

Space

INTELLIGENCE NOTES

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

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FROM THE WORLD PRESS

COSMONAUT BADGE. By order of the Soviet Defense Ministry, a new insignia for cosmonauts has been issued. This insignia, to be worn above the left breast pocket, represents unfolded golden wings consisting of five feathers each. In the center is shown the globe of the Earth, the Soviet flag, and a flying spacecraft. The globe is circled by a golden satellite orbit.

The lower part of the insignia has a protruding shield with the number 1, 2, or 3 on it (Fig. 1).



FIG. 1

The cosmonaut insignia will be awarded to 1st, 2nd, and 3rd class cosmonauts.

The 3rd class insignia is given by order of the Commander-in-Chief of the Soviet Air Force to cosmonauts completing one space flight. The 2nd and 1st class insignias will soon be awarded by order of the Soviet Minister for Defense to cosmonauts who will complete two or three space flights respectively. (Source: Russian News Brief, Publication of Electro-Optical Systems, Inc., March 8, 1963)

SOVIET MANNED FLIGHT BOOSTER SIZE GIVEN. After much confusion and many questions on the subject, an East German engineer has been quoted as saying that the rockets used to place Vostoks III and IV into orbit consisted of a six engine cluster for the first stage. H. A. Vilter stated that "the power of the six rockets of the initial stage was roughly 20 million horsepower." This indicates that the boosters were approximately two thirds the size of the first Saturn C-1.

The Russians have referred to six engines before in connection with the Vostok boosters but had left it unclear whether they meant a total of six engines in all stages or six in the first stage.

If the six engines are of equal size, they would be rated at slightly under 150,000 lb thrust each. This is about the thrust generated by our Thor booster's single engine or each of the Atlas Mercury launching rockets. (Source: Washington Star, January 11, 1963)

MARS PROBE'S COURSE CORRECTED. On March 2 the Soviet Union released a startling bit of information. On March 1, at a distance of 78,843,000 km (49,000,000 mi), they claim to have performed corrective guidance maneuvers on their Mars probe by transmitting signals to the probe. This is a capability not believed to be presently possible by US scientists and if true, indicates a gap between the US and the USSR in the communications field. Some question has been raised as to when the correction would be made and what procedure would be followed, as was reported on in January, February, and March issues of Space Intelligence Notes.

The Tass article revealing the information stated that the strength of radio signals received from the Mars probe decreased somewhat when the orientation was made. The spacecraft's velocity was given as 14.84 km per sec (9.2 mi per sec) on the day of the correction. (Source: Russian News Brief, Publication of the Electro-Optical Systems, Inc., March 6, 1963)

US-FRANCE ANNOUNCE COOPERATIVE SPACE PROGRAM. The National Aeronautics and Space Administration and the French National Center for Space Studies (CNES) announced today the signing of a Memorandum of Understanding for a cooperative program to investigate the propagation of very low frequency electromagnetic waves at altitudes above 74 km.

The first phase of the program consists of the launching from Wallops Station, Virginia, during 1963 of NASA sounding rockets carrying French instrumented payloads built by the French National Center for Telecommunications (CNET). They will probe the characteristics of the region between 74 and 100 km through simultaneous measurements of electric and magnetic VLF field strength and local electron density.

If, based on the results of the above flights, these experiments prove to be scientifically and technically feasible, the two organizations will proceed to a second phase--the launching into Earth orbit of a scientific satellite to investigate VLF characteristics above 100 km. The satellite would be entirely constructed under CNES responsibility, scientific experiments being directed by CNET. It would be launched by a NASA Scout vehicle.

No exchange of funds is contemplated in implementing this program. The experimental results will be made freely available to the world scientific community. (Source: NASA News Release, March 11, 1963)

BLUE VEGETATION ON MARS. According to reports recently received from Soviet astronomer G. A. Tikhov, vegetation on Mars is blue in color rather than green as on Earth. "There are substantial differences between Martian and Earth vegetation," he stated. He bases his reasoning on the belief that Mars vegetation exists by a quite different system of light absorption. He noted that the spectrum of Earth plants clearly shows chlorophyll absorption bands lacking in the spectrum of the Martian seas. Terrestrial plants greatly scatter infrared rays whereas the Martian seas absorb them. (Source: The Evening Star, February 14, 1963)

RUSSIANS ESTIMATE WATER ON MARS. Drs. A. I. Lebedinskii and G. I. Salova of Moscow State University have recently made estimates of the water vapor on Mars. Their observation is based on the degree of cloudiness of the Martian atmosphere and the rate of evaporation of the polar caps. Their claim gives an estimate of two billion tons of water for the red planet. When one notes that Earth has approximately ten thousand billion tons of water in its atmosphere, it can be seen that Mars is an extremely dry planet if the estimate is correct.

The Soviet Mars probe is said to be equipped to study the ice caps, so that when the rendezvous is made on June 25, the estimate may be verified. (Source: Science News Letter, January 12, 1963)

RUSSIAN CLAIMS ROCKET-FROM-SATELLITE CAPABILITY. The December 1962 issue of Space Intelligence Notes contained an article entitled "Is U.S. Destruction from Space Platforms Planned?". In it information was given that had been released by Mr. Kilsoo Haan on Soviet plans for their space warfare program. He stated that the Soviets, among other things, planned to have space platforms in orbit by 1965 capable of delivering and detonating nuclear bombs and launching and guiding missiles to designated targets.

