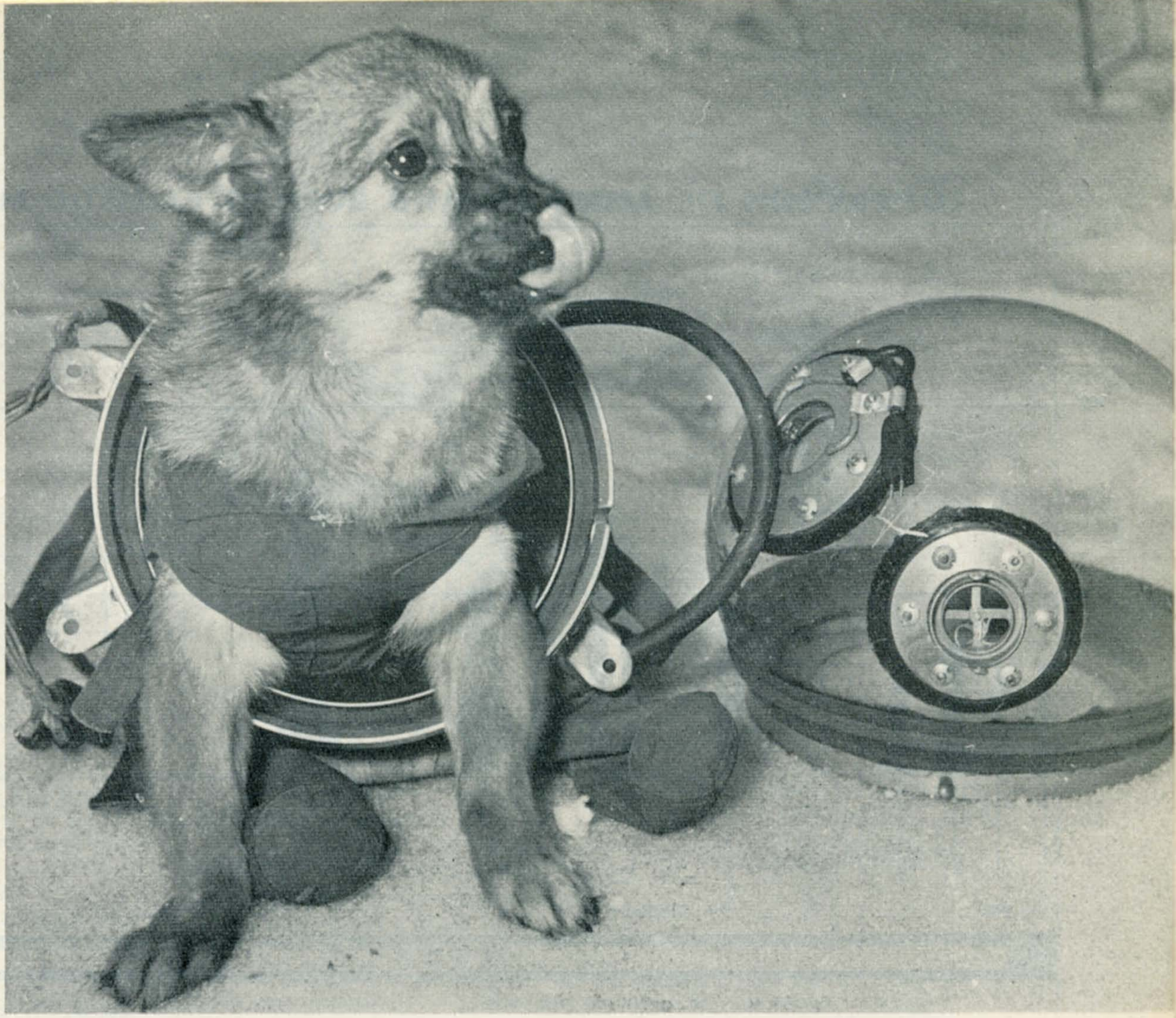
M. K. Pikhanizov some eight years ago wrote a report on a Moon rocket which would weigh approximately 1,000 tons and attain a velocity of 11 kilometers per second. The vehicle would carry a crew of two over a circumlunar trajectory and then return to Earth. A modification to this particular program would result in a vehicle being launched from an Earth-orbiting space station. Such a vehicle would weigh approximately 100 tons and would take off with a velocity of 3.5 kilometers per second. Some reports even suggest that design has already begun on the former vehicle and that its length is 60 meters; it has a maximum diameter of 15 meters. The overall weight would be 1,000 tons, and it would have 20 motors which could build up 350 million horsepower.

The Russian literature has fully covered lunar landings with all their attendant difficulties—take-off from this type of planetary environment, crew safety, and the various maneuvers of bringing orbiting vehicles around the Moon and back to Earth. Studies on the Moon would include the search for an atmosphere, determinations of surface conditions, and experiments to obtain geological data.

Soviet scientists have devised a scheme whereby the Moon may be explored by a small unmanned tank. The "tankette laboratory" would be landed on the lunar surface by the probe rocket, the former vehicle being radio controlled from Earth. Equipment in the mobile laboratory would include a television camera which would transmit details of the Moon's surface to observers on Earth. Other experiments conducted with this device would be geological sampling, gravity and temperature determinations, etc.

In the background of the Russian Moon program is the Soviet work on guided missiles. In this field they have constructed, and have launched, and have in production, every type of missile that is known from underwater-to-surface through the missile spectrum to surface-to-surface. Their progress in the ICBM and IRBM field is well known since test

The dog "Moduitso", shown in the foreground, supposedly has "just returned safely from the flight." This instrument and animal container section of a Russian experimental rocket was reported to have been parachuted from a height of 212 kilometers. (From "Pravda")



Another "experienced" Russian "astronaut" by the name of "Malyshka" and its space capsule. (Photo by S. Gurory)

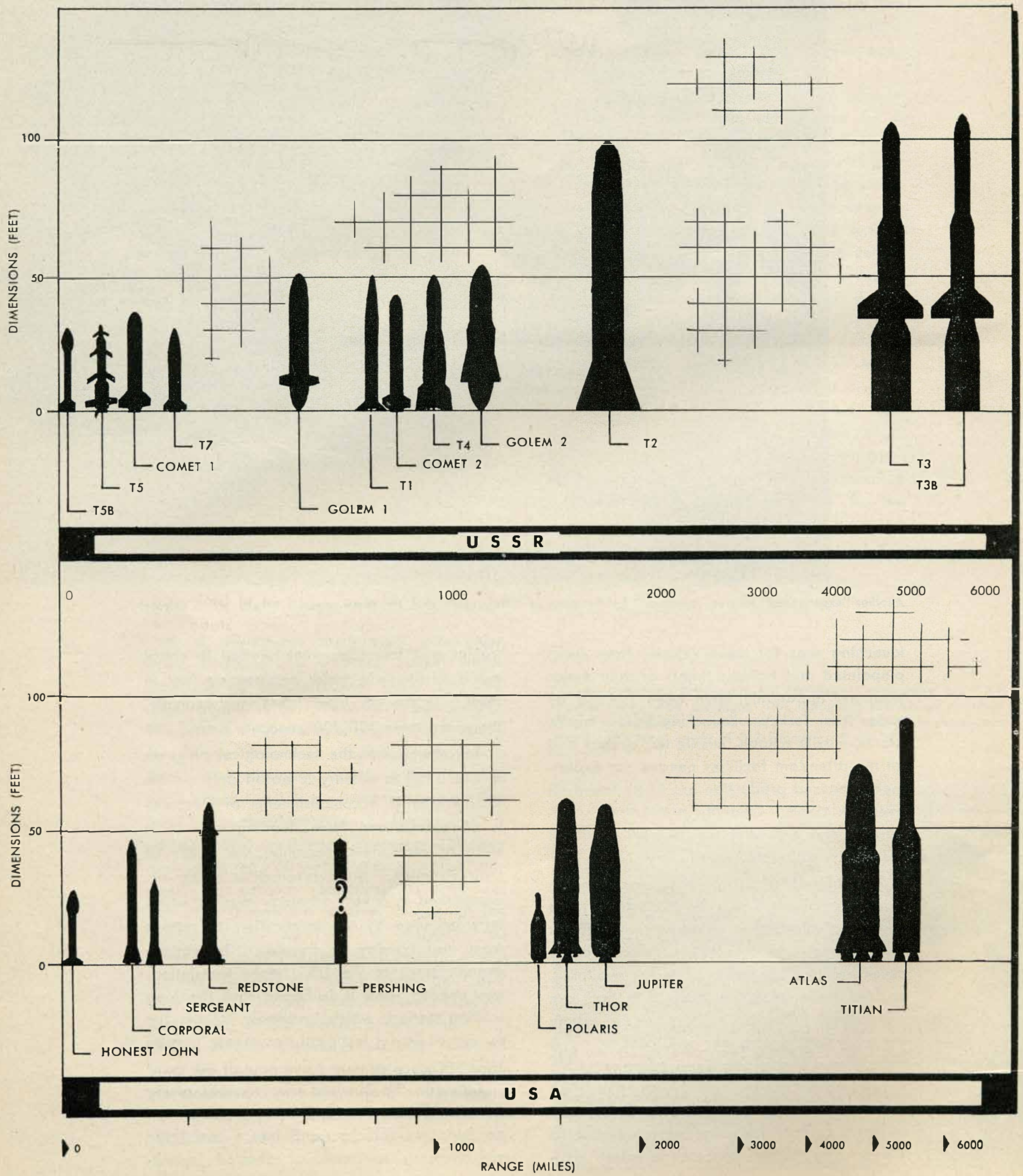
launching sites for these vehicles hove been pinpointed and ballistic flights of their major weapons apparently hove been tracked by radar from Turkey. Launching bases, missile plants, missile schools, missile test centers and all the attendant facilities needed for experimentation and production ore to be found all over the USSR. Quantity production is apparent, and we hove no reason to doubt the quality of the products.

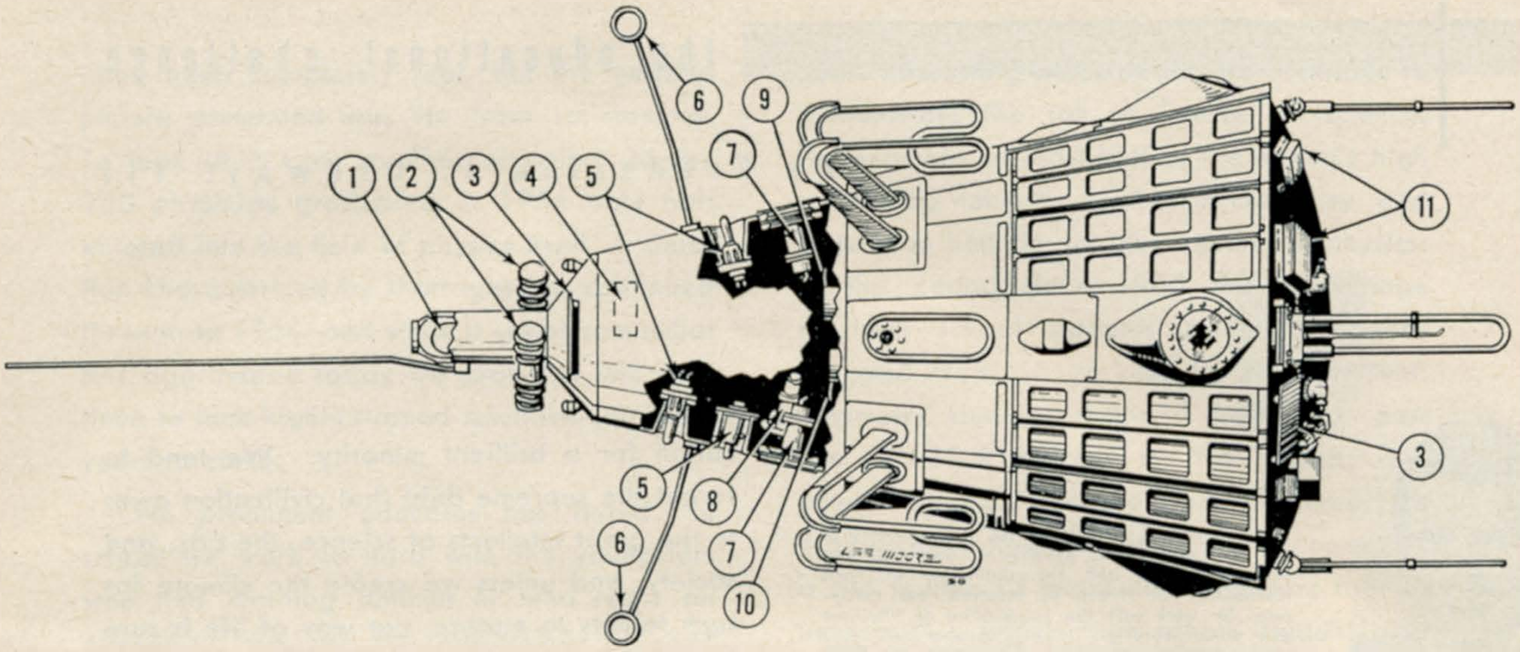
The strength of Soviet advances mode in technological areas may be illustrated by the number of production or operational missiles in evidence. In the IRBM category alone seven vehicles ore believed to be available, and of these probably more than half ore operational. The design of a missile system (as any missile engineer will confirm) is a complicated and exacting procedure requiring the coordination of many highly qualified scientists and engineers. Thousands of complicated components must be integrated to insure compatibility, and the necessary electronics and test equipment needed to check out a missile is a major engineering feat in itself. In the US Atlas ICBM, for example, there ore over 300,000 separate ports.

To assume that the technological progress of the USSR in missilry is based only on the World War II accomplishments of Germany is dangerous and false, leading only to a state of seriously underrating the ability of their scientists. Basic research is being accomplished in a very scholarly manner which may be seen by the publication of reports from that country as translated by various organizations in the US. More translations ore needed, and it is hoped that the long waiting period, which invariably follows the receipt of Soviet technical documents, con be reduced.

Although the Russians wisely ovoid giving advance data on the launching dotes of IGY participation vehicles, and hence avoid the embarrassing spectacle of aborted launch-

COMPARISON OF AMERICAN AND RUSSIAN BALLISTIC MISSILES





Sputnik III

1. MAGNETOMETER
2. PHOTO-MULTIPLIERS FOR THE REGISTRATION OF THE CORPUSCULAR RADIATION OF THE SUN
3. SOLAR BATTERIES
4. DEVICE FOR THE REGISTRATION OF PHOTONS IN COSMIC RAYS
5. MAGNETIC AND IONIZATION MANOMETERS
6. ION CATCHERS
7. ELECTROSTATIC FLUXMETER
8. MASS SPECTROMETRIC TUBE
9. DEVICE FOR THE REGISTRATION OF HEAVY NUCLEI IN COSMIC RAYS
10. DEVICE FOR MEASURING THE INTENSITY OF PRIMARY COSMI RADIATION
11. PICK-UPS FOR THE REGISTRATION OF MICROMETERS

ings, they have given details of the experiments to be conducted. These include:

1. Structure parameters of the upper atmosphere, temperature, pressure, and composition.
2. Movements of the upper atmosphere.
3. Study of the electrical properties of the upper atmosphere (ionosphere).
4. Study of cosmic radiation.
5. Study of the ultraviolet part of the Sun's spectrum.
6. Study of the solid composition of interplanetary material (micrometeorites).
7. Study of corpuscular rays from the Sun.

A recent tour of the USSR by US engineers attending a radio engineers' convention in that country resulted in their obtaining first hand knowledge of Soviet progress in this field. Among the facilities visited was Pulkovo (some ten miles south of Leningrad) where a radio astronomy station is located. The focal length of the radio telescope is 50 meters and it has a diameter of 75 meters. It has a paraboloid section and uses flat mirrors, each of which is adjustable to relate these to the theoretical contour.

Other places visited by this group included the Television Research Institute at Leningrad and the Television Broadcasting Station at Moscow. The latter organization broadcasts on two 8 mc wide channels. Current planning indicates that 60,000 kilometers of wide band microwave circuits will be available by 1960. When this rate of progress is related to the known status of this country in these fields some ten years ago, it may be seen that a great deal of research has been successfully accomplished.

Education is the key to Soviet progress, and this particular basis has been firmly established. From grade school through university, great emphasis has been given to scientific training. This approach has resulted in the graduation of these scholars whose efforts today are successfully keeping the USSR ahead of us in the race to the Moon. Only a complete overhaul of our own school system, programmed to concentrate on the scientific areas in which we are deficient, can result in the negation of this lead.

the educational challenge

By Frederick I. Ordway, III

Frederick I. Ordway, III, was educated in the geoscientific and geophysical fields at Harvard University and the University of Paris (Sorbonne). In France he received four certificates for work with the Loboratoire de Physique de l' Atmosphere. He has also studied specialized courses at other European universities and holds diplomas from the US Air University. He has lectured widely in both the US and Europe on rocketry, high altitude research and space flight. He is the author of dozens of articles on these and related subjects. At present, he is vice-president of the National Research and Development Corporation.

One of the most widely discussed subjects in the US today is education. For the first time in memory the nation has begun to think in terms of the *quality* of the "educated man" as well as the *quantity* (of which we in America are manifestly proud) of graduates churned out by our schools and universities. Although there is much about our system to justify pride, forward-looking educational authorities have realized there are many shortcomings in our schools; and strong efforts are happily being made to improve them.

True, there is no sca·city of "experts" who, while worshiping the status quo, defend their achievements and misguidedly think that everything American has to be best. These people are bound to fight improvement programs every inch of the way. Yet, it is clear to most of the thinking community that something has to be done, and done quickly, if coming generations are to yield leaders capable of maintaining America's position in the world.

Our educational problems stem from many causes. On the one hand we have been far too eager to achieve a mediocre education of the masses to the detriment of superior education for a brilliant minority. We tend to forget the supreme debt that civilization owes to the great intellects of science, the arts, and society, and unless we create the climate for such talents to nurture, our way of life is sure to wither.

On the other hand, we suffer from the fetish of insisting on thousands of bright, shiny and often gaudy new schools with little or no thought for the excellence (or even living standards, for that matter) of the teaching staffs within them. It has been far from obvious to many that a school or a university can be no better than its teachers. The physical aspects may be important, but they alone do not provide the climate of scholarship so necessary in a creative society. Great teachers, rather than great buildings, are necessarily the cornerstone of any system that calls itself educational.