On February 21, Soviet Marshall S. S. Biryuzov, commander of Russian strategic rocket forces, claimed on Radio Moscow that they now had such a capability. He stated that rockets could be launched from satellites "at any point of the satellite's trajectory."

Talking of his particular command, Marshall Biryuzov said, "The strategic rocket groups are a new type of the armed forces created on the initiative of Nikita Khrushchev. They are troops of an enhanced fighting capacity. They are equipped with the most perfect rockets, among them intercontinental and global rockets capable of carrying warheads of tremendous devastating force to any point of the globe with great precision.

"Soviet rockets have removed from military strategy the notion of geographical invulnerability. Our superiority over the Western bloc in nuclear weapons is beyond question." (Source: The Washington Post, February 22, 1963)

TRITONS' REVIVAL CLAIMED AND DENIED BY RUSSIANS. A claim was made recently that Russian scientists had successfully brought to life two tritons (an amphibian which inhabited the Earth during the Mesozoic era). The account was broadcast over Radio Moscow on February 26 of this year:

"Some time ago Soviet geologists found something resembling a lizard at a depth of about 8 m (25 ft) in the frozen ground of northern Siberia.

"It revived after being kept at room temperature for some time. Scientists finally classified it as a four-toed triton, one of the oldest and most primitive orders of tailed amphibia that inhabited the Earth in the Mesozoic era (the dinosaur age).

"Judging by the state of the earth in which it was found, biologists concluded that the triton had been asleep for about 5000 years.

"On awakening the creature behaved exactly as it had thousands of years ago. It ran around, ate, and slept. It was not afraid of people, willingly eating wild berries, flies, and mosquitoes out of their hands.

"It died after three weeks.

"Another triton was found frozen about 4 m (13 ft) underground. This one also revived and lived practically all summer."

The next day a prominent Soviet scientist, Prof. Gleb Lozinolozinsky of the Leningrad Institute of Cytology, described the claim as "pure invention."

According to Prof. Lozinolozinsky, the story is based on a children's story book which he read two years ago. In it, the story was told of geologists finding tritons buried in "eternally frozen ground." Even this was never proven according to him. (Source: Birmingham Post-Herald, February 28, 1963 and Huntsville Times, February 26, 1963)

FROM THE SEMITECHNICAL LITERATURE

A LOOK AT THE EARTH FROM ORBIT. This article from Priroda (Nature) is the first of a series to be translated by Mr. B. J. Soshinsky from the Russian language and published in Space Intelligence Notes by the Science and Technology Section.

This particular article is an account by A. G. Nikolaev and P. R. Popovich of their twin orbit. The photographs mentioned in the text are unavailable.

"How Does the Earth Look from Outer Space?"

by A. G. Nikolaev and P. R. Popovich,
Pilots-Cosmonauts USSR. Heroes of the Soviet Union

"How often we are asked this question! We will attempt to give our impressions and describe what we saw through the pages of the journal Priroda. We will supplement our brief remarks with colored photographs.

"Picture for yourself how the spaceship, overcoming the Earth's gravitation, bursts into orbit. Silence comes unexpectedly; everything is unfamiliar, weightless; and the journey around the world, which takes only an hour and a half, begins.

"The illuminator is directed downward. The Earth travels exactly beneath the ship and appears to be alongside. There is a good old proverb: 'Better to see it one time than to hear it one hundred times.' And truly, it is hard to believe that it is possible to distinguish so much on Earth at such a great height from here. Naturally we do not see 'lion tracks in Africa,' but evidence of man's labors is everywhere. Large rivers and mountains are clearly visible, as are artificial water reservoirs, green masses of forests, and square cultivated fields.

"Oceans and seas are easily distinguishable by their characteristic color, outline, and relief. In some places the ocean seems to be resting and is a very deep blue. A large swell is distinguishable as well as the direction of the movement of the waves. The shore lines are extremely beautiful with legible broken lines which are bordered by the seas; above the shore lines float small fleecy clouds against whose background the shore line appears an emerald color. Near islands and abrupt shore lines the departure from shallow to deep water is clearly defined. The shallow areas of the sea are light beige. Deeper it becomes emerald and then changes to blue.

"Oceans and seas have characteristic color values: greenish in the Caribbean Sea, dark blue in the Indian and Atlantic Oceans, dark azure in the Mediterranean Sea. From orbit large rivers appear to be fantastic yellow ribbons dotted with dark green islands.

"It is very interesting to observe the great mountain masses of Tienshan and the Himalayas. Their peaks are visible, covered with white snow caps, as are the winding dark hollows of valleys and gorges with the light yellow rivers flowing along the valleys between the mountains.

"The characteristic color of deserts ranges from an even dark brown in the Gobi to the golden brown in the Sahara.

"At night cities are clearly seen, and by means of the bright lines of lights it is possible to determine the direction of the main thoroughfares.

"Several times we observed storms; blue flashes of lightning against the background of whitish clouds were very distinct. It was interesting to observe, in the external circle of the optical orientator, lightning that resembled a flash of a voltage arc.

"In space the Moon appears very much brighter than on Earth; its magnitude and sphericity can be perceived much better. In the Earth's shadow the stars are very clear against the background of the black heavens.

"Before the craft leaves the Earth's shadow a purple belt appears and over it a pale azure one. The purple belt widens, and above it, without an abrupt change, an azure belt begins, then a dark blue one, followed by the deep black sky. The contrast is constantly lessening, and suddenly the fiery-red Sun appears with its blinding rays.

"While the ship is in the Earth's shadow, the horizon offers considerable contrast, which decreases as the Sun is approached. Subsequently the color changes from azure to orange-azure; then the dark blue shades rapidly darken. The azure shade predominates during observation of the surface near the horizon, while the horizon itself has a soft-azure shade. As we look vertically downward, the coloring approaches the normal appearance from Earth.

"It is very interesting to observe the clouds: the cumulus rain clouds differ from the strata types. The clouds above water surface can be seen especially clearly, and their altitude and appearance may be determined.

"We would like to mention some of the possibilities in the utilization of these observations in future space flights, both around the Earth and also other planets of the Solar System.

"Firstly, a knowledge of the singular characteristics of the terrain relief details, shore lines, and the color determination of continents, oceans, and seas will permit the accurate orientation by pilot-cosmonauts, during their flights in the near-Earth region. Besides this, during the piloting of cosmic flying craft it is essential to have a range of observations concerning the coloring and brightness of the Earth's surface

under diverse conditions of lighting and meteorological situations. In this connection it is unwise to underevaluate the observations of visibility and contrast within the horizon in various areas of the spectrum.

"Certainly the attainment of experience in the recognition of terrestrial landscape features will permit accurate recognition similarly on other planets of the Solar System.

"Secondly, the receipt of observations in the near-Earth space will assist in the expedient development of scientific studies in the fields of meteorology, geo-physics, etc. Thus, for example, climatology and biology obviously will receive substantial knowledge concerning the existence and seasonal changes of vegetational cover over extensive areas of the Earth's surface. Obviously, even oceanologists may utilize the relation of the brightness and coloring of oceans and seas with various hydro-physical processes. Geo-physicists are given a direct opportunity to observe the optical characteristics of the atmosphere at great altitudes.

"Truly, wide prospects are opening for mankind. Having burst into space, he is receiving newer and newer opportunities for further study of Earth and cosmic space." (Source: Priroda, No. 1, 1963)

"GOOD LUCK" OF SOVIET SPACE PROGRAMS. In answering the question, "Are the present Soviet space achievements due to mere good luck or to something else?" Dr. G. A. Tokaty says, "The Soviet philosophies do not believe in 'good luck.' The Soviet philosophies demand that any education and scientific knowledge must have an aim, a purpose."

This former chief of the aerodynamics laboratory of the Zhukovsky Academy of Aerodynamics of the Soviet Air Forces in Moscow and now head of the Department of Aeronautics and Space Technology, Northampton College of Advanced Technology, London, analyzes his outlook as politically and ideologically in disagreement with the Soviet government. This, he states, does not prevent his having a high opinion of Soviet rocket technology.

Much of the historical background of early Russian space technology, including mention of men such as Kibal'chich, Konstantinov, Meschersky, Lomonosov, and Zhukovsky, is recounted to lend weight to Tokaty's argument that space research and technology have long been encouraged by the USSR. The St. Petersburg Academy of Sciences had created and maintained excellent tradition in mathematics, theoretical mechanics, and theoretical physics, according to Tokaty.

He says that the five year plans of industrialization gave Russia a modern aero/space industry, which, in turn, created favorable conditions for the formulation of huge research establishments. Among the establishments mentioned were the wind tunnel facilities built from 1933 to 1938, the

Institute of Fluidmechanics of the Academy of Sciences erected in 1959, and the State Scientific Research Institutes. In Dr. Tokaty's opinion the scientific facilities of Russia compare favorably with those of any other nation on Earth. Among their greatest assets he lists: activities well planned, programs effectively coordinated and directed, and complete freedom from financial problems.

In supporting his views concerning the assistance provided the space industry by the Soviet government, he discusses the creation of a special Central Bureau for the study of problems of rockets in 1924. That same year the Society for the Study of Interplanetary Flights was formed. From 1927 through 1930, the keen interest of the government was manifested by an International Exhibition of Rocket Technology, a number of closed and open conferences of Soviet rocket enthusiasts, and publication of scientific articles and books.

The following five statements are made by Dr. Tokaty in attempting to answer the very pertinent question, "Why, if the USSR had so many rocket scientists, technologists, engineers, projects and prototypes, were there no operational rockets or jet aircraft until after World War II?"

1. "It is not true at all that there were no rockets in the Soviet Union; 'Katayushas' of several types were in mass production and wide scale use in 1941-45.
2. "The main industrial centres of the USSR had been either occupied by the Germans or evacuated to the East and this caused serious delays.
3. "Resources and efforts had to be concentrated on the immediate needs of defense.
4. "The Soviet industry was still young and unexperienced.
5. "As admitted by the XXth Congress of the Communist Party itself, Stalin and his lieutenants had committed too many mistakes in preparing the country's defense."

The doctor follows up these "reasonable explanations" by disputing the allegations that present Soviet space achievements are due to "hundreds of German rocket scientists and engineers deported from Peenemünde and Berlin to Russia." He indignantly asserts that the USSR did not get a single leading V-2 rocket engineer or administrator, not a single complete rocket factory, and not a single new project. He quotes Marshall Stalin as saying in regard to the above, "We defeated Nazi armies, we occupied Berlin and Peenemünde; but the Americans got the rocket engineers. What could be more revolting and more inexcusable?"

The present high level of scientific and technological accomplishment was achieved, the doctor says, with the help of ordinary German engineers, technicians, and workers. By early 1946, V-2 production was fully restored, he states. The USSR had full scale serial production of improved versions of the V-2 with a maximum range of 900 km (559 mi). Tokaty generalizes by saying that the Peenemünde V-2 level of 1944 was reached by Russia in 1946-1947, and by 1949-1950, the Soviets had exceeded this level in both quantity and quality.