In the paragraphs that follow we shall cover various general factors applicable to US and Soviet education, giving particular attention to scientific aspects and implications.

The availability of scientific and engineering talent is a crucial factor in today's world of ICBM's, H-bombs, and artificial satellites. All major nations are aware of the importance to their security of technically trained manpower, and at least some have well-planned programs designed to encourage youth to enter scientific fields of endeavor.

The US is the most important example in the world of a nation without a definitive educational program in science or technology. Some comparative figures are informative in this context. In 1954 American industry needed 30,000 new engineers, but only 18,000 were graduated that year from our colleges and universities. This shortage may or may not

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have been completely real, but the general picture presented was far from satisfactory. To look at it from another direction, of the 250 physicists graduated in 1954 only half entered into the field of physics itself. A situation characterized by shortages has continued through to 1958; and while it seems somewhat less aggravated today we probably will continue to lack highly trained scientists for many years to come.

One prominent educator has noted "in school we work so hard with the youngsters who find learning difficult or who resist an education, that we fail adequately to deal with the sparks of genius when they appear." He went on to say that "our greatest failures in the schools of America are those youngsters who have the ability to become the creative leaders of tomorrow. The real major leaders of the future in science, industry . . . must be challenged to do their best, not merely to be better than the average."

One of our main jobs is to select potential talent early in life, and to nourish it carefully so that it may grow or achieve maximum development. Our leading educators are beginning to emphasize, more than ever before, the importance of obtaining more and better instructors; and they warn us not to rely on fancy new buildings and unplanned "crash programs" to achieve our educational aims.

Reduced to its essentials, an educational system consists of: (1) schools, (2) students, and (3) teachers. A knowledge of construction techniques permits us to build an acceptable school. The supply of students seems both plentiful and inexhaustable. Teachers, on the other hand, represent an entirely different commodity—one difficult to create, by no means plentiful, and decisively important.

We are troubled to learn that competent teachers are becoming harder and harder to get. There has been at least a 50 percent drop during the past five years in the number of college graduates whose educational programs have prepared them for high school science teaching; and of the relatively few persons qualified to instruct scientific subjects, only about half make teaching their career.

Some interesting percentages are available to demonstrate the fall of interest in science. For example, at least half of the nation's high schools do not offer courses in chemistry, and more than half do not give courses in physics. In the period since 1900 the percentage of high school students studying algebra dropped from 56 percent to 24.6 percent. Geometry students dropped from 27.4 percent to 11.6 percent in this period; and physics students declined from 19 percent to 4.5 percent. Perhaps even more discouraging is the feeling of many key educators that at least half a million high school students are taught mathematics by teachers not qualified to give instruction in the subject. Some 300,000 students are exposed to physics by nonqualified instructors.

A nationwide survey by the National Education Association shows that only 36 percent of persons who prepare to teach chemistry and who receive their certificates intend going into the teaching field. Furthermore, less than half those qualified to teach general science, biology, physics, and mathematics will actually teach. This situation has been described by many as "tragic." One interesting, though dismal, sidelight was shown by a survey demonstrating that the difficult subject of mathematics is often being taught by teachers qualified in such subjects as English, music, social science, and speech! Physics and chemistry classes are often taught by specialists in agriculture, physical education, or social science! Furthermore, it has been shown that only 148 of 303 chemistry classes in 30 states surveyed were being taught by teachers who had majored in chemistry! The implications of these figures should shock even the most complacent of an indifferent public.

Coupled with this, we find that today well over 50 percent fewer persons receive certificates to teach science as compared with only five years ago (the comparison would be even more startling if longer time period were presented.) About 51 percent fewer students receive mathematics certificates than only five years ago.

Estimates made for the year 1956 show that our schools were faced with a shortage of 6000 science teachers; and at the same time only 4000 were being graduated (out of which only *half*, as we saw, actually expected to go into teaching.) Thus, at a critical period in the history of science 2000 teachers were trying unsuccessfully to do what 6000 would normally be expected to do.

Naturally, such figures as these have evoked comment from authorities in the scientific and teaching fields. One important educator has said that "the staggering deficiency in scientists and engineers that confronts us will spell disaster to the American people unless we take action at once." Incidentally, these words were uttered three years ago, and it is discouraging to see that relatively little progress has been made since that time.

Rise in Science Pupils

Changes in enrollments in mathematics and science in public secondary schools in the United States (grades 9-12) and related data, 1948-49 and 1956-67.

Item	Typical Grade	Enrollments 1948-49	Enrollments 1956-57	Per Cent of Increase
Subject				
General Science	9	1,074,000	1,518,000	41.3
Biology	10	996,000	1,430,000	43.6
Chemistry	11	412,000	520,000	26.2
Physics	12	291,000	310,000	6.5
Other Science	9-12	155,000	265,000	70.9
Total	9-12	2,928,000	4,043,000	38.1
Elementary Algebra	9	1,042,000	1,518,00	45.7
Intermediate Algebra	11	372,000	484,000	30.1
General Mathematics	9	650,000	976,000	50.2
Plane Geometry	10	599,000	788,000	31.6
Solid Geometry	12	94,000	160,000	70.2
Trigonometry	13	109,000	200,000	83.5
Other Mathematics	9-12	91,000	275,000	202.2
Total	9-12	2,957,000	4,401,000	48.8
Population				
Age 14		2,126,000	2,556,000	20.2
Age 15		2,140,000	2,393,000	11.8
Age 16		2,231,000	2,292,000	2.7
Age 17		2,206,000	2,300,000	4.3
Age 14-17		8,703,000	9,541,000	9.6
Enrollment				
Grade 9		1,641,000	2,254,000	37.4
Grade 10		1,491,000	1,933,000	29.6
Grade 11		1,242,000	1,513,000	21.8
Grade 12		1,026,000	1,263,000	23.1
Grade 9-12		5,399,000	6,963,000	29.0

Source: Offerings and Enrollments in Science and Mathematics in Public High Schools (Office of Education Pamphlet No. 120).

Moscow University students on their way to a lecture at the University.

Another educator cautioned that "science has become a neglected subject. We have not prepared enough high school students in the sciences to meet future needs." A still more astonishing warning came from Dr. M. M. Boring of the Engineering Manpower Commission who said, "It is an incredible and dangerous paradox that in the age of science and engineering, secondary school interest and activity in science and mathematics, the necessary prerequisites to technical careers, are decreasing proportionately. . . . This trend must be reversed, not only because our needs for vital and professional personnel are bound to increase, and must somehow be met, but also because our future citizens must have at least the fundamental background necessary to an understanding of the times in which they will live and work."

The deficiency of science teachers has led the American Association for the Advancement of Science to set up a $300,000 grant to study the shortage and the problems it poses. The final report resulting from the study showed that in one recent year about 250 persons were graduated from American colleges and universities capable and prepared to teach high school physics. Of these only half went into teaching. The situation was shown to be very similar in other areas of science and in mathematics. A number of reasons are given for this:

1. We were faced with an increasing population, making greater demands on our schools. This was coupled with the fact that relatively few

teachers were coming available (partially due to the low birth rate of the 1930's).

2. We must consider the extremely low salaries paid to teachers. This fact turned potential science teachers to other, more lucrative, fields.
3. During recent years the high school has changed from an educational institution whose primary function was to train relatively few students to pass college entrance examinations prior to going to college to a system designed to give terminal training to students not going on to follow university careers.
4. It has been frequently pointed out that many of the persons teaching sciences in schools are inadequately prepared to give instruction; such a situation can completely blunt the scientific inclinations of the student, or at least hamper his development.

It seems evident that, in order to improve scientific teaching, we must draw from the ranks of college graduates who have studied science but who may not have received formal courses in educational techniques. Such people know their science even though they may not have been trained in education. It is logical to believe that qualified scientist-teachers are preferable, even though they lack educational courses, to the hundreds of inadequately trained science instructors present in our schools today.

Fortunately, there are responsible individuals and organizations who have become deeply concerned with finding and cultivating as much scientific and engineering talent as possible. What the future holds in store for American education in science may be largely left in the hands of such groups as the Scientific Manpower Commission, Office of Scientific Personnel of the National Research Council, Engineering Manpower Commission on the Engineers Joint Counsel, the Chief of Engineering Education of the United States Office of Education, the American Association for the Advancement of Science, and educational committees and panels attached to industrial organizations and scientific societies.

There is an admitted and vast difference between the European and American concept of everyday life at the university. *American universities feel they are educating partially grown children, and accordingly often go to extraordinary lengths to care for them.* Thus we find elaborate rules of conduct, all types of administrative devices to insure that classes are attended, "dean's lists", and other such instruments as are believed necessary to take care of our young as they pass through university life. All this has resulted in the lamentable fact that the American student matures in his university at a far slower rate than the European does in his.

The average university in continental Europe takes little or no responsibility for the life of the student. There are generally no dormitories or other special houses for students to live in. Student unions, fraternities, dining halls, and similar activities may very well be absent; and, of course, there are unlikely to be college athletic facilities, sports arenas, and so forth. Therefore, being a student in Europe is a far more gruelling experience. One must forage for his own, so to speak, but the immature are quickly weeded out from the mature.

In Europe one is unlikely to see professors taking attendance; it is entirely up to the student if he does or does not attend a lecture. Nor are the universities interested in his personal life, his finances, his habits of study, and his home environment. If he pays, he can attend courses; if he does not pay, he cannot attend courses. It is his own responsibility to attend classes. If he passes his final exams, he gets credit towards a degree, regardless of whether or not he attended classes. There are no warning notes, and mid-semester grades on general course work prior to the final examination are rare or absent.

The European university assumes it is educating an adult, not a child. The emphasis is on learning, not on techniques of teaching, as was pointed out by Harvard's Professor Howard Mumford Jones several years ago in a leading university alumni publication. It is assumed that if the European student does not take advantage of the great educational advantages given him, he is a fool, and if he wants to be one it is entirely his own business. The American system, on the other hand, spends much time and effort trying to keep him from being one. As Jones has said, ". . . in Europe it is universally assumed that a

N. S. F. Research Grants

National Science Foundation Research Grants by Fields of Science

Field	Fiscal years 1952-56 Number	Fiscal years 1952-56 Amount	Fiscal year 1957 Number	Fiscal year 1957 Amount	Total Number	Total Amount
Biological and medical sciences:						
Anthropological	18	$ 184,800	17	$ 153,500	35	$ 338,300
Developmental	70	586,182	32	382,750	102	968,932
Environmental	82	746,860	65	777,200	147	1,524,060
Genetic	75	994,700	41	659,250	116	1,653,950
Molecular	181	2,748,730	84	1,784,950	265	4,533,680
Psychobiology	134	1,659,550	54	783,100	188	2,442,650
Regulatory	215	2,921,145	114	1,870,400	329	4,791,545
Systematic	177	1,399,080	89	706,575	266	2,105,655
General	40	721,510	31	503,200	71	1,224,710
	992	$11,962,557	527	$ 7,620,925	1,519	$19,583,482
Mathematics, physical, and engineering sciences:						
Astronomy	75	1,261,800	33	453,900	108	1,715,700
Chemistry	254	3,106,200	147	2,653,700	401	5,759,900
Earth Sciences	102	1,318,275	54	770,150	156	2,088,425
Engineering	181	2,008,700	103	1,369,950	284	3,378,650
Mathematics	128	1,553,200	64	1,038,900	192	2,592,100
Physics	195	3,036,400	53	1,348,300	248	4,384,700
Sociophysical	8	105,100	12	154,100	20	259,200
General	1	7,000	4	119,000	5	126,000
	944	$12,396,675	470	$ 7,908,000	1,414	$20,304,675
Total research grants	1,936	$24,359,232	997	$15,528,925	2,933	$39,888,157

university . . . is a mature intellectual enterprise primarily concerned with preserving and extending knowledge and maintaining the great professional classes . . . without which no culture can survive."

In general it is far easier to gain access to an American university than to enter one on the Continent. A great many reasons exist for this, but they are beyond the scope of this article. However, I recall that when I first entered the University of Paris' Faculty of Sciences, I had to establish that my previous American college education was *equivalent* to the French Baccalaureate, or secondary system. I was perhaps lucky to have passed this and to have received additionally several credits toward an advanced degree. I remember a number of American college graduates whose work was not, in the eyes of the French authorities, considered of sufficient significance to warrant the all-important "equivalence." Though this may seem exaggerated, it at least affords a basis for comparison.

When we think of the dozens of diversionary activities associated with American university life (being invited into the proper fraternity, getting on various athletic teams, participating in club life, dances, dating, etc.), we often may wonder how academic progress is made. Our "normal," well-rounded, overprotected student is the average student, one whose extracurricular activities may often be more spectacular than his academic record.

He, and not the "brain," is the hero of the US campus.

Most of these outside distractions do not exist in the continental European counterpart, at least not to the extent as in America. Perhaps the great question that America has to answer is how it can mature its undergraduate student body, how it can dispense with its long-extended adolescence. That is the challenge that the European education gives the American system and is the particular challenge posed by the enormous progress of Soviet education today. The roots of a nation's scientific and technological greatness are found in its educational system. Our schools and colleges must produce the leaders of tomorrow's world of science. Our system must become second to none if our way of life is to survive.

Russian education is similar, but by no means identical, to that of continental Europe. The basic educational landmark in Russia is the ten-year secondary school, which handles children of the ages 7 to 17. During this period, a student would study ten years of Russian langauge and literature, a like amount of mathematics, five years of physics, four years of chemistry, six years of biology and botany, six years of geography, seven years of history, a year of astronomy, and various practical subjects such as metal working and engineering drawing. During the later years of the secondary education, the student is generally in class seven hours a day and has five hours of homework.

With a 12-hour day, the student must also count on a 6-day week and a 10-month academic year. It need hardly be pointed out that the US system is far more relaxed than this extremely difficult academic grind to which Soviet children are exposed. Another thing one should not forget is that a student is financed through his education by the state, and this, of course, allows Russia to pick out from the whole mass of its people the best available minds. The above-average students get the best training, while those of below-average abilities are weeded out rapidly so as not to pull the average down. There is apparently no acute teacher shortage in Russia, a fact which is not surprising considering the material benefits and prestige they derive from their career.

It is known that since 1927 the Russian educational system has grown by fantastic leaps, starting with 11 million arts and sciences students and numbering now 30 million. In the higher educational institutions they started in 1927 with a 169,000 enrollment and now have more than two million. In the secondary system the courses given are far more complete and difficult than in the US. For example, the Soviets teach algebra in the sixth grade and calculus starts in the ninth. A typical seventh grade student in the USSR is likely to have zoology, anatomy and physiology of man, mathematics, history, geography, biology, Russian language and literary reading, chemistry, foreign language, physical education, technical drawing, practical shop work, agriculture, and sex hygiene on his study program.

The actual secondary school graduates per year are 1,500,000 versus 1,300,000 in the US. Dr. Laurence G. Derthick, United States Commissioner of Education, has said that "it would be tragic . . . if the evolution of education in the USSR should be considered as any cause to question our basic concepts of freedom in education. Rather, it should challenge every American to re-examine the extent to which we as a people support our democratic system of education . . . . It should, in fact, challenge Americans to take new interests in meeting the needs of our schools, colleges, and universities as they serve the purposes of our society: freedom, peace, and the fullest development of the individual."

It is generally understood that to achieve the maximum benefit from a nation's total brain power resources, outstanding talent must be identified at an early age, encouraged to progress from the time it is identified, and above all be given the best conceivable training. Reports strongly suggest that the embryo scientist is far more readily identified in the USSR than in the US, and that when he is identified something is done about him. Outstanding students are pushed ahead

Cramming for an exam in one of the rooms of Moscow University's student dormitories. (Photo by D. Sholomovich)

rapidly and are not forced to follow the pace set by their intellectual inferiors.

Perhaps the most significant thing about the Soviet system is its very hard schedule and the fact that all students are under constant pressure to excel. The leisurely pace typical in our American schools cannot be tolerated in the Soviet Union. As has been pointed out frequently in recent years, school teachers and college professors form part of the Soviet social and intellectual elite, an almost diametrically opposite situation to that which prevails in the US. With a hard schedule, excellent teachers enjoying top prestige, and good facilities, it is not difficult to understand why Soviet progress in education is evoking such interest today.

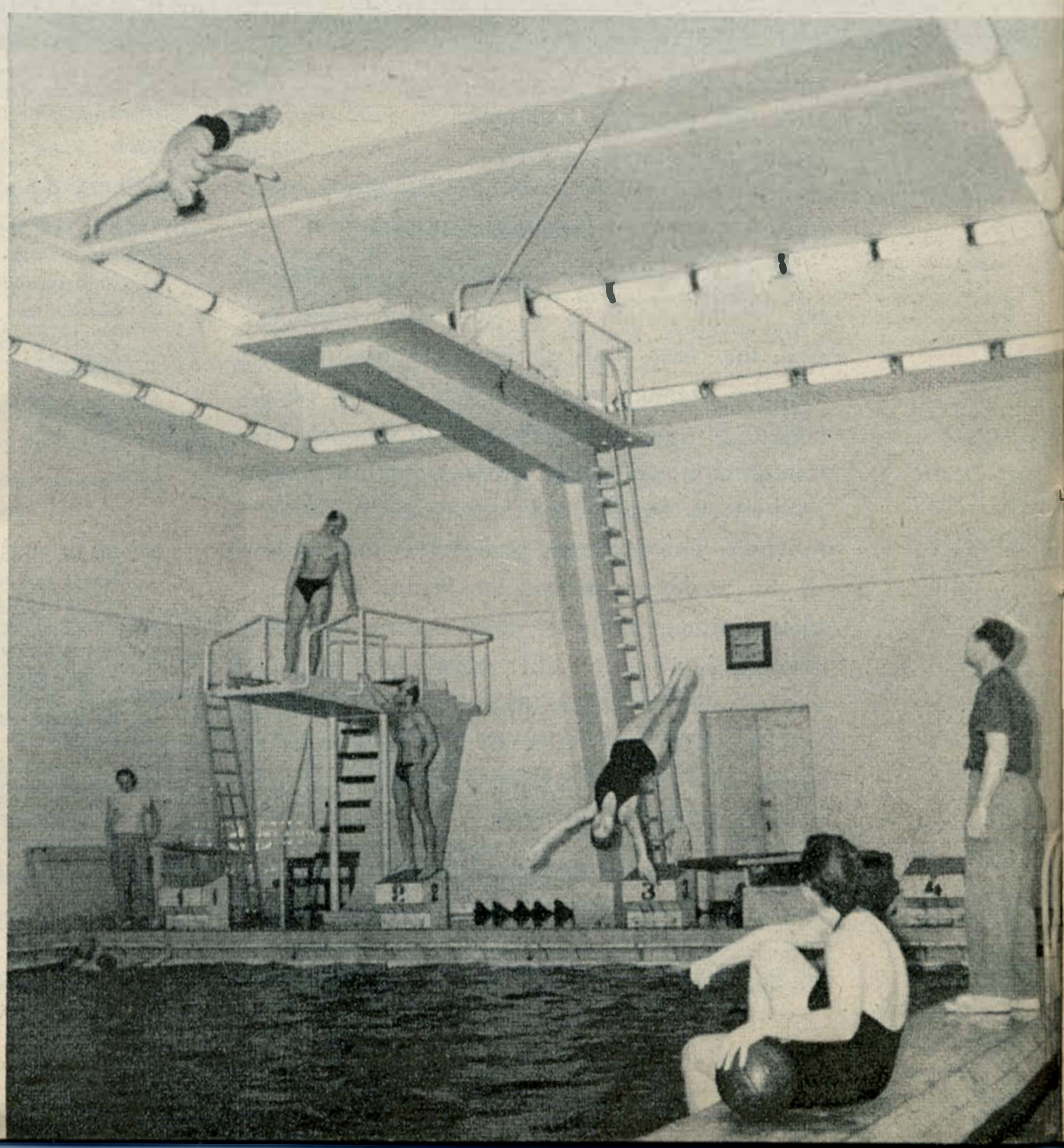
The rules of conduct applicable to pupils in the Soviet Union are interesting and informative. In 1943 the Soviet People's Commissars of the Russian Soviet Federation of Socialist Republics set up the following: "It is the duty of every school child:

1. To acquire knowledge persistently in order to become an educated and cultured citizen and to be of the greatest possible service to his country.
2. To study diligently, to be punctual in attendance, and not arrive late at classes.
3. To obey the instructions of the school director and the teachers without question.
4. To arrive at school with all the necessary textbooks and writing materials; to have everything ready for the lesson before the teacher arrives.
5. To come to school clean, well groomed, and neatly dressed.
6. To keep his place in the classroom clean and tidy.
7. To enter the classroom and take his place immediately after the bell rings; to enter and leave the classroom during the lesson only with the teacher's permission.
8. To sit upright during the lesson, not leaning on his elbows and not slouching; to listen attentively to the teacher's explanations and the

other pupils' answers, and not to talk or let his attention stray to other things.

9. To rise when the teacher or the director enters or leaves the room.
10. To stand at attention when answering the teacher; to sit down only with the teacher's permission; to raise his hand if he wishes to answer or ask a question.
11. To take accurate notes in his assignment book of homework scheduled for the next lesson, and to show these notes to his parents; to do all the homework unaided.
12. To be respectful to the school director and teachers; when meeting them, to greet them with a polite bow; boys should also raise their hats.
13. To be polite to his elders, to behave modestly and respectfully in school, on the street and in public places.
14. Not to use coarse expressions, not to smoke, not to gamble for money or for any other objects.
15. To protect school property; to be careful of his personal things and the belongings of his comrades.
16. To be attentive and considerate of old people, small children, the weak and sick; to give them a seat on the trolley or make way for them on the street, being helpful to them in every way.
17. To obey his parents, to help them to take care of his small brothers and sisters.
18. To maintain cleanliness and order in rooms, to keep his clothes, shoes, and bed neat and tidy.
19. To carry his student's record book with him always, to guard it carefully, never handing it over to anyone else, and to present it upon request of the teachers or the school director.
20. To cherish the honor of his school and class, and defend it as his own."

Russian accomplishments in both the primary and secondary educational fields are impressive. The best results of their efforts move on into the universities, whose output is also impressive. For example, we know they produce one and a half million scientists and engineers out of two and a half million graduates. In the US we get about the same number of technical graduates from twice the number of college graduates, so the percentage of science and engineering output here is much lower than in Russia. On a yearly basis, the Russians produce between two and three times the number of scientists and engineers that the US does. The US awards about the same number of doctoral degrees as the



Moscow University's swimming pool. (Photo by D. Sholomovich)

Soviets, but in our case nearly 2 ½ to 1 are weighted in favor of the arts while in the USSR about 3 to 1 are in favor of engineering and science. We know that while in Russia technically-trained students are graduating at a higher rate than in the US, there is a decline in graduates from American universities taking place (corresponding with this increase in Russia). Dr. Alvin C. Eurich, vice president and director of the Ford Fund for the Advancement of Education, made the following comment after returning from Russia recently: "To me the accomplishments in the field of education which Russia has made in a relatively short time are much more frightening than announcements that come from Russia concerning atomic or hydrogen bombs, or guided missiles. From our point of view there is much one could criticize. There is no question, however, about the speed with which Russia has moved in the past and is now moving with its educational system. As much as we *dislike to place our educational developments in competition* we have to be realistic."

Last November the United States Office of Education released an excellent report entitled "Education in the USSR". The conclusions of this report are given in the belief that it is enormously important to understand what an important American body of educational authorities thinks about the situation. The information has been published in a two hundred and twenty-six page report which represents over two years of work.

Text of Conclusions of the U. S. Report on Soviet Education

Millions of school-age children, variety in racial strains and cultural traditions, diversity in climate and topography, concentrated center of population and sparsely populated remote areas are some of the factors affecting educational policy in the U.S.S.R. and in the U.S.A.

The principle of free and universal education has been adopted as a national policy and is in process of implementation in the U.S.S.R. today. The same principle is traditional with the people of the U.S.A., who have had it in practice for generations.

Diametrically opposed are the philosophical bases from which educational theory, programs and procedures have evolved in the two countries. Authoritarianism characterizes the Soviet philosophical base; the goal of education is to meet the needs of the state. Constitutional representative democracy characterizes the philosophical base on which the people of the U.S.A. govern themselves. In theory and in practice, the individual is of surpassing worth and the goal of education is the development of each person as an individual with freedom and with opportunity to choose his life's work in his best interests.

Many Entities in Soviet

The Soviet Union is an accretion of separate entities on which there is an overlay of Russian language and Communist party control. As a matter of educational policy, the U.S.S.R. one-party state capitalizes on the linguistic and cultural heritage of minority groups which resist assimilation. The U.S.A. is an amalgamation of heterogeneous nationalities electing to establish their homes in the United States, and of native-born population. The democratic educational systems in the U.S.A. are crucibles in which many nationalities fuse in language and in culture.

Neither country has a national ministry to control education. In the U.S.S.R. the Communist party, consisting of about 3 per cent of the total population, is the minority group which directly and indirectly controls education through a mechanism which centralizes power at the top. In the U.S.A. control of education is vested in the people in each of the states at the local and state levels.

The U.S. Office of Education provides leadership—not control. It encourages understanding of and responsibility for policy development, management and operation of local and state educational systems by the people themselves. It promotes agreements on common goals, and administers grants in specific fields and conducts educational research. On the basis of research findings, it provides authoritative information to the profession, the states and the general public.

Differences in Scope Noted

Soviet educational-cultural planned budgets embrace a range of activities which include on the one hand schools and institutions of higher learning, and on the other, clubs, radio, press, television, movies, theatres, and the like. Educational expenditures reported in the U.S.A. relate exclusively to schools and institutions of higher learning.

Education as it is understood in the U.S.S.R. has no exact parallel in the U.S.A. Preschool programs—nurseries and kindergartens—are an integral part of the national economy of the U.S.S.R. Nurseries are health centers for the care of children and the release of the time of mothers for work and other activities in the interests of the Soviet State. Kindergartens are educational centers providing similar child care and similar release of the mothers' time for productive activity deemed appropriate by the Soviet state.

In the U.S.A. child care establishments are social welfare centers, including in their programs child care assistance to those mothers who are breadwinners as well as homemakers. Nursery schools provide programs to serve the health, social and educational needs of 4 and 5 year-olds. They are partly or entirely independent of the public school system, though an increasing number cooperate with the public school system and receive assistance in staff training, counseling and other services. Kindergartens are an integral part of the educational systems in the U.S.A.

School Six Days a Week

General primary-secondary education in the U.S.S.R. consists of a prescribed ten-year, six-day-a-week program of studies subordinated to the interests of the regime in the formation of a Communist society. In the U.S.A. the prescribed elementary curricula and the secondary curricula of prescribed and elective courses extend over a twelve-year period, five days a week, in the interests of the development of educated citizens able to contribute as individuals and in groups to their own welfare and to that of society as a whole.

In the U.S.S.R. pupils are expected to participate in extracurricular work-activities sometimes known as "voluntary-compulsory" programs. These work-activities are centrally controlled and intergrated with the primary-secondary curricula for the benefit of the state. In the U.S.A. extracurricular activities are school activities which usually develop in keeping with the interests of the children. In general, they originate spontaneously and result in educational dividends for the children. On their own initiative, youngsters who have reached the minimum age for work—generally 16 years for non-hazardous occupations—may engage in paid part-time work after school hours and in paid summer employment.

Student Has Little Choice

The U.S.S.R. party-state aims to determine, through its national planning mechanism, the skills which are needed and the proportion of the student population to be trained in each skill. The more brilliant student in the U.S.S.R. has some individual freedom of choice; the state retains control over curriculum content and methods of instruction and distribution of students among academic fields, adjusting all to suit prevailing political doctrine and current manpower requirements of the Soviet economy.

Political indoctrination normally is included in course content throughout the curriculum—in the natural and social sciences, in language and literature, in the arts and in other disciplines. In addition, specific courses in the fundamentals of the prevailing political doctrine are required of students regularly enrolled in institutions of higher learning. Students are expected to interpret their studies from the point of view enunciated by the state. Natural sciences and mathematics receive major emphasis.

Students in the U.S.A. are free to explore the various vocational and professional fields. According to their capacities, they are free to elect any field of employment in which they can meet the technical requirements; they may change their individual jobs or positions and shift from one field to another in keeping with their own interests and desires. Under the guarantees provided by the Bill of Rights in the Constitution of the U.S.A., they are free to make their own political interpretations, whether or not these interpretations are consonant with those of the political party in power.

Vocational education in the U.S.S.R. usually is terminal training for a specific job or type of work needed by the state. Vocational education is provided in schools administered by the Chief Directorate of Labor Reserves under the U.S.S.R. Council of Ministers and in schools organized by the ministries and agencies for their own employees and for workers for whom they are operationally responsible.

Semi-Professional Training

Vocational education in the U.S.A. is an integral part of public school offerings at the secondary and technical levels. Vocational training in the U.S.A. is on-and-off-the-job training provided by organizations and agencies concerned with the specialized training of their employees by institutions assisting individuals in their efforts to advance themselves.

Semiprofessional schools and technicians in the U.S.S.R. are responsible for preparing students to render a single specific "support" service to persons considered qualified in a professional field. Advancement from semiprofessional to professional status is unlikely in the U.S.S.R.

Semi-professional training in the U.S.A. is sufficiently broad to help individuals acquire professional knowledge and techniques essential for employment in their chosen field and is prerequisite to study leading to full professional status. Advancement from semiprofessional training to professional training and status is common in the U.S.A.

Higher education in the U.S.S.R. aims to prepare qualified specialists—with the accepted political point of view—to serve the needs of the state. Diploma work for which no degree is awarded roughly approximates the level of the thesis requirement for the first professional degree in the U.S.A.

Degrees Given at 2 Levels

For researchers and teachers a degree may be awarded at each of two successive levels after advanced or postgraduate study. The first, or candidate of sciences, degree may be awarded after a three-year course roughly approximating the level of the doctoral programs in the U.S.A. Those recognized in the Soviet scientific and academic world may be permitted to enroll in the advanced postgraduate program leading to the second, or doctor of sciences, degree.

In summary, service to the Soviet state is exacted from students in the U.S.S.R. in return for state-provided educational programs. As a surcharge on their economy, the people of the U.S.A. provide educational programs for their own advancement and welfare and, in turn, for the welfore of society as a whole."

Hand in hand with progressive educational policies and superior teaching staffs go the physical plants. The showplace of Soviet education is the University of Moscow, which is certainly one of the most imposing centers of learning in the world. The main building is 32 stories high and it has over 2,000 rooms. In fact, one authority has likened it to a typical large American hotel. The central building is called the Palace of Science, which is bounded on each side by dormitories capable of housing 6,000 students. The edifice includes museums, auditoriums, classrooms, libraries, laboratories, and a wide variety of small conference rooms. Other buildings are scattered throughout the city to house various faculties. It is suspected that already something like three-quarters of a billion dollars have been spent on this enormous project.

The professors who teach the university's 25,000 students are well paid. The basic monthly salary of a professor is reported to be $1,500 and an additional amount of money is earned if he writes a textbook (the rate of compensation here is 2000 rubles, or approximately $500.00 for each 23 typewritten pages. This is indeed a wonderful remuneration.)

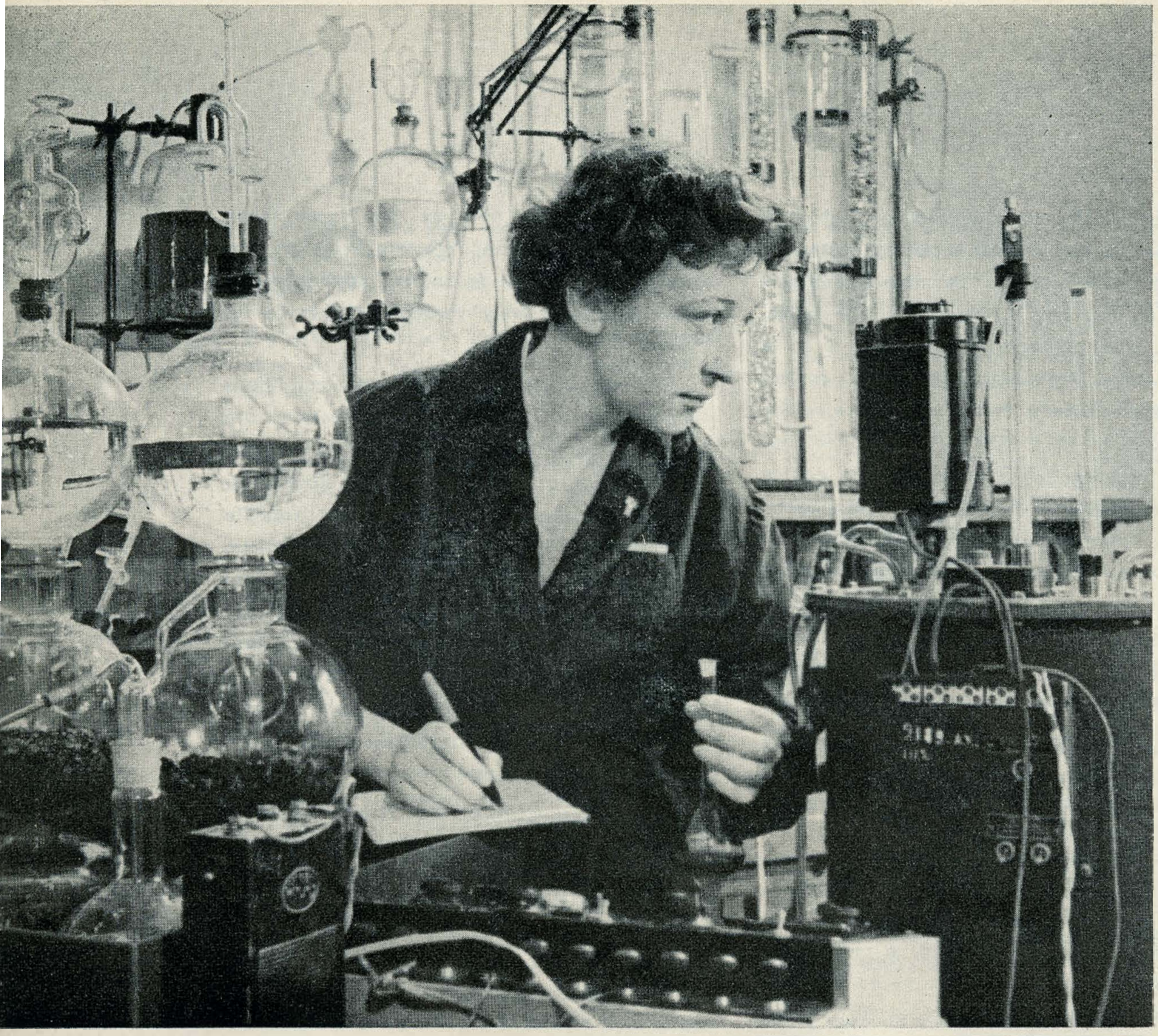
Should a professor become a member of the National Academy of Sciences he would pick up another 2500 rubles a month. This is more than $500.00 a month and is a very respectable addition to his salary. Should he become academician it would bring him up to an even higher salary, and he may be able to get up to $50,000 a year for all his accomplishments (Harvard's top professorial salary is $20,000 a year.) It is reported that his medical expenses are handled by the government and that his children can be educated at no cost, thereby affording him further savings. Taxes and rent are also low. Surely the life of a scholar is attractive in Russia. Incentives are plainly high to encourage academic careers.

Many Western authorities feel that, contrary to popular belief, there is a considerable amount of freedom of science in the Soviet Union. This feeling has been considerably strengthened during recent years, particularly since the death of Stalin. It is evident that Russian scientists are now traveling to foreign countries in greater numbers than was previously customary, and by the same token Americans and other Western scientists are attending Russian technical meetings and traveling extensively throughout the Soviet Union.

Evidence shows that despite the conditions imposed by a dictatorship, the Russians are quite strong in a wide variety of fields from mathematics, astronomy, and solid state physics to atomic energy, rocketry, and satellite technology. Many Western scientists believe that freedom in the sense we know it is not essential to scientific progress, and such authorities as Dr. von Braun, of the Army Ballistic Missile Agency, and Dr. Furnas, of the University of Buffalo, have clearly demonstrated that important progress can be and is being made in a dictatorial community.