In summarizing recent Soviet accomplishments, Dr. Tokaty says that "none of these events surprised me. . . Those Russians. . . realized years ago that rocketry is the elite of modern science and technology." Their ministers, administrators, planners, and co-ordinators of aero/space efforts are distinguished scientists, technologists, and engineers.

He concludes that Soviet progress emerges logically from the general program of space research. It does not step forward until all preliminary problems have been fully worked out. No experiment or design is undertaken unless theoretical aspects have been thoroughly studied. This, says Dr. Tokaty, explains why the Soviet Union has "good luck" with its rockets and sputniks. (Source: Space Flight, March 1963)

MOON TO BE USED AS POWER SOURCE. One Soviet scientist has already decided on a method to make the tremendous expenditures to reach the Moon economical. Academician Nikolai N. Semenov, the first Soviet Union Nobel Prize winner, put forth his ideas in an article in the Communist Youth League newspaper, Komsomolskaya Pravda (Komsomol Truth).

Realization of either of his two ideas would first require major advances in the technology of power transmission, but with the undreamed-of advances made in the last few decades who is to say it is not possible?

One of Academician Semenov's ideas for making the Moon a power source for the Earth is based on utilizing the Moon's solar energy. The Moon's surface receives about one-fifth as much solar energy as does the Earth's surface. Semenov feels that covering the surface of the Moon with semi-conductors and photoelements of high efficiency would be economical. This, he suggests, would permit the solar energy falling on the Moon to be converted to an electrical production capacity of several trillion kilowatts.

Academician Semenov's second proposal is to use the Moon as a site for all atomic and thermonuclear power stations. He points out two advantages for doing this.

The first would be to safeguard the Earth from radioactive contamination resulting from the operation of these nuclear power stations. The second reason is to avoid overheating the Earth during the generation of power. Semenov believes that when controlled thermonuclear power becomes a reality, the total of such power actually generated on Earth will have to be limited to 5 or 10 per cent of the total solar energy falling on the Earth in order to avoid overheating the Earth and its atmosphere.

Even more distant in the future, Semenov argues that an unlimited amount of power at the disposal of man will allow him to make Mars habitable. These vast amounts of energy can be used to extract oxygen from water and rocks on Mars, giving that planet the life-supporting atmosphere it is now believed to lack. (Source: New York Times, September 23, 1962)

VENUS UNVEILED, AND ASTRONOMICAL UNIT MEASURED BY RADAR. On May 12, 1961, an article in the Izvestiya No. 112 (News) by V. A. Kotel'nikov and I. S. Shklovskiy stated that Russia had now compiled quite accurate information on the inclination, period of rotation, and physical characteristics of the planet Venus. The article enumerated previous unsuccessful attempts to compile the critical information; it then supplied general data on Soviet radar methods used and their findings. Another highly important feature of the release was the revised calculations of the Astronomical Unit.

They stated a belief that our sister planet, enshrouded in clouds, had foiled all previous attempts to ascertain her period of rotation and seasonal variations. The plane of rotation and direction had not been determined, they claimed, in spite of efforts by French astronomer, Dalfuss; Russian astrophysicist, Belopol'skiy; and various other scientists of the USA and England extending back over a sixty-year period. These supposedly unsuccessful devices included the Spectroscopic Method, Radio Telescopes, and Radar.

The two writers believed that inadequate capabilities of US apparatus used in 1958 were blamed for inconclusive results using radar. Powerful transmitters, antennas, and receivers of the USSR were acclaimed capable of transmitting 15 watts to Venus and receiving signals strong enough to permit measuring differences in radial velocities.

From measurements made, rotation period of Venus was said to be calculated at approximately 9 days, and inclination was accepted as 58°.

In turning their discussion to the Astronomical Unit (mean distance between the Earth and Sun) attention was called to the four accepted methods of calculating the Unit. Although these four methods tend to support the generally accepted figure of 149,500,000 km (92,898,300 mi), the possible error in this fundamental Unit upon which all space calculations are based may be 100,000 km (62,140 mi). According to the release, the Astronomical Unit is 149,457,000 km (91,872,580 mi) correct to within 5000 km (3107 mi).

Conclusions drawn by the Russian scientists were:

1. "The radar location of Venus, which was responsible for the substantial improvement in the degree of precision of the Astronomical Unit's value determined reliably the basic characteristics of Venus' rotation."

2. "The new, quite precise value of the Astronomical Unit, obtained by the radar method, improves considerably the reliability of calculation of interplanetary rockets' trajectories."

(Source: Izvestiya, May 12, 1961)

FROM THE TECHNICAL LITERATURE

ASTRONOMY

ELECTRONIC ASTRONOMER. On January 23, Izvestiya reported that Maris Abele, an engineer at the Astronomical Observatory of the Latvian State University, has developed a small electronic device which makes it possible to determine automatically from photographs the coordinates of artificial Earth satellites. This "electronic astronomer" is equipped with a magnetic memory and operates according to a prescribed program. (Source: Izvestiya, January 23, 1963)

ASTROPHYSICS

RUSSIANS FIND MOON INTERIOR TO BE HOT AND SURMISE A PUMICE-LIKE SURFACE.