Dr. von Braun has pointed out that the Germans made enormous headway in rocketry and aeronautics while under the political dictatorship of Hitler. He emphasized that "as far as personal freedom of movement is concerned, as well as free exchange of ideas in the strictly scientific and technological sphere, it would simply be misleading to assume that things (in wartime Germany) were much different than in a free country." Dr. Furnas said, at a meeting considering what we may expect during "The Next Hundred Years," that he had a confession to make: "For a long time I have felt that freedom in initiative played a part in science. I have heard true science could only grow in comparative freedom. The demonstration of what has been accomplished by Soviet science, in terms of objectives obtained over a 30-year period, have disproved this. I do not think that the results obtained by the Soviets are the types of scientific achievement that is going to benefit humanity in the long run—over one hundred years. For this, freedom is best. But in particular areas, science can grow and flourish in an atmosphere not free." Western science is beginning to heed such warnings.

Turning now to the diffusion of technological and scientific knowledge, we have again found ourselves in a rather awkward situation. Since World War II we have lived in a state of semi-isolation from world science, largely



Dilia Asipova, assistant of the optics department of Moscow University's physics faculty conducting scientific research on the influence of temperature on intensity of infrared absorption. (Photo by D. Sholomovich)

because of the partial, and temporary, eclipse of Western European scientific output. The US was not immediately prepared for the post-war Soviet technological onslaught, and unfortunately reacted to it slowly and half-heartedly. It took Russian MIG's, ICBM's and Sputniks to change our minds about achievements in science and technology in the Eurasian heartland.

In recent years, and particularly since Sputnik I, American scientists have become more than conscious of the value and desirability of knowing about what the Russians are writing and publishing. We know there are thousands of Soviet scientific reports and journals which have been received in the United States (particularly by the Library of Congress), but they generally serve no purpose other than to gather dust. Few scientists in the US read Russian, and translation facilities are lacking. This has resulted in an appalling lack of knowledge of what they are doing, and, as a consequence, there has been an enormous amount of duplication in research: many things we should know we simply do not know of because our scientists do not read Russian and translations are few.

There is good evidence that the Russians have developed very efficient methods of translating and diffusing foreign knowledge. They have a large, centralized clearing agency which collects and disseminates scientific information prepared and distributed by scientists and engineers from all corners of the world. It is reported that Soviet scientists often have a Russian translation of an important French, German, English, American, or other foreign publications before the scientists in the country of its origin have read the original editions.

The Soviet Union's All Union Institute of Scientific and Technical Information has a permanent staff of about 2300 translators, abstractors, and publishers. These are supplemented by a part time staff of 20,000 translators and abstractors. The institute releases thirteen abstract journals that contain each year more than 400,000 abstracts of scientific articles appearing in journals representing more than 80 countries. The institute translates, indexes and abstracts some 1400 of the 1800 scientific journals which are released in the United States of America.[1]

Compared with this system, what have we done in the US to facilitate the diffusion of knowledge of foreign scientific and technological progress and developments? Fortunately, the American government is beginning to realize the extent of the problem and some important efforts have been made. There is a variety of organizations of a public and private nature that do some work in the field of interest, and, while much remains to be accomplished, we have moved ahead. For example, the House Subcommittee on Government Information has held hearings on the subject and it is expected that progress will be rapid towards establishing a necessary government clearing agency. The Government Office of Technical Services is planning to increase its contributions very rapidly. Probing efforts are being made in many distinct areas, and it remains to be seen if we end up with a large central clearing house run by the government, or rather, a series of smaller, privately managed operations.

We receive about 20,000 Soviet scientific reports and journals a year, but only a small fraction is translated or even summarized. An example of the duplication of work resulting from the lack of knowledge of Russian scientific progress is given by a case cited by the National Science Foundation. It was learned that several American industries spent five years of research and hundreds of thousands of dollars on the design of electrical circuits only to discover that the work had been fully described in a Soviet scientific publication well before the research had begun in the US.

By the same token, it is interesting to know that, contrary to general belief, the radio frequencies used in Sputniks I and II were publicized well before the October and November, 1957, launchings. Indeed, in the Soviet journal *Radio,* the frequencies were published at least four months prior to the launchings of the vehicles. Much has been made in this country of the supposed fact that we were not informed of the frequencies prior to the establishment in orbit of Sputnik I. Good translation and diffusion services would have kept our scientists up to date on Soviet progress and planning. Russia may not release much, but it does release something. This "something" cannot be ignored.

Compare the Russian clearing house discussed earlier with its present counterpart in this country, called the Office of Technical Services. This boasts a total of less than 40 persons who index and abstract technical re-

Senior student Galina Kolenchuk working on her graduation paper "Electrochemical methods for defining uranium" in the polargraphy and ammeter laboratory of the analytical chemistry department of Moscow University. (Photo by D. Sholomovich)

[1]Including SPACE Journal.

ports. It operates on research programs which are carried out under contract for our government, and releases about 700 reports a month on sponsored projects.

There is a considerable belief that the Department of Commerce, which has the responsibility to maintain a clearing house for information of a scientific and technical nature, does not operate very efficiently. However, many officials say that, rather than build up a large government institution similar to the All Union Institute in Soviet Russia, it would be better for private groups to prepare their own journal and abstracting indices for the scientific world. Possible financial assistance from the government and foundations could, of course, be accorded. Others feel that the government should directly aid in the translation of journals and indices[2], particularly those from the Soviet Union, thereby assuring a nationwide distribution of material to contracting agencies, private enterprises, research centers, and universities.

There is some encouraging information suggesting that more Russian material is being translated in the US. The National Research and Development Corporation of Atlanta, Georgia, has recently added to its technical staff one of the nation's leading authorities on Soviet Russia, and other firms have taken similar steps. The Pergamon Institute of New York is busy translating technical documents, and the Consultant's Bureau, Inc., does a considerable amount of work in this field. The Soviet's journal of *Applied Mathematics and Mechanics* is to be translated and results of importance for designers of airplanes and rockets should become more readily available. Financial support to both Pergamon and the American Society of American Engineers has reportedly been arranged. At the present time up to 40 Soviet scientific journals are regularly translated within the country, both with government and with nongovernment support.

[2]It is interesting to know that there are about 15,000 scientific journals appearing each month throughout the world, and such journals contain anywhere from a few to a hundred or more articles and reports.

The Consultant's Bureau, Inc., yearly publishes about 48,000 pages of Soviet scientific translations, which moves into a region of some 12 million words. It translates 28 major Soviet journals in chemistry, metallurgy, electronics, biology, physics, and geology, as well as certain books and articles of related fields. The Pergamon Institute translates about 20,000 pages of material on Soviet scientific progress in biology and medical science. It has a summary review of 200,000 pages and during 1958 it is expected to increase its production to 30,000 pages of material taken from 400,000 pages of research in geophysics, atomic energy, and electronics.

In 1953 the Association of American Universities made the following statement in a series on the "Rights and Responsibilities of Universities and Faculties": ". . . to fulfill their functions the members and university faculties must continue to analyze, test, criticize, and reassess existing institutions and beliefs, approving when the evidence supports them, and disapproving when the weight of evidence is on the other side. Such investigations must not be confined to the physical world. The acknowledged fact that moral, social, and political progress have not kept pace with mastery of the physical world shows the need for more intensified research, fresh insights, vigorous criticism, and inventiveness. The scholar's admission requires the study and examination of unpopular ideas, of ideas considered abhorrent and even dangerous. For just as in the case of deadly disease, or the military potential of an enemy, it is only by intense study and research that the nature and extent of the danger can be understood and defenses against it perfected." Today, the very basis of our educational system is being probed in this light, and current investigations and criticisms across the land give promise of producing far-reaching results.

The US is now taking stock of its educational situation and several foundations are sponsoring searching studies of our system. Our private, and free, universities are proud of their rich heritage and know they must work hard and long to survive in a socialistic

In a laboratory of Moscow University—Left to right: Emilia Perevalova, M.Sc. Chemistry; Academician (one of top Soviet scientists) Alexander Nesmeyanov, and Tatyana Tolstaya, M.Sc. Chemistry. (Photo by D. Sholomovich)

world. One of the greatest endeavors in history to obtain privately subscribed support is the "Program for Harvard College," which will attempt to raise $82 ½ million.

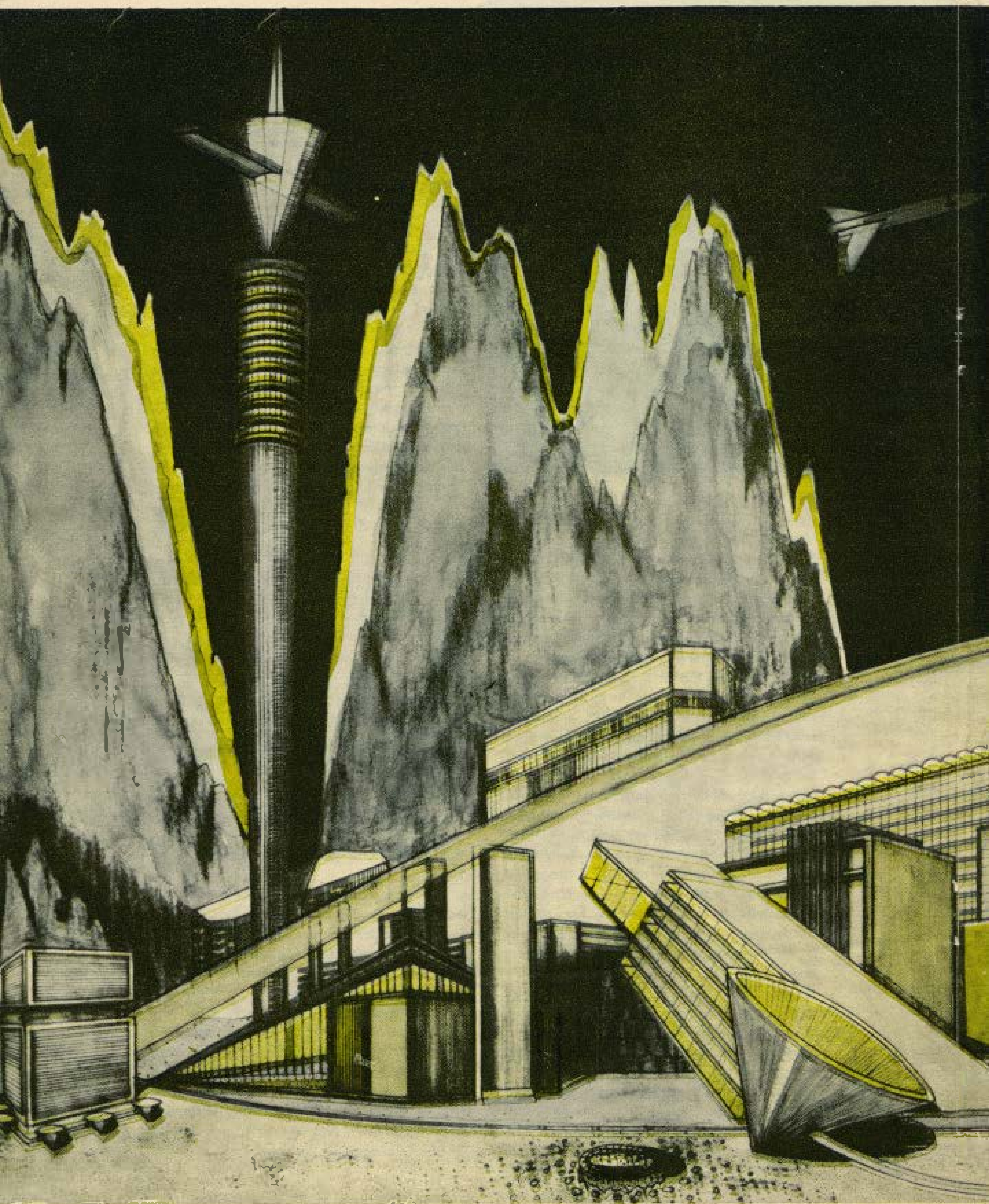
First and foremost, $16 million will go to support new faculty salaries, not including $5 million for additional professorial appointments. This is a very respectable amount of money going to further the support of teachers and to bring their salaries up to a significant level. For students, $8 ½ million in scholarships and other financial aids will be made available. The library endowment will be increased by $15 million, and approximately $15 million will go into facilities. To improve the so-called "climate of scholarship" about $25 million will be spent. There may be some doubts as to the validity of establishing so much money for "climate of scholarship," rather than further increasing the amount for faculty salaries, but at least this is a step in the right direction, and may be indicative of what we are to expect from enlightened American educational circles in the age of science and technology into which the world has progressed.

In a commencement address at Harvard University, President Kirk of Columbia stated the following, "The primary function of a great university is the pursuit and the transmission of knowledge, that knowledge which is the basis of genuine wisdom because it may be regarded hopefully as valid for all time. A search for such truth is never ending, but the true university . . . is the foremost institution devised by man, in which this quest can be carried on free from the limitations of conforming in teaching or in research to any currently accepted ideas, and free as one may ever be from the influences of special pleading and vested interest and selfish ambitions. Such a university is the arsenal—the one greatest arsenal—with which men's minds can be equipped to battle against the forces of ignorance and prejudice which are forever reaching out of the mire to clutch at the human soul and drag it down. A university like this—is the focal point of the hopes of mankind."

Recommendations for National Science Foundation Research and Amounts Voted by Congress

Fiscal Year	Appropriation	Presidential Recommendation
1951	$ 225,000	$ 475,000
1952	3,500,000	14,000,000
1953	4,750,000	15,000,000
1954	8,000,000	15,000,000
1955	12,250,000	14,000,000
1956	16,000,000	20,000,000
1957	40,000,000	41,300,000
1958	40,000,000	65,000,000

With this we can close our inquiry into the educational background to the Russian challenge. We believe our great, free universities have no peers on the planet, but beneath and around them lies an immense zone of uncertainty. Will our primary, scondary and university systems (which must provide us with the bulk of our educated men) become sufficiently strong to answer the requirements of the Space Age? We can only hope that the many weaknesses inherent in these schools will be discovered, analysed and corrected. This is the one great answer to the Russian Space Challenge to the free world.



the implications of soviet progress in science and engineering

By Col. J. G. Mayton

Col. Joseph G. Mayton is a graduate of a Russian college in Manchuria. He also attended the Oriental Institute where students were trained for diplomatic service in the Far East under the Czarist regime. He received his A.B. (1921) and M.A. (1922) from the University of California and his Ph.D. (1929) from the Brookings Graduate School of Economics and Government (now Brookings Institution). He majored in economics and political science, with special emphasis on Russia and the Far East. Col. Mayton served as Air Force liaison officer and interpreter in connection with the Big Three Conference at Yalta. He is a consultant with National Research and Development Corporation.

In the preceding two sections of this study, the authors surveyed Soviet Russia's technical advance and her educational preparations in the field of science and engineering which have made such progress possible. In this section, the aim will be to analyze briefly and concisely the political, economic, and military significance of Russia's accomplishments in these directions.

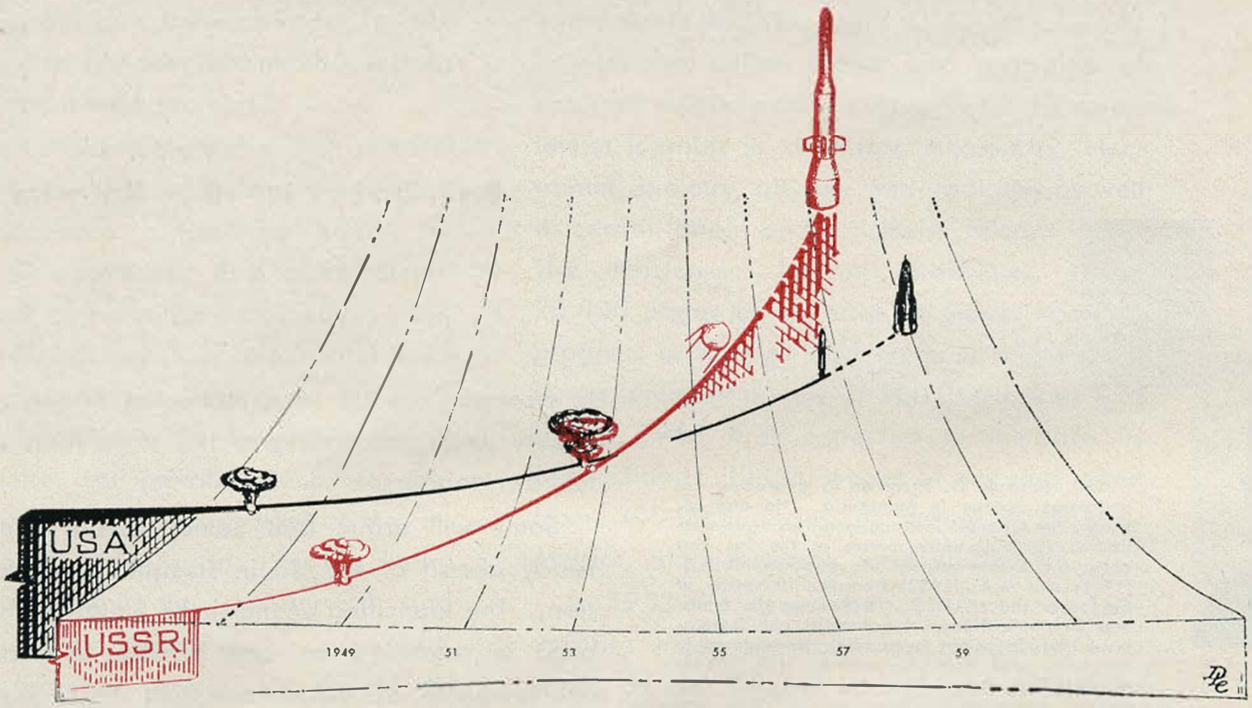
No one can deny that Russia's advance in science and engineering has been sizeable. As Defense Secretary Neil H. McElroy said after the Russians had orbited their second satellite: ". . . the fact that they did get a couple of satellites into the air and into orbit indicated a degree of scientific sophistication which has got to make this country respect the Russian scientific capability . . ."

This is especially significant considering the fact that less than fifty years ago Russia was regarded as being quite backward by Western standards. The nation was then primarily agricultural; the Industrial Revolution, which by that time had already overtaken all of Western Europe, was still in its very infancy in Russia. Yet, today after a lapse of only half a century, she is the world's second great industrial nation, and entertains the ambition to overtake the US in a matter of fifteen or twenty years, according to the statements of her own leaders.