The January 16 issue of Turkmenskaya Iskra (The Turkomen Spark) reports experimental verification of a hot lunar interior by measurements of radio emission intensity at wavelengths of up to 50 cm (20 in.). At depths of 15 to 20 m (50 to 66 ft) the temperature was more than 25° higher than at the surface, and at depths of 50 to 60 km (50 to 66 ft) it was about 1000°C (1850°F). The wavelength growth characteristics indicated that upper layer structure is homogeneous to a depth of approximately 20 m (66 ft). The Russians considered measurement errors to be negligible and therefore concluded that the temperature increase with wavelength is attributable to the existence of a hot lunar interior.

The report estimated that the density of lunar internal heat flow is about that of the Earth, and the density of matter composing the lunar surface has been determined to be half that of water. Therefore, the Russians believe that the lunar surface layers must be of a pumice or honeycomb-like nature. (Source: Turkmenskaya Iskra, January 16, 1963)

GEOPHYSICS

ELIMINATING THE ARCTIC ICE CAP. What would happen if it were technically possible to melt the Arctic ice cap? L. R. Rakipova stated his theory in Meteorologiya i Gidrologiya (Meteorology and Hydrology).

The theory considers the basic factors determining the thermal and dynamic state of the atmosphere. Changes in the latitudinal variation of three basic factors--albedo, evaporation, and precipitation--which would determine the potential change of the zonal temperature field with the artificial destruction of arctic ice are theoretically computed or evaluated for the winter (October-March) and summer (April-September) months.

The results indicate the winter zonal temperature field would differ little from the existing field, but in summer the temperature difference between the equator and the pole would decrease from the present 32° to 19° as the result of the meridional equalization of the albedo. If the seasonal heat exchange between the surface of the Arctic Ocean and its deeper layers is taken into consideration, it is seen that a large portion of the huge amount of heat entering the Earth-atmosphere system at high latitudes is stored in the deeper oceanic waters in summer but released and expended in raising the air temperature in winter.

The resultant smaller temperature difference between the equator and the pole in winter would result in a weakening of the zonal circulation and in turn in a leveling of the annual variation of the circulation index. These computations make it possible to presume that if the arctic ice were artificially destroyed, it would not develop again to the same extent as under present climatic conditions. (Source: Library of Congress, A.I.D. Press, No. 900, February 15, 1963)

LIFE SUPPORT

ALGAE FOR SPACE FLIGHT. Planners of life-support systems for long-range space flights agree that green algae must be an essential element, owing to the ability to utilize solar energy effectively, the rapid growth, the ease of cultivation, and the high nutritional value. N. N. Boyko, V. P. Bychkov, Yu. I. Kondratyev, and A. S. Ushakov report that *Chlorella* and *Scenedesmus* have been found most useful for mass cultivation. Normal types flourish at 20 to 25°C (68 to 77°F), while thermophilic types prefer temperatures of 35 to 40°C (95 to 104°F). Under favorable conditions the biomass may be increased fourfold daily.

Among the many attractive properties of these algae is their ability to change their chemical composition if the mineral content of the growth medium is changed. Thus the following ranges in content have been produced in *Chlorella pyrenoidosa*: ash, 3 to 4 per cent; protein, 8.7 to 88.2 per cent; carbohydrates, 5.7 to 37.5 per cent; fats, 4.5 to 85.6 per cent. This indicates that the composition of algae can be adjusted to suit the nutritional needs of cosmonauts. (Source: Library of Congress, A.I.D. Press, No. 897, February 12, 1963)

PHOTOSYNTHESIS STUDIED. Russian technologists claim to have verified work done by William H. Storey, Jr. and a group of researchers assembled under the direction of Dr. George Pish at the Southwest Research Institute in Texas. The work was done with chloroplasts and spinach leaves in trying to understand photosynthesis, the process by which green plants, algae, and certain bacteria use water and carbon dioxide to produce oxygen and carbohydrates (sugars). This understanding not only is essential to

the problems of space travel but also will become more and more important with the ever growing world population. If the population continues to increase at its present rate, the only known solution for feeding this multitude of people is a series of synthetic food production factories which have as their base an understanding of the mechanism of photosynthesis.

Mr. Storey's group decided to take a new look at the phenomenon of photosynthesis. Instead of painting the separated chloroplasts on metal rods for observation, they decided to suspend them in a medium which more closely resembled their natural environment. They then utilized electron spin resonance (ESR) to determine what really went on. ESR is a means of looking inside the molecules and observing any unpaired electrons which may be present. Such observations were made to give a clue to the mechanism immediately following the absorption of light.

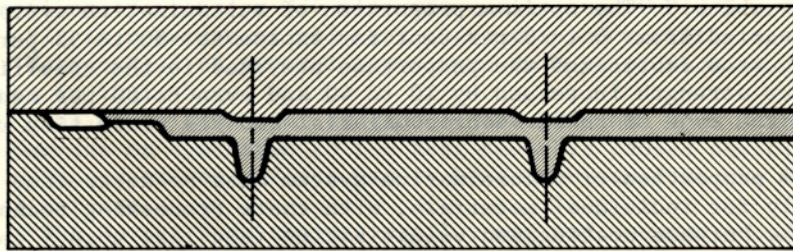
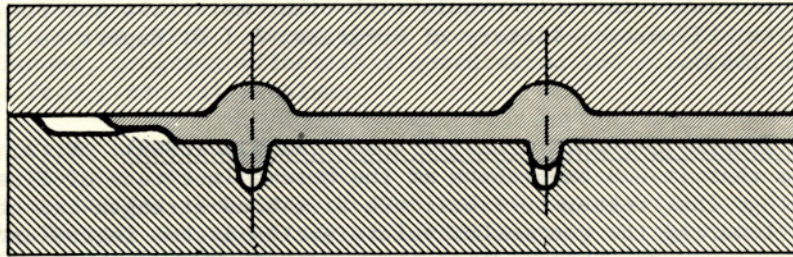
The ESR signals observed appeared much more slowly than would be expected from previous investigations by other organizations. One finding which disagreed with previous work was the dependency on the prior addition of oxygen.

The Southwest Research Institute results were shown to Russian investigators Terenin and Holomogrov, who had reported similar signals, working with crystalline chlorophyll a+b. They had not observed the need for oxygen, however. They attempted the experiments made by Storey and reported a confirmation of the findings. (Source: Tomorrow Through Research, Publication of the Southwest Research Institute, January and February, 1963)

MATERIALS ENGINEERING

LOCALIZED DIE FORGING OF ALUMINUM PANELS. A new method for the manufacture of ribbed panels, "localized die forging," has been developed by the Soviets. This process involves forging an entire panel at one time as is done with conventional forging; however, forging pressure is concentrated in the areas of the panel that are more difficult to shape. Better conditions are thus created for shaping panel sections with high thin ribs.

Localized forging can be performed in one or two steps, depending on panel size and shape. The same bottom die but differently shaped top dies are used in each step. The top die used in the first step forms a fuller or projection of metal depending on the desired shape, directly above the rib cavities. In this step metal is forced into the rib cavity but somewhat less than the height of the rib cavity. The die used in the second step reduces this fuller or projection to the desired finished



A - FIRST STEP
B - SECOND STEP

FIG. 2

shape, thereby concentrating pressure in an area directly above the rib cavity. The "localized" forging pressure thus created causes an overall metal displacement that results in deeper penetration into the rib cavity with a subsequent higher rib on the finished panel. The overall metal displaced is equal to one and one half times the volume of the rib cavity (see Fig. 2).

As compared to conventional die forging, localized forging increases filling of the rib cavity by 20 - 25 per cent. In addition, the deformation force required is 25 - 30 per cent lower, metal utilization is 17 - 20 per cent higher, and panel cost is 20 - 25 per cent lower.

Although the experiments conducted by the Soviets were limited to aluminum panels, it appears that it would be very feasible to adapt this method for the manufacture of panels with other materials and for other similar parts. (Source: Library of Congress, A.I.D. Report No. S-63-19, January 30, 1963)

INCREASING RUBBER-TO-FABRIC ADHESIVE BOND STRENGTH (USSR). V. A. Panov et al claim that it has been shown at the Moscow Institute of Fine Chemical Technology that rubber-to-fabric adhesive bond strength can be increased by lowering the content of vulcanization system ingredients in friction compounds or rubber adhesives used to bond the rubber coating layer to the fabric.

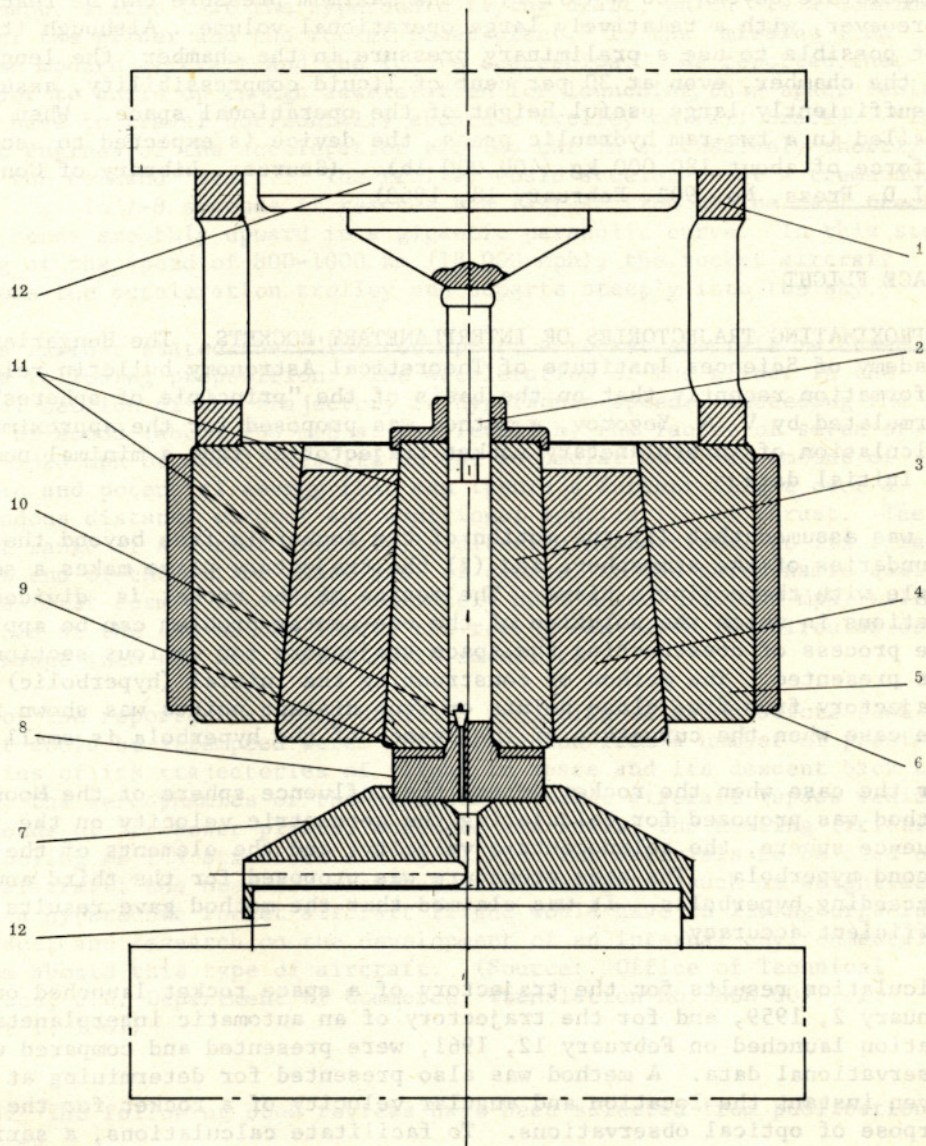
Experiments were conducted with capron and light or heavy cotton fabrics (percale "A" and "kord-pnev") coated with rubbers of serial production. Some experiments were carried out with capron fabric impregnated with an epoxy-amine resin frictioned and coated on one or both sides. The adhesive strength was evaluated in stripping tests on specimens doubled "rubber-to-rubber." The optimum proportion of vulcanization system ingredients varied from ~0 to 5 per cent for capron to ~50 to 55 per cent for heavy cotton fabric (of the proportion provided in the specifications). The adhesive strength increased by 10 to 40 and even to 80 per cent, depending on the type of rubber-fabric material and its processing method.