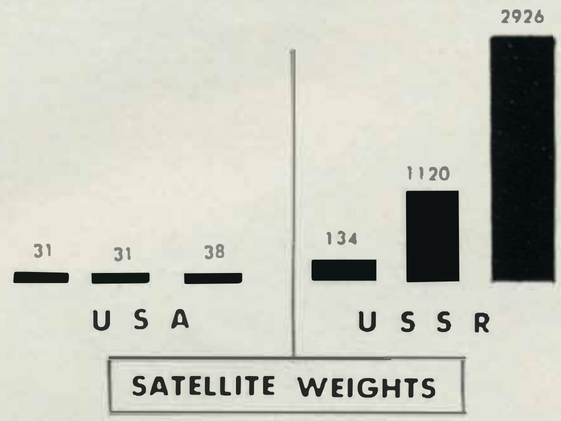
Some will argue that Soviet Russia is already ahead of the US in scientific exploration. The launching of the three Sputniks into orbit is regarded as one of the foremost achievements of Soviet scientists and engineers. The scientific world and the man in the street were astounded when the Russians achieved these magnificent feats. Undoubtedly it was a great scientific achievement, and no one can take that "first" away from her. It was also a masterstroke politically from the Communist point of view. Russia scored a psychological victory which is not likely to be erased.

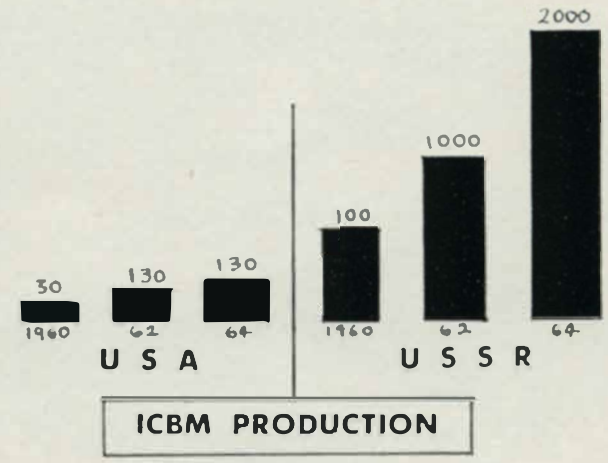
Broadly speaking, in the general field of science and in engineering, the US continues to be ahead of Soviet Russia. Industrially, Russia is still no match for the US. However, under the stimulus of five or six Five-Year Plans, the Russians have made tremendous industrial progress by concentrating their manpower and resources almost exclusively on heavy industry. Since World War II, the USSR has more than doubled its production of such strategic key materials as steel, pig iron, crude petroleum, coal, and cement. It claims a sizeable increase in electric power production, almost approaching our own, and shows similar advances in the production of cotton and woolen fabrics. Most significant has been Russia's superior position in the design and production of jet aircraft and its use in transportation. Although the US, as the foremost industrial country of the world, also shows sizeable gains in the same period, its *rate of increase* appears to be *far less* than that of Soviet Russia.

MAJOR TECHNOLOGICAL MILESTONES



		USA	USSR
1st	A-Bomb	1945	1949
1st	H-Bomb	1952	1953
1st	Satellite	1958	1957





* Sen. Kennedy—Aug., 1958
(Congressional Record)

This hos led some observers to suggest that if the progressive rote of industrial growth claimed by the USSR continues, the lotter could catch up with us within a decode or two, as Soviet leaders maintain. Should that happen, Soviet Russia could gain not only in political prestige, but also in economic power, with all the advantages that such power con bestow. She would then become a formidable competitor in world trade. She could also score a tremendous victory through her foreign aid program, especially in the underdeveloped areas of the world into which she is trying to penetrate. This seems to be the current direction of the Soviet foreign policy with its attendant idea of gaining converts to her way of life as well as enabling her to force other notions to become economically dependent upon her. Such dependence could then be exploited by Soviet leaders politically.

A politically and economically strong Soviet Russia, extending her sway over many satellites in both Europe and Asia (and in Africa, too) con truly present o serious threat to the free world. In possession of the atomic bomb, the hydrogen bomb, and the several kinds of missiles, Soviet leaders already try to throw their weight around. Accordingly, if we ore to meet the Russian challenge, we must maintain equal, or superior, military capability. Furthermore, we must never foll behind in missile development or in the development of new and more destructive or foster weapons.

This state of affairs hos prompted many geopolitical analysts to suggest that o stalemate may eventually develop in the armament race between the US and her allies on the one hand and the USSR on the other. The fear of retaliation would prove a strong deterrent. This would restrain Russia for more than the US since aggression is alien to our military and foreign policy. Our strict adherence to the United Notions Charter hos been attested ever since that organization come into existence. However, if and when we foll behind in our scientific research and engineering endeavors, and if and when Soviet leaders feel that their military and industrial power is strong enough to paralyze the US and the free world, they would not hesitate to use it. That is why recent Russian accomplishments in science and engineering, coupled with the rote at which her progress in those directions is going, is of such concern to the US and the other free notions of the world. With the advent of the Space Age in which Russia hos already mode a head start, the challenge hos become even more formidable. In the hands of the US, science and engineering is used for the benefit of all mankind; in Soviet hands it is o means of extending Communist control and consequent enslavement.

FRONTIERS

by Wade Wellman

Philosophy is what we do not know,
Religion fosters grief and petty hates;
Belief in God relieves men of their woe,
Art entertains, and science educates.
Pure knowledge is elusive of our minds..
And hides from us when in our books we grope;
Theism is a fantasy which blinds
Our eyes, and yet results in shining hope.
But think of this, as man goes into space:
That truth has dawned at last upon the world
Of thought, and that it shows its gleaming face
As would a brand-new flag just now unfurled.
For knowledge lies upon the path we tread,
When ignorance and fallacy are dead.

dialectical materialism—the real challenge of soviet science

By Dr. Karel Hujer

Karel Hujer was born in 1902 in Czechoslovakia. A graduate of Prague University with a Doctor of Science degree in 1932, he has done graduate work in France, at the University of London, and at the University of Chicago. In addition, he has also studied astronomy in India, China, Tibet, Japan, Mexico, Peru, and many countries in Europe. In 1935 he was invited to India by Mahatma Ghandi and stayed at Ghandi's ashram in Wordha where he lectured at the evening gatherings. In 1949 he returned to India at the invitation of Dr. Rajendra Prasad, president of the Republic of India. In 1957, at the request of the Prague National Observatory, Dr. Hujer returned to Czechoslovakia for a series of lectures on the advancement of American astronomy. He has taught at Iowa Wesleyan College and Michigan State College before coming to the University of Chattanooga where he is now in charge of the Jones Observatory. An author of many articles on astronomy, Dr. Hujer is a fellow of the American Astronomical Society and the Royal Astronomical Society of London; a member of the Astronomical Society of the Pacific and the Société Astronomique de France, as well as many honorary societies.

After the first Soviet satellite blazed the trail into outer Space, great concern was expressed in this country as to the status of American science and scientific education compared to that of the USSR. Since that time much has been written and continues to be written, almost to the degree of alarmism, on the marvelous advances of Russian science in general, and Russian physics in particular. This concern stands in odd contrast to the complete indifference paid Soviet scientific activity prior to Sputnik I. We need only remind ourselves that as early as April, 1957, Nesmeyonoff, president of the Soviet Academy of Science, announced that Soviet scientists were almost ready to launch their first artificial satellite. The world, particularly America, either ignored or failed to heed this announcement.

Only after the Sputniks began orbiting around Earth was this ominous American concern directed toward the startling Soviet technological accomplishment. Yet in all the countless comments on the Soviet technology little reference has been made to the curious and perhaps all important aspect in which Soviet education most earnestly and meticulously exposes and interprets science: the Soviet teacher of science, whether he is a physicist, chemist, astronomer, mathematician, sociologist, or biologist, must know how to interweave his subject with that specific philosophical outlook or *Weltanschauung* known as dialectical materialism. Whereas scientific technology has an immediate, sensational, and ponderous impact on human society, dialectical materialism cumulatively builds up its influence with the lapse of time, the consequence of which portentously tends to supersede the effects of an H-bomb or the accomplishment of a trip to the Moon. Why? Because it is the idea which in the course of time shapes and motivates events in the physical and material world.

What is dialectical materialism? In what way is this doctrine closely interwoven with Soviet science and scientific instruction? At present this philosophical doctrine is the official, authoritative school of thought behind the Iron Curtain; and all students are inevitably channeled through its indoctrination whatever their particular scientific field may be. As an illustration, it is not unusual to find as a foreward to a serious Communist work on natural science *Die Entwicklung im Universum (Evolution in the Universe)* by Dr. Walter Hollitcher, professor of philosophy at Humboldt University in East Berlin, a quotation from Stalin:

> . . . Everywhere, from astronomy to sociology, the idea that in the world there is nothing eternal, that everything undergoes constant change and

evolves, encounters constant confirmation. This means that we must look upon everything in nature from the standpoint of movement and evolution. This means that the spirit of dialectics permeates the entire contemporary science.

Dialectics, the reality of change caused by struggling opposites, although set forth in the nineteenth century by Hegel, as an idea has been known since the ancient Greek school of Heraclitus. For Hegel, however, dialectics was in the realm of theology and philosophy, the struggle of opposites being between the absolute, Divine Mind and the finite mind of man. Hegel's dialectics is, then, a dialectics of absolute idealism. Likewise, materialism, the belief in the primacy and objective reality of matter, had its birth in ancient Greece. Revived in the eighteenth century, it became fashionable among French materialists until it was shaped and refined into the popular system of Auguste Compte's positivism. This concept occurred in the midst of the golden era of physical science. The progressive drift away from Hegelian idealism began with Feuerbach, Bauer, and other young Hegelians and continued until the arrival of two outstanding personalities, Karl Marx and Fredrich Engels, who were to formulate an ideology that would shape the destiny of the twentieth century. The very fact that Marx and Engels appeared at that historical moment seems symptomatic, for they both claimed the scientific age to be the age of the proletarians.

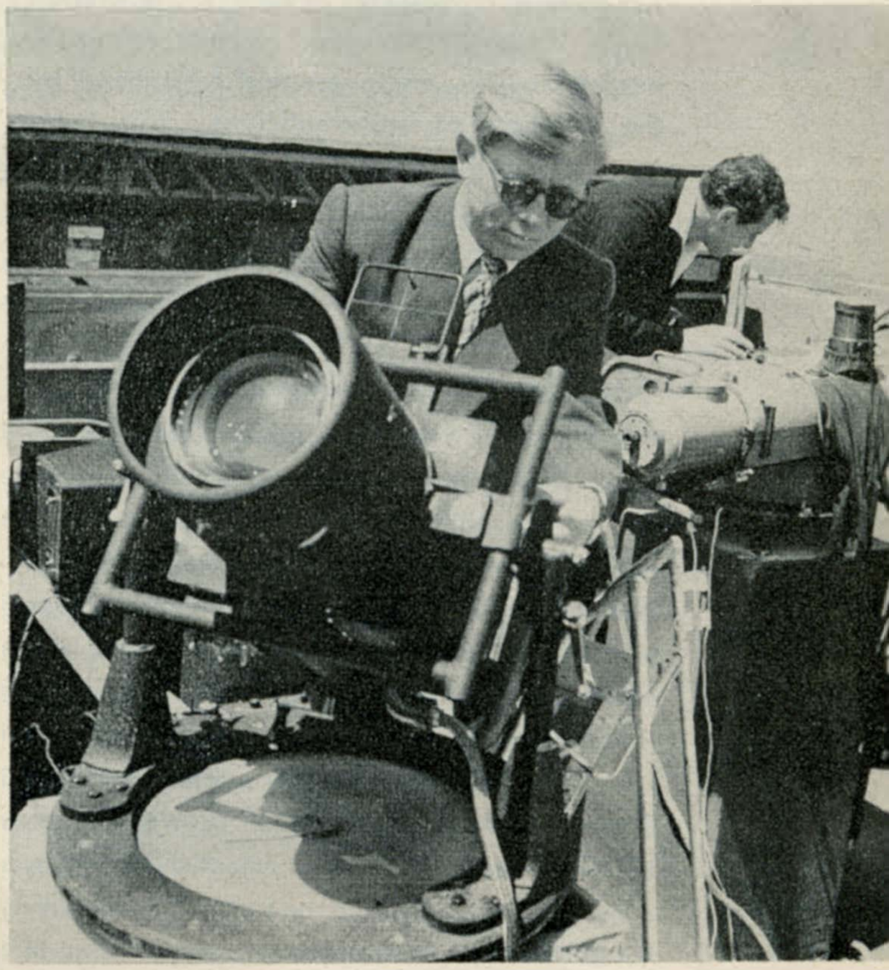
As a reaction against Hegelian idealism, both Marx and Engels more than anyone else are responsible for the historic combination of dialectics with materialism. In their view science and the scientific method completely justified this union. It was in the middle of the nineteenth century, pregnant with scientific discoveries of the greatest importance, that Marx shaped his ideas. He believed he had discovered the key to human life in the economic categories in which his materialism took the form of economic determinism, an idea strangely parallel to the present view of the deterministic Universe of the physicist. Marxian dialectics takes the form of class struggle, and the social and historic existence of man becomes the measure of everything. Marx, however, never thought of constructing an all-inclusive philosophical or ideological system and concept of the world.

Such a concept was formed by his lifelong friend and supporter Engels and continued vaguely and cumulatively by various followers, Lenin being the foremost. Thus we have at present the dialectical materialism of the Marxist-Leninist version that directs the way in which science textbooks must be written wherever the Communists have political control. The Marxists are usually inclined to attach the adjective *scientific* to their system of philosophy. After all, Marx denied the need for any philosophy, and Engels declared that philosophy died as science grew. But it is evident that neither Marx nor Engels could foresee the fruits of their own labor. Apparently neither could have imagined an ominous, mushroom cloud which would arise on the horizon of the mid-twentieth century, a cloud which would prove beyond doubt that science without philosophy becomes a grave social menace—even for the most dialectical of materialists.

Nevertheless, when the socialist panacea of Marxist philosophy was firmly fixed in the Communist state, the picture of the world and of human society was described as perfect, logical, and unquestionable. Communist cultural planners and party liners shaped Marxism-Leninism into a final code and unfailing guide beyond which there could be no other appeal except treasonable diversionism. In other words, Marxism-Leninism became the one belief in the order of the Communist-Socialist society. According to one of its basic articles, there is no science except that science which serves and supports the Communist Party. In this way physical science, particularly astronomy, enjoys the greatest freedom in an otherwise rigidly controlled system because it is least open to the peril of interference from Communists cultural planning. On the contrary, it is physics or astronomy that is supposedly associated with the most effective means of propaganda for certain favorite Communist beliefs which the official party line considers as standard and patronizing guidance for the human masses and the key to the promised land for the proletariat of the world. Thus in the USSR the social and economic position of a good physicist is equal to that of a cabinet minister and indeed may be a source of envy for his Western counterpart.

The inevitable question arises, then: What are these qualities of physics and astronomy that are so appealing to the Communist cultural planners? Let us briefly look at some of those qualities of physical science which bolster research to such a surprising degree in the Commmunist countries. Above all it is important to the state that the Universe is knowable and deterministic—in other words, that the Universe is dialectically materialistic. There is nothing supernatural about it. It is a Universe without God. This means that it is only a question of time before man solves all of the mysteries which have in the past been described as the handiwork of God. This, then, is basically the Communist Universe. But even more startling is the fact that the Western world holds a view of the Universe which is not too far removed from that of the Communists. It holds this view despite its apparent religiosity. Let us examine the origin of this materialistically philosophical point of view.

The formative period of Marxism belongs to the great age of physical science which flourished in the nineteenth century. Materialistic philosophy received fresh impetus in 1798 when Laplace published his sensational mathematical formulation of his hypothesis on the origin of the solar system, *Exposition du Systeme du Monde. It is said that* Napoleon, a jealous supporter of cultural activity in the growing empire, commented while he was preparing to bestow the title of marquis on Laplace that he could not find the name of God mentioned in the book. Laplace retorted: "Your majesty, I did not need him." This incident is typical of the attitudes found during the growth of the physical sciences during the nineteenth century. Another example is characterized by



This camera was installed at the Kazakh Academy of Sciences to take pictures of the third Soviet artificial Earth satellite. (Photo by I. Budnevich) the astronomer Leverrier's deterministic calculation of the position of the unknown planet Neptune—a triumph of Newtonian mathematical physics. The idea was further exemplified in physics by Kelvin and Helmholtz and their deterministic and rather gloomy views that the total energy in the Universe would eventually be so diffused that the Sun's flow of heat to Earth would eventually cease. A picture was developed which saw the Universe as merely a complex machine, something which could in time be reproduced on a model scale by engineers and formalized by the equations of mathematicians. This, then, was the world view that nurtured Marxist theories and one which reached its intellectual climax in the middle of the nineteenth century with the work of such figures as Faraday, Maxwell, and Darwin.

Thus the triumphant march of science and the Industrial Revolution which logically followed had a tremendous impact on the formation of the philosophy and the social life of man. Together these two factors forecast a new and redeeming age in which man was to become the coordinator and finally the master of the laws of the Universe. This view is boldly set forth in the significant work *Life in the Universe,* recently published by the Soviet Academy of Sciences. It was written by two outstanding Soviet scientists, the biochemist A. I. Oparin and the astronomer V. G. Fesenkov. These two authors refer in a friendly and patriotic manner to the eighteenth century Russian scientist, M. V. Lomonosov; and they point to the fact that from the style of his writing Lomonosov was tributary to the masters of his time. Likewise Oparin and Fesenkov, in turn, are subservient to the new masters of this age when they quote from Engel's *Dialectics of Nature,* a work little known to Western scientists but a Bible for the Communist scientists. The views of Oparin and Fesenkov coincide with this context. Life, they feel, including any higher state of consciousness and subsequent qualities it involves, is only the natural result of the cosmic evolution of matter. Both authors maintain that life began in the complex vibrations of ultimate particles of physical matter and that any idea that it had a divine beginning as the result of God's work is merely a relic of man's primitive mythology. The implication here is obvious, they feel; it is only a question of time and systematic research until man's intellect, a product itself of chemical processes, will discover these delicate vibrations and be able to create life in a test tube.