The optimum proportion of vulcanization system must be determined experimentally for individual materials, with their processing technology and the time between coating and vulcanization (not less than 5 to 10 hrs) taken into account. It is stressed that the physical and mechanical properties of rubber-fabric materials are not affected by the proportion of vulcanization system ingredients in friction compounds; these properties are determined by the rubber layers, which are prepared in accordance with existing recipes. (Source: Library of Congress, A.I.D. Press, No. 878, January 16, 1963)

PHYSICS

HIGH PRESSURE DEVICE BUILT. R. Wiśniewski reported in Postepy Fizyki that work had been done in Poland on a high pressure device. Figure 3 shows the device for generating high pressures, built by the Department of Experimental Physics at Warsaw Polytechnic Institute.

It was anticipated on the basis of data in the literature that a maximum pressure up to 30-40 kbars could be obtained by using a high-strength steel for construction of the device and a liquid as a means of pressure transfer. Under these conditions internal heating will not raise the



- | | |
|---------------------------|-------------------|
| 1. Support | 7. Centering base |
| 2. Plunger | 8. Electrode seat |
| 3. High-pressure chamber | 10. Electrode |
| 4. & 5. Reinforcing rings | 9. & 11. Lining |
| 6. Safety rings | 12. Rams |

FIG. 3

temperature beyond 300°C (572°F). The maximum pressure can be reached, moreover, with a relatively large operational volume. Although it is not possible to use a preliminary pressure in the chamber, the length of the chamber, even at 30 per cent of liquid compressibility, assures a sufficiently large useful height of the operational space. When installed in a two-ram hydraulic press, the device is expected to secure a force of about 180,000 kg (400,000 lb). (Source: Library of Congress, A.I.D. Press, No. 902, February 18, 1963)

SPACE FLIGHT

APPROXIMATING TRAJECTORIES OF INTERPLANETARY ROCKETS. The Hungarian Academy of Sciences Institute of Theoretical Astronomy bulletin released information recently that on the basis of the "principle of spheres" formulated by V. A. Yegorov, a method was proposed for the approximate calculation of interplanetary rocket trajectories from a minimal number of initial data.

It was assumed that (1) the motion of the rocket is free beyond the boundaries of the atmosphere and (2) the trajectory plane makes a small angle with the ecliptic plane. The motion of the rocket is divided into sections in which the solution of the one-center problem can be applied. The process of constructing the space trajectory for various sections was presented. The method of constructing the initial (hyperbolic) trajectory from five close points or from distant points was shown for the case when the curvature of the branch of the hyperbola is small.

For the case when the rocket enters the influence sphere of the Moon, a method was proposed for calculating the geocentric velocity on the influence sphere, the selenocentric velocity, and the elements of the second hyperbola. The same procedure was proposed for the third and succeeding hyperbolas. It was claimed that the method gave results of sufficient accuracy.

Calculation results for the trajectory of a space rocket launched on January 2, 1959, and for the trajectory of an automatic interplanetary station launched on February 12, 1961, were presented and compared with observational data. A method was also presented for determining at any given instant the location and angular velocity of a rocket for the purpose of optical observations. To facilitate calculations, a series of nomograms was given. (Source: Library of Congress, A.I.D. Press, No. 900, February 15, 1963)

A RUSSIAN'S CONCEPT OF A HYPERSONIC ROCKET AIRCRAFT FOR SPACE FLIGHT. An article that appeared in the October 1959 issue of Grazhdanskaya Aviatatseva (Civilian Aviation) discussed using a rocket aircraft for flight into space, which would be a new method for the launch and Earth-return of a manned spacecraft.

N. Romanov stated that the hypersonic flying craft, which "is a combination of the glider and the rocket power plant," is the "missing link between modern aircraft and the future spaceships." He reported that in order to build up enough acceleration for launching this space vehicle would have to travel horizontally aboard a trolley on rail tracks. "The rocket engines of the acceleration trolley cut in successively shortly after the command 'start.' The trolley would accelerate at a tremendous rate. . . In 7-8 seconds it reaches the last section of the rail track which bends smoothly upward in a gigantic parabolic curve. In this stage, moving at the speed of 800-1000 km (18,000 mph); the rocket aircraft abandons the acceleration trolley and departs steeply into the sky."

It was further stated that "the concept of a rocket aircraft is based on the following proposition: The acceleration of the glider in the initial section of the trajectory to hypersonic speeds, exceeding the speed of sound (about 760 mph at sea level) by the factor of seven or more (5320 mph or more), results in the accumulation of an amount of kinetic and potential energy that can insure a further flight over a tremendous distance without any additional application of thrust. The flight range of a rocket aircraft is directly proportional to its speed at the end of the active phase and, of course, to the aerodynamic quality. If the first cosmic speed (approximately 8000 m/sec) (18,000 mph) will be attained at the end of the boost, the rocket can reach the circular orbit and change into the artificial Earth satellite."

Some of the reported existing problems requiring solution before such a flight could be attempted were: the selection from a number of possibilities of its trajectories of flight in space and its descent back to Earth; the aerodynamics of the hypersonic rocket aircraft (space vehicle); the needs of its power plants, engines, and fuels; the heating (friction) and cooling of its structure during flight; the materials to be used on this aircraft; the need for research of the effects (such as weightlessness) a hypersonic rocket aircraft flight would have on living organisms in space; and research on the development of an internal environmental system aboard this type of aircraft. (Source: Office of Technical Services, U.S. Department of Commerce, Translation No. MCL-607/1+2, August 1, 1961)

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

Bondi, H., Cosmology. Published by Cambridge University Press, London and New York, 1961. Second edition. \$2.45 (paper edition). The book contains 182 pages and is reviewed by Thornton Page.

As if to eliminate the old idea that cosmology is a disconnected collection of idle speculations that cannot be related to observed facts, Bondi has presented the subject in a carefully ordered and logical form. Indeed,

he makes a good case for the point of view that "cosmology is the most fundamental of the physical sciences, the proper starting point of all scientific considerations." The order that serves so well is: (1) a broad discussion of concepts and principles (assumptions or axioms); (2) a survey of the pertinent observational data; and (3) a more detailed description of theory and its consistency with observations.

Despite his systematic treatment, Bondi has avoided textbook style and has maintained a refreshing matter-of-fact objectivity. This is enhanced by--or perhaps necessitated by--the wide variety of cosmological theories covered: Newtonian cosmology, relativistic cosmology, kinematical relativity, steady-state theory, and (less thoroughly) the theories of Eddington, Dirac, and Jordan.

Most remarkable, perhaps, is the way in which Bondi avoids the domination of mathematics. At first glance the book seems quite unmathematical--mostly words and few equations. There are no lengthy mathematical derivations, and the conceptual basis of each equation cited is developed so clearly in the text that undergraduate physics majors can easily follow. However, in more than half the book--the portion dealing with specific theories--the level of sophistication is high. In order to comprehend fully, the reader must understand terms such as "symmetrical tensor," "Euler's equation," "Laplace's equation," "Poisson's equation," etc.

The forty-six pages devoted to observational data summarize the significant facts in concise and readable form. References appear to be reasonably complete up to 1958, and the picture of the universe given is the one generally agreed upon by astronomers today. It is typical of Bondi's approach that he first considers the significance of the obvious observational fact that the night sky is mostly dark. If stellar light sources at rest had been distributed uniformly to infinity throughout clear Euclidean space for a long time, the sky could not be dark; the fact that it is implies some deviation from these idealized conditions. In much the same way the more complex observations of galaxies, their forms, distribution and motions are presented, together with their further implications.

In bringing together fact and theory so provocatively, in its coverage of several theories, and in its conceptual clarity, Bondi's Cosmology is a unique contribution that should stimulate study and research for many years. (Source: American Journal of Physics, July 1962)

Gorlich, H. C. P. and G. Szigeti (eds), Solid State Physics. Published by Akademie Verlag, Berlin, 1961, 432 pages with 365 illustrations and 18 tables. Price: Bound DM 92. Reviewed by Georg Schmeier.

This book contains 65 lectures, held at the Conference of the Eötvös Lóránd Fizikai Tarsulat in conjunction with the Physical Society of the GDR in Balatonfüred from the 14th-20 September, 1959. Thus a further volume of conference reports of the Physical Society has been published, with the purpose of making the material discussed at the Conferences accessible to a wider circle of people.

The book has been written by outstanding specialists and gives an excellent survey of the position and physical problems of solid state physics. The predominating part of the lectures is in German, while only a few lectures are in English, Russian or French.

The lectures have been divided into suitable groups of subjects: structure, crystallization, order processes, surface conditions, impurities, purification, optical and photoelectric investigations, noise effects, luminescence phenomena, thermal properties, electrical conductivity, catalysis, magnetic and ferroelectric properties.

Discussions included are electrical phenomena in CdS, Indium sulphide, germanium and selenium, catalytic properties of magnesium oxide, as well as the magnetic susceptibility of semi-conductors.

The range of lectures therefore covers a very varied program, and the book may be an excellent means of information on the stage of development work. Whoever wishes or has to acquaint himself more thoroughly with solid state physics will be able to learn much from these contributions by leading experts. Careful editing and good technical production of the book are worthy of approval. (Source: Jena Review, December 1962)

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