The continuing success of science and laboratory triumphs encourage this bold assumption. These omens have produced self-confidence, and the Marxist architects of social reorganization feel assured that the future belongs to them. This same belief is echoed by the present leaders of the Communist world, as witness the Kremlin belief that "time is on our side, we'll bury you." Despite all these self-confident boasts, the free world still asks: Is dialectical materialism the last word in human knowledge as the Marxists so fervently believe? Have we not seen many times throughout the broad sweep of man's history the proposal of similar, categorical manifestoes? And have we not also seen them pushed aside by circumstances and the very changes in the course of history? The briefest glance into the story of philosophy will show that dialectical materialism can claim to be only one of many philosophical systems that rose and flourished until they completed their function or role and then vanished into the dormant galleries of history and were recorded in the infinite annals of time. Each of these many systems, including among others the notorious scholasticism of the middle ages, contained an element of truth; but in each case the system itself was converted to evil when it became vested in power and the idea of infallibility and permanence. The Marxist dogmatists are already exposed to this historic peril when they speak authoritatively from the throne of their political sovereignty when they proclaim the intellectual and philosophical sovereignty of dialectical materialism. The situation is close to that of the scholasticians confronting Galileo in their dogmatic self-assurance and righteousness. Now the Marxists fail to profit from the truth and the reality of historical truth, and thus they sow the seeds of their own philosophical destruction.

We cannot, however, be lulled into a sense of false security by a knowledge of the weakness of a philosophical system that now governs the lives of an essentially simple people. Marx never dreamed that his ideas, intended for an industrial civilization, could ever be planted in what was and still basically is a peasant Russia. But they were; and Russia is an extremely vigorous nation and so are the effects of an utterly Western philosophical system. Before the influence of the doctrines of dialectical materialism so avidly cultivated by the rulers of Communist dominions will spend itself, we have no less than half a century to look for immediate and unpredictable results for better or worse with residual vestiges lasting for centuries.

Viktor Spitsin of the USSR Academy of Sciences is shown lecturing on inorganic chemistry in Moscow University. (Photo by D. Sholomovich)

Here is something of a portentous nature to look for, and it is of great importance to mankind today. Although our terrestial vanities may be concerned as to who will be first to reach the Moon, it is incomparably more important to know what our earthly mind will carry along into the wastelands of the lunar reaches: Will it carry the ideas of a semi-civilized and tribal caveman, or will it be those of a man who is admittedly his brother's keeper? In the meantime our only consolation rests in the logical conclusion of history that is forever valid for every civilization and for every individual: the truth that power corrupts. In our case, looking across the political barrier, we state that the authoritarian Marxists today, no matter how loudly they proclaim themselves the custodians of science and scientific progress, will ultimately perform by the very power they possess all the acts that invariably will choke the spirit of free scientific inquiry, the only true condition for the advancement of science.

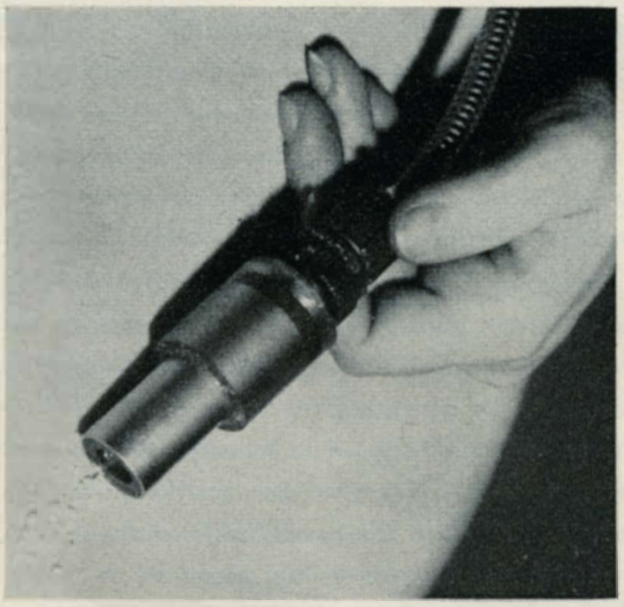
space reporter

GOOD FOR MAN, BEAST, AND ICBM

One more guided missile headache has been cured by General Electric's guided missile engineers. And they cured this one with that reliable old standby Bromo-Seltzer.

GE is developing nose cones for the Atlas ICBM and the Thor IRBM at its facility in Philadelphia.

To house recording instruments during test flights of these missiles, GE's engineers developed a spherical capsule which is carried in the missile nose cone and is ejected before the nose cone hits the earth. Electrically operated markers help engineers



locate the capsule. However, to function properly, these markers must be delayed for a few minutes before operation.

And here's where the Bromo-Seltzer comes in.

Bromo-Seltzer, packed around electrical wires, delays completion of the electronic circuit for the few minutes required for operation.

Considerable time had been spent in perfecting mechanical switches, none of which worked satisfactorily. The engineering headaches involved were extremely annoying until GE's engineers found the answer in the family medicine cabinet.

EXPOSURE: 5,000,000,000th OF ONE SECOND

Development of the world's fastest camera shutter, capable of taking photographs with an effective exposure time of five-billionths of one second, has been announced by Electro-Optical Systems, Inc., of Pasadena, California.

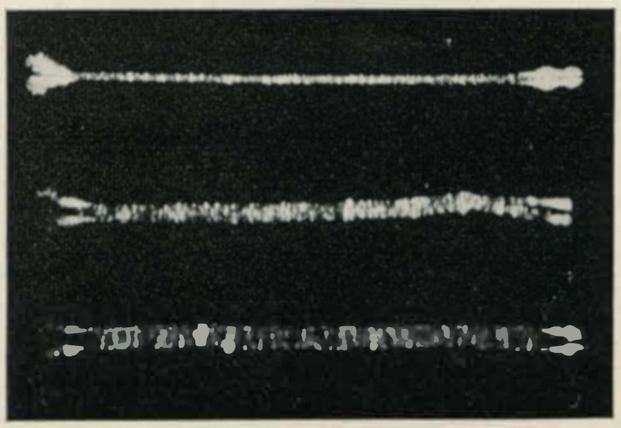
Dr. A. M. Zarem, president of the company and developer of the camera, said that it would prove highly valuable in helping to solve special problems in the study of intense explosions, of ultra-sonic shock waves, and of special nuclear reactions.

The novel feature of the camera is that it contains a hermetically sealed, large-aperture, wide-angle Kerr cell shutter which possesses no moving parts. It is pulsed electronically to obtain photographs of extremely brief exposures. Dr. Zarem said that with further development and refinement of techniques used, the camera may be capable ultimately of taking pictures with exposures of a fraction of a billionth of a second.

To illustrate the speed of the camera, it was pointed out that the satellite Sputnik, moving at approximately 18,000 miles per hour, would travel only one-and-one-half thousandths of an inch—a distance less than the thickness of a human hair—during the time of one exposure.

The camera was developed for the Samuel Feltman Ammunition Laboratories at Picatinny Arsenal, Dover, New Jersey.

The photographs show the electrical disintegration of three aluminum wires, each one-thousandth of an inch in diameter and one-quarter of an inch long. Explosion of the wires was photographed at three phases: 20-billionths of a second, 30-billionths of a second, and 40-billionths of a second after the discharge was started.



a proposal for a village on the moon

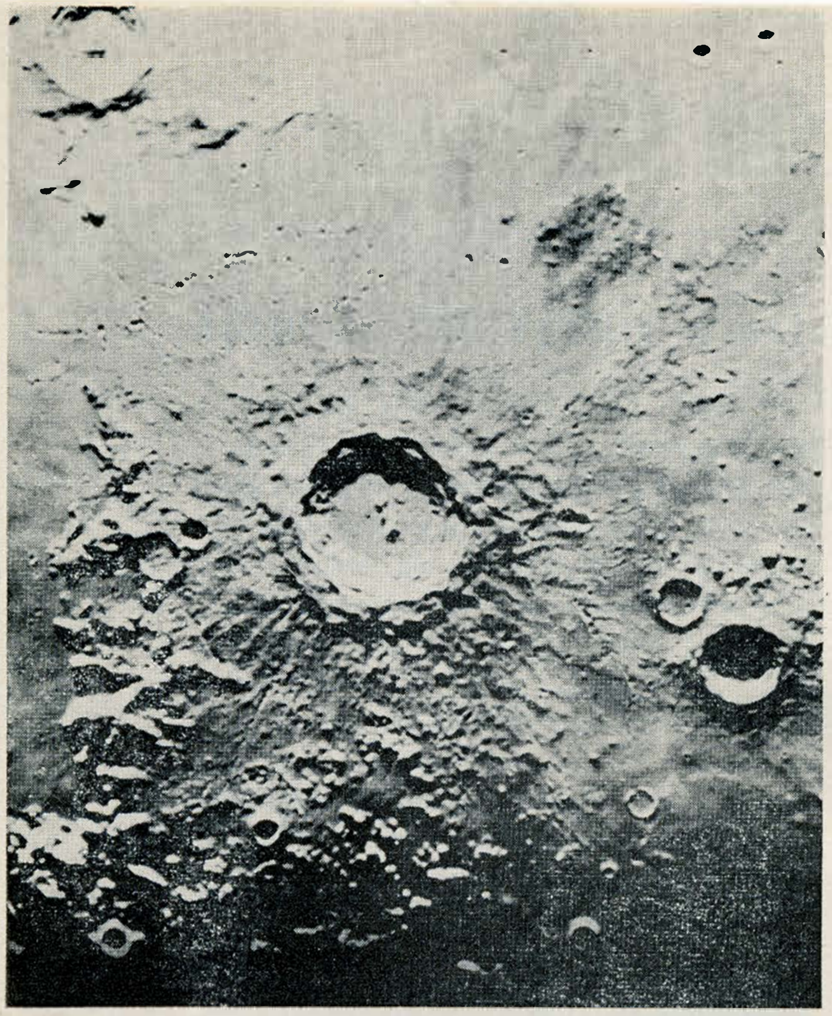
By Hiroshi Kumagai

Hiroshi Kumagai was born in Japan in 1931 and received a bachelor of engineering degree in architecture from the Tohoku University in 1955. After graduation from college, he worked in architectural and structural design for companies in both Japan and the US. He is a member of the American Rocket Society, the Space Travel Association of Japan, and the Japanese Institute of Architects. He is presently a member of the Gehres D. Weed architectural firm and lives in Kalispell, Montana.

If man is, as scientists and engineers speculate, going to land on the Moon within the next 30 years, it seems obvious that there should be some preparation for habitation on that barren satellite of Earth. It behooves us now to begin planning suitable structures for man's prolonged existence there; and the problem, while being complex, is by no means completely insolvable. The solution to this problem of constructing a village on the Moon lies initially in sending up prefabricated structures or building materials by space ship or rocket. Once the preliminary exploration of the lunar surface has been completed, space cargo ships carrying prefabricated materials can be launched from Earth and landed in selected areas on the Moon's surface. These ships would be relatively economical in that they would not have a human crew and the complex and expensive equipment which would be needed to sustain a crew during the flight from Earth.

Much valuable basic research into the techniques of design, manufacture, and assembly of prefabricated housing has already been accomplished—at least indirectly—by the scientific effort which has gone into the International Geophysical Year. The shelters which protect our scientists participating in IGY activities at the South Pole are excellent examples of prefabricated structures designed to meet unusual and rigorous environmental conditions. But the first scientists to visit the Moon will be faced with conditions far more hazardous than those existing at Earth's South Pole. In addition to the purely physiological and psychological aspects of adjusting to life on the Moon, our scientists will be subjected to a gravity one-sixth that of Earth; bombardment by cosmic rays, X-rays, and meteors; and extreme temperature changes, to name but a few. Their base on the Moon must be designed and built to specifications which will permit them to exist in such surroundings despite such dangers and inconveniences.

Before we can proceed with an elaborate experimental program for lunar prefabrications on Earth, we will need to know much more about the environmental conditions on the Moon. As this data becomes available through a continuing process of space research and exploration, it will be added to the basic architectural research which the leading architects and building construction engineers will have undertaken. Some of these conditions we already know, and we can begin now to plan ways in which to cope with them. For example, we know that on the Moon there is a *daily* temperature differential between midnoon and midnight of approximately 400°F. This compares with a maximum *seasonal* temperature variation, between winter and summer, on Earth of only some 200°F. To minimize the effects of these extreme temperature differences, we could construct our shelters underground—or undermoon, if the term be permissible—where the insulating properties of the lunar surface would lessen the severity of such a change. At least one geo-



Architect Kumagai suggests that one of the Moon's craters, such as Copernicus shown here, would be the logical choice for a space station or his proposed village. (Photo by Yerkes Observatory)

graphical feature of the Moon, the Ariadaeus Rill near the lunar equator, suggests itself as a possible subsurface site in which to construct the first shelters.* If no natural declivities, overhangs, or caverns are to be found in the rill, then it would be necessary to prepare artificial ones by blasting them out of the walls. In addition to simplifying the problem of temperature control, such a subsurface shelter would offer some protection against the smaller of the meteors which our scientists must expect.

Moreover we know that the Moon has practically no atmosphere (about 10^{-4} of that of Earth). This fact simplifies at least one of our problems: with little or no atmosphere, heat from the Sun is for all practical purposes by radiation only. The problems incident to the control of heat within our shelters are then reduced. For example, our structure need only be constructed of a material opaque to radiant heat in order to reduce the temperature within. With no atmosphere there can be no high winds, hurricanes, or tornadoes such as we have on Earth. The walls of our structure then can be designed without the consideration of horizontal loading due to these forces.

Since we know that the gravitational pull of the Moon is six times less than that of Earth, we can design structural beams and columns with sectional areas six times less than those required for similar construction on Earth. This also means that we can erect taller, relatively heavier, and more imaginative structures within the limitations imposed by the use of materials such as concrete, steel, lead, lead glass, etc., which are necessary to block out cosmic rays and X-rays.

For the moment, we must assume that the early colonization of the Moon will be done by scientists who will live in prefabricated shelters built partially or wholly below the lunar surface. But later buildings for more permanent residents need not be subsurface. As our knowledge of lunar environmental conditions and the techniques of building construction on the Moon increases, we can build bigger and more complex structures. Once the geology of the Moon is definitely known, it may be possible to use indigenous material for such construction purposes.

For those shelters to be built above the lunar surface, we must rely on a plastic dome. This dome will actually consist of a dome within a dome. The outer one will be composed of triangular plastic units, approximately six inches thick, assembled with special expansion joints. These units will be made of a plastic which is strengthened by radioactivity, and they will contain lead. Thus the outer dome will be effective in stopping meteoric ash and small meteors. It will also offer some protection against cosmic and X-radiation. It will be coated to reflect heat, but it will allow some light to enter. Since the outer dome will be a rigid structure, it need not rely completely on an internal air pressure to support it. Three feet within the outer dome will be a flexible, one-inch thick, inner dome. This dome must be airtight and must be supported entirely by internal air pressure. Since the stresses in it would be tensile rather than compressive, it will consist of several layers of plastic film reinforced by fiberglass. The space between the two domes will be filled with air at a pressure lower than that of

*Eric Burgess, *Satellites and Spaceflight*, p. 120

the inner dome. This pressure differential will balance the negative vertical force and the gravitational force. Provided the outer dome is large enough, it should be seen from the Earth as a gleaming mirror when the Moon is between the full and crescent phases.

Inside the dome, walls and roofs are unnecessary for the individual buildings, but these structures are designed for special function. Walls are needed then for temperature control or protective reasons. The atomic power station must have walls to protect nearby buildings from thermal radiation, even though the power station itself is located within a crater the sides of which shield other installations from radioactivity. The solar power building will have walls consisting of semiconducting units and these units will move like louvres, always following the Sun. In the daytime these units will produce electricity. Cone-shaped reflectors around the building will be used as refractory furnaces for the smelting and refining of metals from ores mined on the Moon.

For structures outside the plastic dome, the walls must be both airtight and capable of reducing cosmic and X-radiation as well as offering protection against meteors. Such walls could be made of concrete, plastics, or steel. When concrete is utilized, as in the

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THE SIGHT in my opinion is the source of the greatest benefit to us, for had we never seen the stars, and the sun, and the heaven, have spoken about the universe none of the words which we would ever have been uttered. But now the sight of day and night, and the months and the revolutions of the years, have created number, and have given us a conception of time, and the power of enquiring about the nature of the universe; and from this source we have derived philosophy, than which no greater good ever was or will be given by the gods to mortal man.

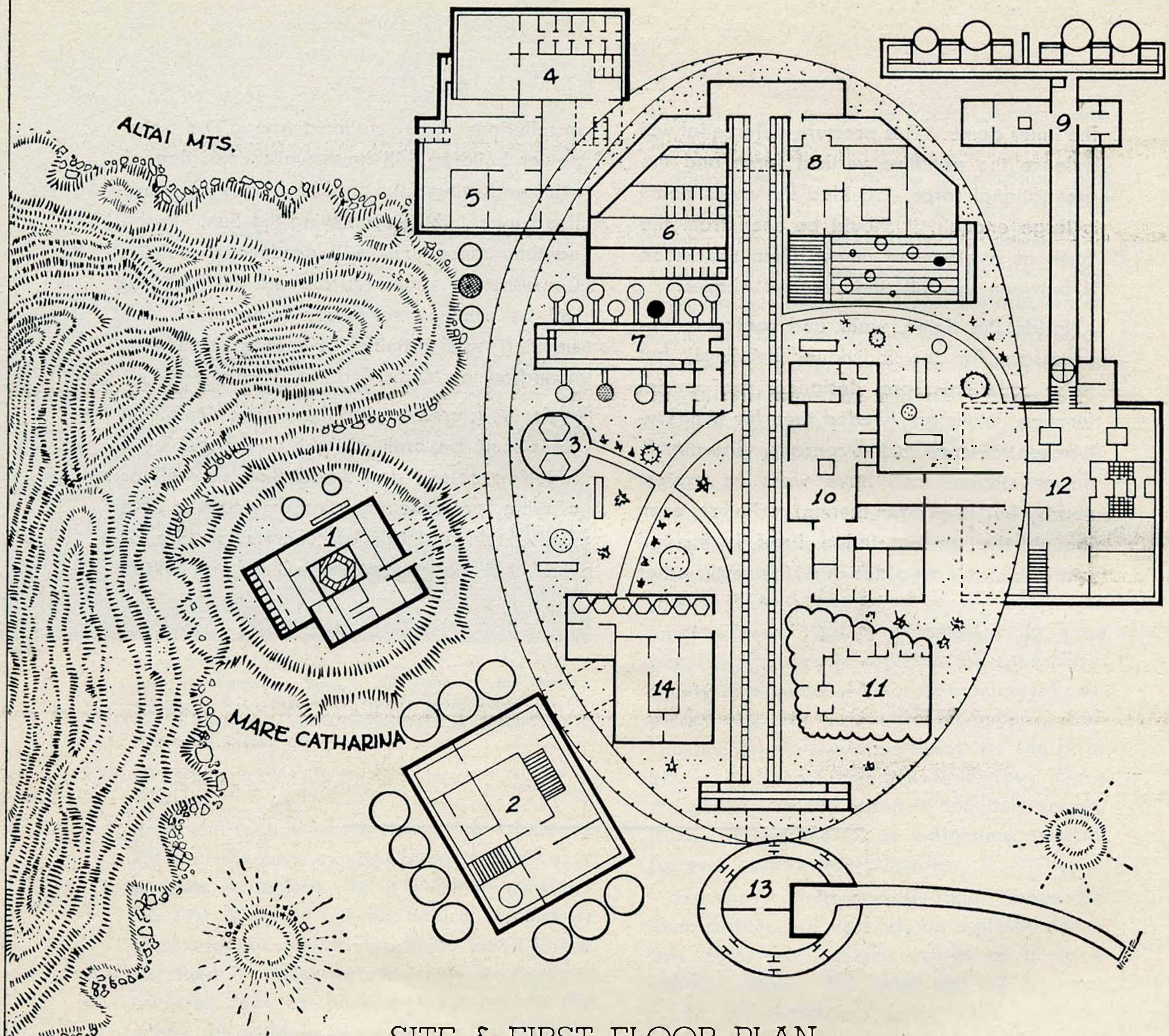
—Plato.

WITH THE FLIGHTS of instrument-carrying rockets to these nether reaches of the earth's atmosphere—and beyond—all our old assumptions are bound to be challenged. This is no time for dogmatism.

—*The Christian Science Monitor.*

It is the stars,
The stars above us, govern our conditions . . .

—King Lear.



SITE & FIRST FLOOR PLAN

SCALE 1" = 200' 0"

VILLAGE ON THE MOON

FOR SCIENTISTS AND VISITORS

DESIGNED BY: Hiroshi Kumagai

1. ATOMIC POWER STATION
2. SOLAR POWER STATION
3. COMMUNICATION AND ASTRONOMICAL OBSERVATORY BUILDING
4. CARBON DIOXIDE AND WASTE PRODUCTS DISPOSAL BUILDING
5. WATER, AIR AND MINERAL SUPPLY AND REFINING PLANT
6. VEGETABLES AND PLANTS SUPPLY BUILDING
7. CHLORELLA REARING BUILDING
8. FISH REARING BUILDING
9. ROCKETS AND SPACESHIPS STANDS AND PORT
10. ADMINISTRATION AND LIVING CENTER
11. SPORTS CENTER
13. LUNAR TRANSPORTATION BUILDING
12. LUNAR PHYSICS AND MINERAL LABORATORY
14. BUILDING FOR AIR, LIGHT, TEMPERATURE AND WATER VAPOR CONTROL OF DOUBLE PLASTIC DOME

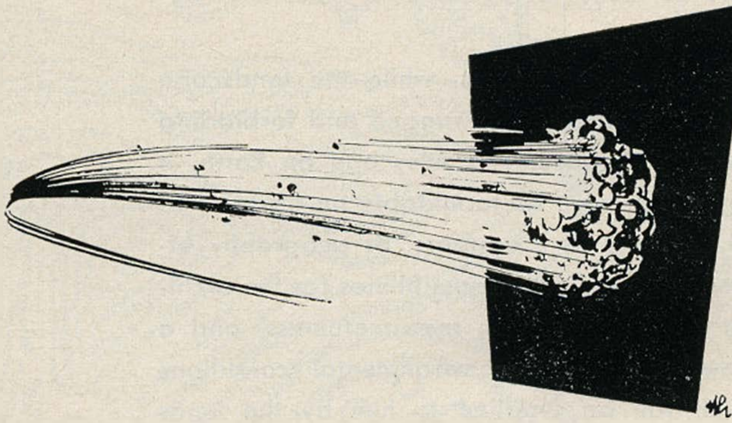
case of the communication and astronomical building, both the inside and outside must be coated with a lead plastic. In addition to blocking radiation, this protective coating would also help retain the moisture in the concrete and thereby strengthen it. This same technique of plastic-coated concrete will be used in the lunar transportation building and the water, air, and minerals supply and refining building.

The lunar physics and mineral laboratory will be constructed with a floor inclined 18° to the horizontal. Since the Moon's gravity is 1/6 that of Earth, this would be relative to a floor on Earth which has a 3° slope. The purpose of the inclined floor is to give the occupants of the lunar buildings a feeling akin to that which they had on Earth. The furniture for the buildings will be designed on the same inclined principle. The net effect will be to give the scientist who works at a desk, sits at a table, or lies in a bed approximately the same gravitational orientation that he would have in similar activities on Earth.

The problem of supplying oxygen for an atmosphere within both individual buildings and the plastic dome can be solved in two ways. One is to cultivate ponds or tanks of *algae chlorella pyre noidosa,* a tiny water plant. The other is to dissociate the water of crystalization which may be present in the rocks of the Moon. Dr. Harold C. Urey believes that at least some of the lunar minerals are like the magnesium silicates which can contain as much as 13 percent water of crystalization. If this is true, then 100 tons of rock will yield 13 tons of water. Heat from the Sun can be utilized to obtain this water, and electrolosis can then break the water down into oxygen and hydrogen. However, not all the water thus obtained would be used for the production of oxygen. In addition to that needed to sustain life, some of it will be used to grow the *chlorella* algae which will produce oxygen; and some of it will be used in hydroponic agriculture. Further uses would be in raising fish which would serve as an economical supplement to the lunar diet. Beyond the immediate biological needs of our scientific outpost, both the oxygen and the hydrogen obtained from the water could be used as rocket or space ship fuels and oxidizers.

In the final analysis, while the landscape of the Moon may look rugged and forbidding through the observer's telescope on Earth, it may not present as formidable an obstacle to the architect as it appears. Its geography offers almost unlimited possibilities for the architect with imagination, resourcefulness, and a knowledge of the environmental conditions which will be supplied to him by the lunar probes and pioneers of the not too distant future.

METEORITES

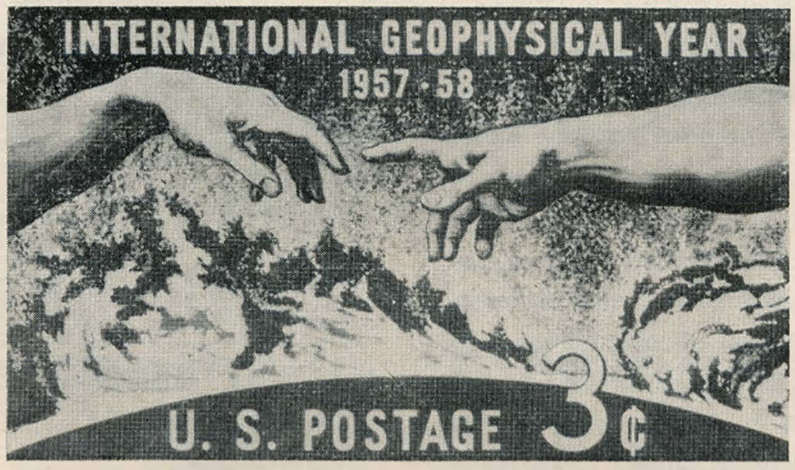


GLOBAL REPORTING

United States

The 3-cent IGY commemorative stamp placed on first-day sale in May in Chicago depicts an area of intense solar activity of a type which is currently being investigated during the IGY. Superimposed above the solar disk is a detail from Michaelangelo's fresco "The Creation of Adam."

Ervine Metzl, designer of the stamp, explained that "In the small confines of a postage stamp we have endeavored to picture man's wonder at the unknown together with his determination to understand it and his need for spiritual inspiration to further his knowledge."



Japan

Japanese and American scientists estimate that the launching site of the Soviet satellites and intercontinental missiles is located in the Karakorum desert (Turkmenistan) at 41° north latitude and 61° east longitude. These figures were derived from calculations of the orbits of the first two Russian satellites.

Russia

Under a recent picture in a Soviet newspaper was the following caption: "The time a space ship needs to circle the Earth is 1 ½ hours at the most. The round trip to the Moon will require 10 days; while the trip in an elliptical orbit, intersecting the orbits of Venus and Mars, giving the possibility of a return to the Earth, will take at least one year."

United States

The journalism faculty of the University of California recently published the results of an investigation into the treatment which the launching of Earth satellites received in the world press. According to the survey, the average number of printed lines per newspaper is

Sputnik I	700 lines	Explorer II	60 lines
Sputnik II	300 lines	Vanguard I	55 lines
Explorer I	75 lines	Explorer III	20 lines

England

The British Interplanetary Society, which is second largest of the national astronautical societies, celebrates its 25th birthday this year. The organization now has 2500 members. Its *Journal of the British Interplanetary Society* has been published for 17 years. In October, 1956, the society began publishing its very popular magazine *Spaceflight*.

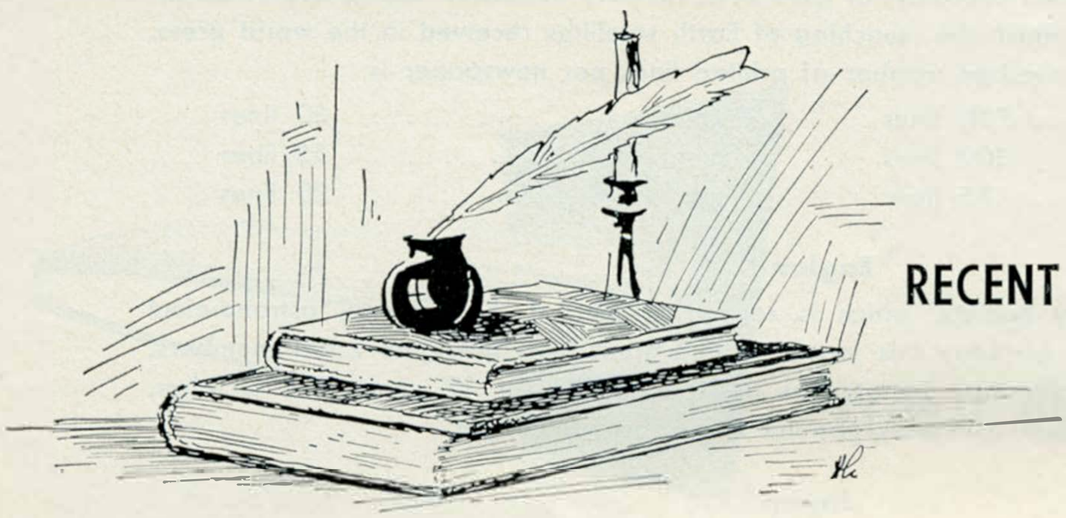
Japan

According to a recent Japanese announcement, rocket engineers in Akita have developed a "supersound [sic]" rocket. The rocket has two stages and will be launched during the IGY for research purposes. The first test flights have already been made. The rocket weighs 300 pounds and is approximately 25 feet long. The first stage is reported to boost it to an altitude of 12,000—15,000 feet.

Czechoslovakia

Laika makes a reappearance in the form of Soviet propaganda. Sputnik II's little canine recently cropped up as an epitath on a card printed in Prague and widely distributed in eastern Europe. Note the misuse of *interplanetarian*.

—SPACE BOOKS



RECENT & FORTHCOMING

Reviewed by

Ralph E. Jennings
James L. Daniels, Jr.
M. Raymond
David S. Akens

Spacepower. By Donald Cox and Michael Stoiko. 262 pages. Philadelphia: The John C. Winston Co. $4.50.

Messrs. Cox and Stoiko raise some pointed questions in *Spacepower*. For example: "What must I do now to prepare for the Space Age?" and "Where do I go from here?" They also offer some convincing answers. This is not a technical book nor is it space fiction. It is a thoroughgoing and thought-provoking book that analyzes the changes about to take place. It analyzes the changes that many men now alive will undoubtedly see. It tells how information gleaned from satellite-tracking systems will begin having its effect on our civilization and how every facet of our society will be affected —our farms, factories, jobs, travel, medicine, homelife, our international relations. The authors probe deeply and examine with startling clarity the hopes, needs, and problems in the fantastic new world which man is building for himself. The book is liberally sprinkled with illustrations created in the fertile imagination of N. Stanilla.

The Rocket Pioneers. By Beryl Williams and Samuel Epstein. 241 pages. New York: Julian Messner, Inc. $3.75.

In his introduction to the book by Williams and Epstein, Dr. Wernher von Braun aptly states: "With the advent of manmade satellites, it is quite appropriate that there be a new edition of *The Rocket Pioneers*." In covering the last 150 years, the authors take the reader from Sir William Congreve who astounded the conservative military men of Napoleonic Europe with a war rocket to the present day Explorers and Sputniks. The authors are interested in the pioneering of rockets, and they steer away from space travel. Their purpose is to show what has been achieved thus far. They show how Konstantin Ziolkovsky, physicist and mathematician, provided theories that led to the belief that space ships would have to be powered by rocket motors; how Robert Hutchings Goddard, father of American rocketry, bridged the gap between theory and accomplishment by actually making and firing rockets; how Hermann Oberth designed the first rocket ship, though it never left the ground; how Wernher von Braun and his team designed the supersonic rocket—V-2. And, of course, the book tells of the VfR, the German Society for Space Travel; the American Rocket Society; the Peenemuende Group

—of all who deserve to be known as the great rocket pioneers. They deserve it because their dreams and their achievements will have led to the fulfillment of space travel when it becomes an accepted transport operation in the not too distant future. Amateur space travel enthusiasts and professional rocket men alike will find this revised edition of *The Rocket Pioneers* to be informative and well written.

Space Book For Young People. By Homer E. Newell, Jr. 114 pages. New York: McGraw-Hill Book Company, Inc. $2.95.

Dr. Newell's *Space Book For Young People* offers a clear and dramatic explanation of the Earth and its position in the Universe—atmosphere, the Moon and satellites, the Sun and the other planets of the Solar System, galaxies, comets, meteors, asteroids, and eclipses. It supplies the mathematics which is necessary for a real understanding of space distances, rocket speeds, and the like. With exciting black-and-white illustrations that bring everything into easy focus for the reader, it is a highly readable book on a subject vital to today's young scientists. It is also the answer to the harassed parent's prayer. Dad can now avoid embarrassment by referring Junior, with his unanswerable questions, to this book.

—Ralph E. Jennings

What's Going On In Space. By Commander David C. Holmes, USN. New York: Funk & Wagnalls. $3.95.

Perhaps the only flaw in this summary of what is going on—and what has gone on—in outer Space is that it was prepared a little prematurely. Commander Holmes has done a good job of summarizing the many projects and problems which lead up to the present state of affairs in outer Space. But, perhaps out of loyalty to the Navy, he has devoted a considerable amount of verbiage to the Vanguard Project. Apparently relying on publicity releases, Commander Holmes gives a fairly complete story of what Vanguard was designed to do but, unfortunately, has failed to do. This emphasis on the role of Vanguard in America's space program results in little documentation of the Army and Air Force programs which have proved to be more reliable and more rewarding.

The book opens with the modest news release with which *Tass* announced the birth of Sputnik I and closes with a paraphrase of a quotation from N. J. Berrill's *Man's Emerging Mind*. In between there is a wealth of material concerning the more recent history of rocketry and its use in warfare, the many and various problems which must be solved before space flight becomes a reality, ICBM's, and a resume of the history of the American Rocket Society. However, there is a great deal of information in this book for those interested in the background of just what is going on in Space.

—M. Raymond

Rocket Experiment Safety, Safety Suggestions for the Rocket Hobbyist. Prepared by the Atlantic Research Corporation, Alexandria, Virginia. 19 pages.

This small pamphlet, prepared and distributed free of charge by the Atlantic Research Corporation, is interesting for two reasons. It is an excellently organized and well-written booklet for the serious amateur of any age, and it illustrates the concern that a progressive manufacturer has for the safety of those interested in rocketry.

The pamphlet contains much valuable information concerning the manufacture, test, and firing of small rockets. It also includes details for making simple but reasonably accurate instruments for measuring rocket performance. In addition there is on excellent bibliography and many suggestions for organizing o rocket club.

The attitude which the Atlantic Research Corporation hos shown in preparing this timely little publication is commendable. It is also in sharp contrast with the attitude of one of the nation's second string aircraft industries which has taken a "public be damned" view toward such projects.

Satellites and Spaceflight. By Eric Burgess. 159 pages. New York: The Macmillan Company. $3.95.

This book is reminiscent of Willy Ley's *Rockets, Missiles and Space Travel,* but is not as broad in scope as that book. As its title implies, Mr. Burgess's book is limited to satellites and spaceflight. It is a well-written book which will serve the serious student of space travel as a valuable text. In addition to covering such subjects as instrumented satellites and space stations, it also has two timely chapters on lunar exploration and the construction of a base on the Moon. At a first glance the book appears to contain a bewildering assortment of mathematical charts and figures. However, as the reader progresses, it becomes apparent that Mr. Burgess has done on excellent job in simplifying the recondite mathematics of rocketry and space travel.

Relativity for the Layman. By James A. Coleman. New York: Mentor Books. $.50.

This reprint of Professor Colemon's popular and widely acclaimed introduction to relativity should be of great interest to the nontechnical devotee of space travel. It is a well-organized book in that it begins with the experimentation leading up to Einstein's special and general theories of relativity, then reviews the experimental proof of the theories and ends with the relationship between the theories and the nature of the Universe. The author has purposefully kept his text free of mathematical formulae—and to good advantage. *He explains relativity by analogy and example*. This method of explanation is done in terms which are familiar to the layman, and thus his explication succeeds rather than further complicates a subject the layman has long considered to be the epitome of scientific confusion.

—M. Raymond

The Space Encyclopaedia. By Sir Harold Spencer Jones & Others. New York: E. P. Dutton and Co. $6.95.

From ondromedids to zodiac, this Space Age compendium unsophisticatedly defines and describes those astrophysical, astronautical, and astronomical things and ideas stumbled over and mumbled over by the average Earthman in his newspapers and magazines. Although its definitive essays on the more complex and often less common terms are apparently authentic, the book commits inexcusable oversights in the case of the more Earthy entries. For example, the entry on Theory of Relativity neatly equates energy to mass times velocity of light squared, and explains some common applications of the theory; yet the entry for Redstone on the opposite page says it is now called Jupiter—competely false. A brief check even in a daily paper would have corrected the entry. Regardless of some such errors, the book's informative entries on comet, galaxy, meteor, rocketry, spectroscopy, star, sunspots, and many others make this a handy volume for the armchair spaceman.

—James L. Daniels, Jr.

Going Into Space. By Arthur C. Clarke. 117 pages. New York: Harper & Brothers. $2.50.

It is not surprising that Mr. Clarke once again crowds into a small book a large amount of *space*. "If you simply sit back and wait, you will reach your destination in due course, assuming, naturally, that you have started off in the right direction," writes the author, with typical poignancy of the British and obviously of Mr. Clarke, too.

As with his *Exploration of Space,* and *Interplanetary Flight,* the author's presentation though scientifically accurate is nontechnical and interesting. "Imagine that you were out in space and that floating beside you was some large heavy object. If you could brace yourself against this object and then give a good kick, you would move off in one direction and the object would move off in another." Thus, Mr. Clarke summarizes jet propulsion.

In a book well illustrated, Mr. Clarke projects space travel far into time and Space. It is a book definitely worth reading, not only for the amateur but for the more knowledgeable reader.

—David S. Akens

REACTION

VOX POPULI

Dear Editor,

. . . I wish to congratulate you and your associates upon the publication of this journal. I shall read it with much interest.

Alabama Polytechnic Institute
Auburn, Alabama Ralph B. Draughon
President

Dear Editor,

After reading Dr. von Braun's article "The Acid Test" in the summer issue of SPACE Journal, I would like to say that I think that it is the most sensible piece of writing to come out of the Sputnik scare. He stated exactly what this test facing us consists of and does so with better qualifications than many others who write on the same subject. He is right all the way in stating that this test involves not only our scientific and technological capabilities, but "every facet of our civilization, every part of our society: religion, economics, politics, science, technology, industry, and education." In other words, probably for the first time in our history, our very way of life, our system of accomplishment, our whole way of thinking—is being challenged.

Dr. von Braun states, "The acid test of men and nations is the measure of their courage and resourcefulness in the face of adversity and peril." We here in the West must realize that today we are faced with a powerful and determined foe far more formidable than any other in the history of the world. What kind of courage and resourcefulness shall we show in the face of this great peril? It must represent the ultimate in the reasons our forefathers had in founding this country on the democratic principle. If it is, we will meet and beat the challenge of the Soviets.

I wish to congratulate Dr. von Braun on his wonderful insight into the problem at hand. Is man, when he is on the verge of the most superb and exciting venture he has yet embarked upon in his existence, to bicker and fight with his fellow men when he is at the bounds of the Universe? Let's hope not.

Trinidad, Colo. Bert Sardello

SPACE Journal is glad to see that the man in the street, if we may so call reader Sardello, realizes that the fruition of man's conquest of Space must cut across all arbitrary and chauvinistic obstacles. In the broadest sense, the race for Space is not really for Space at all—it is a political and technological contest between nations with all the attendant hoopla and publicity. It should, of course, be a world-wide race of man against time. In the final analysis, we feel that it will be the conquest of Space which will unite mankind. Once man is convinced of the ultimate necessity of Space travel, we believe that he will forget the purely political, racial and economical views which have kept

him in a state of physical, mental, and moral turmoil for so many years of his brief span on Earth. Editor.

Dear Editor,

. . . We have long recognized the need for education in a self-governing nation, but have only recently realized that it must be a continuing process. Adult education comes largely from current publications that express the learning of men in every field. Since the pages that can be utilized by educational articles are limited, it seems wasteful to print more fiction.

It is good that our best space and rocket scientists can put their knowledge in words the layman can understand. Today when we are bewildered by the bombardment of conflicting opinions of men in high places, it is good to have the truth from those who speak with the authority vested in them by reason of their advanced work and superior knowledge.

For these and other reasons we are sincerely grateful for SPACE Journal.

Phoenix, Ariz. Mrs. E. D. Gooch

Perhaps the important thing is not that our scientists can put their knowledge into words the layman can understand but rather that our scientists are free to put their words before the layman. Today, more than at anytime in history, we are wrestling ". . . not against flesh and blood, but against . . . spiritual wickedness in high places." With this realization, we believe that it is the right of all scientists to speak openly— not because of their advanced work and superior knowledge, but for the reason that science must be free in order to flourish and that the scientist must not be denied his inate dignity as a human being. Editor.

Dear Editor,

In looking through the summer issue of SPACE Journal, I was struck by the fearful attitude of some of the authors. Two articles were concerned with the far distant times when the Sun burns out. There are attempts to justify space travel on the grounds that it is necessary to undertake this difficult chore to insure man's survival in case of such an event.

May I remind your readers that man in Space will still be man with all his unsolved problems. Space travel will not empty the insane asylums of the world, deal with paranoids on all continents, provide food for the starving, or any other of a thousand measures which will contribute toward survival of the species.

While an increased knowledge of the heavens holds great fascination for me, I still feel that physical knowledge is not any substitute for the spiritual knowledge contained in the great religions or that escape from the realities of Earth will bring any happiness to anyone, including the pioneers of Space. . . .

San Jose, Calif. Richard W. Lundberg

SPACE Journal does not advocate space travel as the absolute panacea for man's ills or as an international form of group psychotherapy. We agree most wholeheartedly that "man in Space will still be man." We do not negate the basic truths of the world's religions by holding them up to modern science. Indeed, we believe that it will be the courage man derives from his religion or philosophy and the knowledge that he derives from his sciences which will ultimately place him in Space. Editor.

Dear Editor,

In his stimulating article "The Purpose of Man in the Universe," summer issue of SPACE Journal, John Hulley raises a number of questions which we have been discussing under the heading of theoretical anthropology. Our analysis, however, has been along slightly different lines, and we submit the following ideas in the interest of furthering careful speculation on man's future possibilities.

A. We take the distinguishing characteristic of Homo sapiens to be symbol-behavior, following Sir Julian Huxley and others. (See

"The Symbol: The Origin and Basis of Human Behavior" and "On the Use of Tools by Primates" in *The Science of Culture* by Leslie A. White.) Note that *symbols* are used freely and arbitrarily, whereas the *signs* used by lower animals have a single, fixed significance.

B. We posit a symbol-continuum (or *semoplasm*) which serves as an instrument of communication both between contemporaries and between generations. In addition it has properties which make it an increasingly efficient instrument of understanding.

C. We hold that any extraterrestial organisms likely to be of great interest to most human beings *must employ this same adaptive mechanism*. Otherwise we would be unable to communicate with them and learn from them.

D. We propose calling such organisms *sapients*. The present terminology covering our possible analogs on other planets is impossibly confused. To call them *human*, as Mr. Hulley does, seems to us to predict too much, since they may not even be primates. They are frequently called *sentient beings*, but this fails to distinguish them from, for example, earthly cows. *Sapients* seems to us both simple and clear.

In his discussion of man's place in nature, Mr. Hulley invokes the ecological balance among lower organisms. . . . Finding that man does not fit into the earthly ecology, Mr. Hulley prescribes for him the mission of interplanetary landscape gardener, whose "disseminating agency would contribute to the profusion of life on the planets he reaches."

But we would suggest that a more accurate appraisal of man's place in nature and a more inspiring purpose can be found in the following formulas.

I. In subhuman species, evolution is an interreaction between organism (O) and environment (E) which can be divided into autoplastic ($\leftarrow$) and alloplastic ($\rightarrow$) phases:

$$O \; \substack{\longleftarrow \\ \longrightarrow} \; E$$

II. But at the human level a new factor enters the evolutionary process. *Sapience is semoplastic adaptation:*

$$O \rightleftarrows S \rightleftarrows E$$

(S equals semoplasm)

This being the case, perhaps we should make it our business to search out other sapients and add our total of the symbol-continuum to theirs. Eventually our combined understanding might make it possible to approach the riddle of the Universe without the overwhelming modesty which Mr. Hulley accurately perceives to be appropriate for the present.

Society for Theoretical Anthropology
John F. Collins
New York, N.Y. Corresponding Secretary

While SPACE Journal feels that it may be unfair to the earthly cows to assume that they are purely sentient rather than sapient—after all, communication with the cow is difficult—we believe that reader Collins and his group have a legitimate point, and we earnestly urge them to submit an article to SPACE Journal putting forth their views—in language the layman can understand. Seriously speaking the problem of communication with extraterrestial beings is a problem which is worthy of scientific investigation; and the problem must be approached from the philosophical rather than the mechanical direction. We can build an efficient electro-magnetic transmitter, but can we adapt the intelligence of the receiver to it? Editor.

Dear Editor,

One of the most striking articles I have ever read, and I do mean striking, as it is electrifying in its meaning . . . was John Hulley's "The Purpose of Man in the Universe." Here at last in black and white is the theory I personally have held for a long time; but laymen cannot always put such thoughts into prose, though they are locked within us. Beautifully thought out, forcibly written, clear as crystal, and as grand as the majesty of the Eternity above us, it has more meaning than a thousand sermons.

. . . Hulley doesn't say it, but I have often wondered, what with man's ten-thousand year history, where all his fossilized remains are. Couldn't the answer lie in the fact that Homo sapiens was indeed only fairly recently disseminated on Earth from another living world. . . ? This may sound startling to one reading it for the first time, but when one calmly mulls it over and eliminates any inborn or acquired prejudices, the possibility carried tremendous weight. . . .

Mudelein, Ill. Mrs. Olive D. Smith

Dear Editor,

. . . My special congratulations on the superior articles by Mr. Hulley and Dr. von Braun. Mr. Hulley's article has a depth in (almost) religious philosophy which has great appeal and value. I certainly wish the US would listen as seriously to Dr. von Braun's views—as presented in his article—as it admires his material accomplishments. . . . Thanks for a fine journal.

Birmingham, Ala. Miss Onnis Waid

We hope that readers Smith and Waid will enjoy John Hulley's next article in a future issue. Editor.

Dear Editor,

Along with most other people, we are a family of space enthusiasts, and so tend to follow and try to understand each new development.

In trying to help my children understand the most recent one, inertial guidance, a new way of presenting the concept occurred to me that they found very helpful, and which we all feel should be shared with others.

This is to consider inertia as *antiwork* which brings it into a parallel relationship with concepts already familiar in the area of atomic particles. Considered as *antiwork*, it is easy to understand the concept of quantity as applied to inertia. Essentially, then, the amount of inertia, or *antiwork*, of a system is the amount of work which it can neutralize or render ineffective.

We would appreciate your comments on the validity and usefulness of this concept.

Boston, Mass. William Gray, M.D.

Rather than get involved in physics and the laws or inertia, we offer as an alternative an article on inertial guidance by Mr. Paul Weinschel in the Spring 1959 Edition. This article is written expressly for the purpose of simplifying some of the techniques of and advances in inertial guidance for space travel. Articles in future issues will deal with the problems of navigation and propulsion. Editor.

Dear Editor,

I just bought the first issue of SPACE Journal to reach the newsstands in Havana. SUPERB.

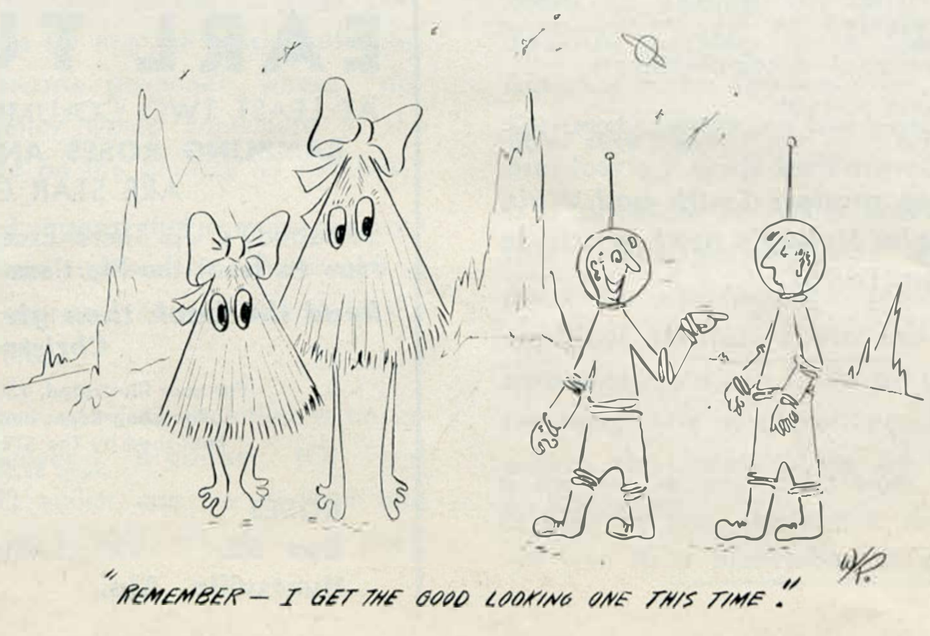
No doubt many armchair rocketeers like me have been waiting for a serious magazine in layman's language . . . .

When I was about 10 years old, I remember watching a newsreel which, among other things, showed two unsuccessful attempts to launch model rockets from a lake in New York . . . I also remember the laughter of the audience and their comments . . . About that time, a local (and short-lived) rocket society did launch a small power rocket from Havana to Guines, some 30 miles to the south, which carried as a payload a special packet of "rocket mail". . . .

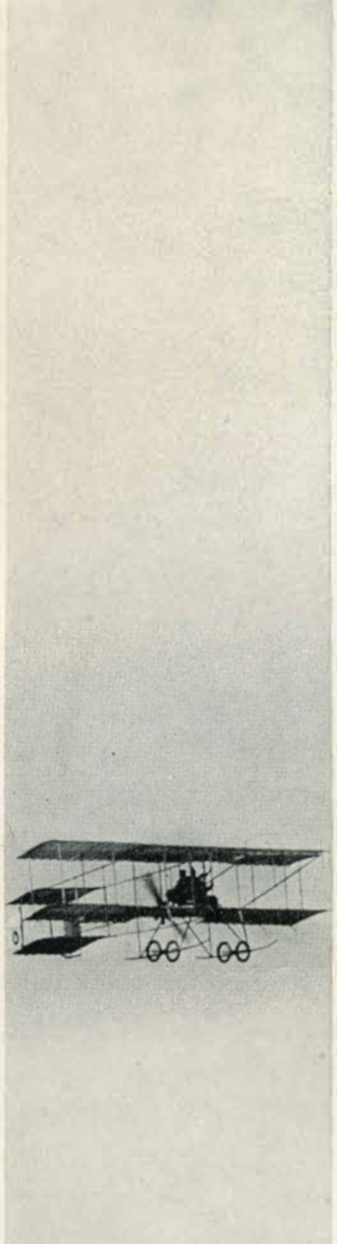
Best wishes for your continued success.

Havana, Cuba — Antonio V. Alvarado

SPACE Journal is interested to hear of this early attempt at organized rocketry in Cuba. Similar attempts in rocket mail were made at approximately the same time in the US and Europe. And SPACE Journal is glad to hear that we have readers in Cuba now. Incidentally, we have heard from readers in New Guinea, Venezuela, Canada, and Bulgaria, to name but a few countries. Abstracts from SPACE Journal are also printed by the Academy of Sciences of the USSR. Editor.



"REMEMBER — I GET THE GOOD LOOKING ONE THIS TIME."



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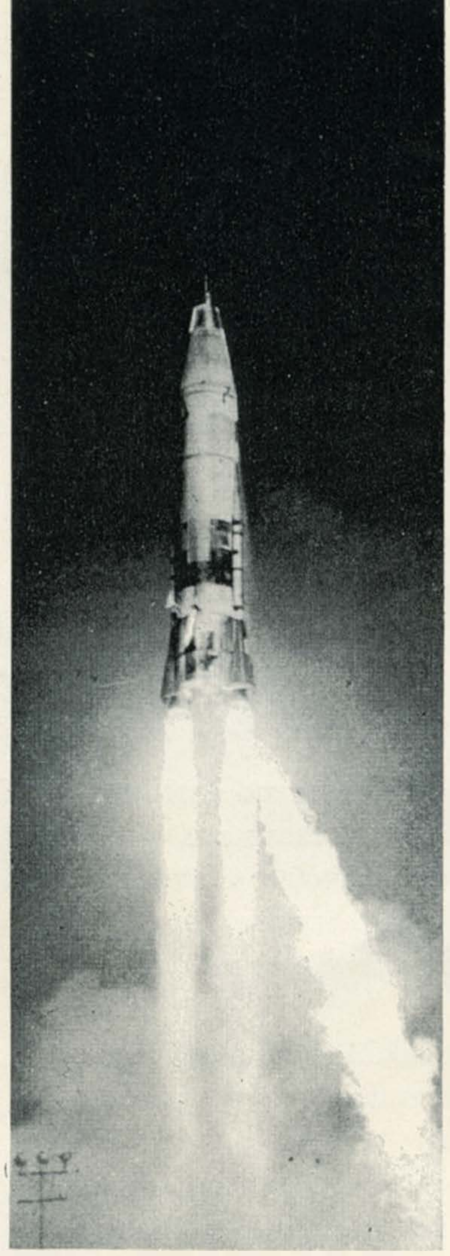

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The need to know–

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Some textbooks were available for the engineers. There was almost no literature for the layman, other than science fiction.

Out of this need to know came SPACE Journal, conceived by the Redstone Arsenal scientists who launched the Explorer satellites.

SPACE Journal is a progress report of a new, furiously expanding field. It interprets for the layman the theories and philosophy of space, interplanetary flight, astrophysics, and the actual accomplishments. Begun as an amateur effort, SPACE Journal's first issue was 5,000 copies. An additional 15,000 copies were printed to satisfy the demand, and sold at the newsstands of twelve cities. A company was formed to continue its publication as a quarterly.

The print order on the second edition was 100,000. There was an instant demand for copies from government agencies, the armed forces, the press, educators and industry. To fill an order for Stars & Stripes in Europe, 2,500 copies had to be taken off the newsstands.

The print order of the third issue was 120,000. SPACE Journal is distributed nationally by the Independent News Company.

The importance of space flight is emphasized by the current appropriations of $510 millions for space flight research. SPACE Journal is read by the people who sign the orders; the designers, engineers, manufacturers; the technicians and servicers who operate them, and a large portion of the educational world. It offers a tremendous new and unduplicated potential for your advertising effort.

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