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SOVIET BLOC INTERNATIONAL GEOPHYSICAL YEAR INFORMATION

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I. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Moscow Planetarium Scientist Discusses Planned Soviet Moon Rockets

In an interview granted the Moscow correspondent of the Copenhagen Communist daily Land og Folk and printed in that paper's 14 October issue, Dr Vitaliy Bronshten of the Moscow Planetarium made the following statements concerning Soviet plans for Moon rockets.

Soviet science has at its disposal rockets of sufficient power to reach the Moon. Soviet specialists are working energetically on a Moon rocket which they expect to fire in the near future. It will be of about the same size as Sputnik II, i.e., about one half ton.

Two variations of the rocket have been prepared, one of them intended to land on the Moon, the other to orbit the Moon and return to the Earth. The calculations for the rocket's trajectory were made by Professor Yegorov.

According to Dr Bronshten, as quoted in Land og Folk, the Soviet rockets will be equipped with instruments for determining the Moon's mass and conductivity of heat and electricity; with apparatus for investigating the Moon's surface and discovering possible landing places for man-carrying space vehicles; with instruments for determining whether the Moon has a magnetic field similar to those of the Earth and Sun; and with television apparatus for viewing the far side of the Moon. (Excerpt from "Conversation With Soviet Expert on America's Moon Rocket," by Erley Olsen; Copenhagen, Land og Folk, 14 Oct 58)

Soviet Rocket Research in the IGY

The study of the upper layers of the atmosphere is a principal part of the program of the International Geophysical Year. Investigations are conducted with the aid of various apparatus, from simple thermometers to complex electronic telemetering and radar devices. For raising instruments to great altitudes, the usual pilot balloons, automatic aerostats, airplanes, helicopters, rockets, and artificial Earth satellites are used.

Extensive information was obtained with the Soviet satellites, which is of great interest to science.

The atmosphere at altitudes of 30 kilometers and over is studied with the aid of rockets. Rockets as well as satellites make it possible to investigate the ultraviolet and X-rays of the Sun and the stars, radio waves coming from cosmic space, electric currents in the ionosphere, the Earth's magnetic field, micrometeorites, etc.

The brevity of rocket flights prevents their use for synoptic experiments and protracted observations. However, the data obtained with the aid of rockets makes it possible to establish the relation between phenomena and conditions at high and low altitudes.

A meteorological rocket designed for investigations of the upper layers of the atmosphere must be stable and oriented in a fixed direction. This is achieved with tail surfaces and launching from a launching tower.

An important condition for the operation of the rocket's instruments is the cleanliness of the air around the rocket. The contamination of the air by exhaust gases, smoke and other gaseous discharges can distort the results of observations. The instrument compartment is hermetically sealed while the motor is operating to avoid this. The results of measurements are transmitted to Earth by radio; tapes with recordings of air samples and experimental animals are lowered by parachute.

The most diverse instruments are installed in the rockets. For measuring air pressure, sensitive ionization manometers -- alphatrons, and also aneroid barometers are used. According to data obtained measurements of air pressure at the top and on the lateral side of the nose cone, the velocity of the rocket and the pressure of the surrounding air is calculated. According to the Mach number and the velocity of the rocket, determined from the Earth, the temperature is then calculated, since its direct measurement is impossible (the heating of the rocket casing will affect the thermometer reading).

The air temperature and wind speed in the upper layers can be found from the speed of the sound of explosions from charges ejected by the rocket at specific altitudes. The rocket is equipped with powder charges and a radar beacon for this purpose. The sound is perceived by ground stations located 2-3 kilometers from each other.

The density of the air is determined by measuring the resistance of the medium according to the acceleration of the falling sphere. The composition of the atmosphere is studied by means of air samples or by a mass-spectrometer equipped with telemetry transmitters. Such a method makes it possible to make many analyses during one rocket flight.

Photographing of the solar spectrum is done with spectroscopes or photon counters. The frequency of collisions with micrometeorites is determined by sensitive microphones mounted on the rocket's casing. The electron density is studied by the measurement of radiowaves reflected from corresponding layers of the ionosphere.

The conduct of the investigations requires a large number of rockets. Rockets using solid fuels are most suitable. They can be successfully launched in the most remote regions, are inexpensive, and simple to service, transport, and store. To these advantages of solid fuel rockets may be added, also, the possibility of launching them from aerostats or airplanes. In this case, it is not necessary to construct complex launching devices. The rocket can be raised by the aerostat to an altitude of 20-25 kilometers and because it does not have to overcome the great dynamic resistances of the lower layers of the atmosphere, it reaches altitudes of 80-100 kilometers. Launched from the Earth, this same rocket would only attain an altitude of 25-30 kilometers.

Aerostats with a polyethylene bag are used for launching. The rocket is suspended below the balloon by a 30-meter-long cable. At an altitude of 25 kilometers, the launching mechanism is switched on either by a barometric device or by radio command.

Rockets are also launched from airplanes -- mainly single-seaters. The plane, at an altitude of about 10 kilometers, goes into a vertical climb and by means of a device for starting the rocket motors, launches the rocket. Beginning from 10 kilometers, each succeeding kilometer of launching altitude increases the flight altitude of a rocket with a payload of 18 kilograms by 7 kilometers. It is maintained that by such a method an altitude of 160 kilometers can be achieved. For investigating the atmosphere over 100 kilometers, single-stage liquid-fuel rockets or multistage solid fuel rockets are used at present.

Soviet scientists, with the aid of rockets, refined data on the density of the ionosphere and revealed its diurnal variations. It was discovered that ions at great altitudes are made of individual atoms. Full dissociation, i.e., the separation of molecules into individual atoms was observed there. It was established that the large majority of meteors move around the Sun in the same direction as does the Earth, and overtake our planet. These results, in the opinion of scientists, will be of very great value in estimating the effect of meteoric particles on the movements of future interplanetary ships.

One of the most important branches of investigation is in the disclosure of the nature of cosmic radiation. These experiments were begun in the USSR in 1947. The study of cosmic rays makes it possible to compile charts of their distribution over the Earth and thereby to investigate the Earth's magnetic field. Scientists established that at a latitude of about 60 degrees in the northern hemisphere, the increased intensity of primary cosmic rays is sometimes observed. It lasts for many years. This indicates the presence of stationary flows of electrons at high altitudes.

Instruments borne by rockets give many interesting readings, in particular, on the change in the number of photons with time corresponding to flares on the Sun and concerning its corpuscular flows. The particles registered are electrons with an energy of about 10,000 electron-volts. Such electrons cannot enter into the composition of the Sun's primary corpuscular radiation, because their velocity is much too large in comparison with hydrogen particles observed in the auroras.

Investigations of the stratosphere and the ionosphere makes it possible to reveal the periodicity of annual temperature changes. It was established that beginning from 20-25 kilometers and up to altitudes of 50-60 kilometers, a tendency toward an increase in temperature was noted which was especially sharp in the summer time. For example at an altitude of 50 kilometers, the mean winter temperature consists of -50 degrees Centigrade, and in summer, +25 degrees Centigrade.

Two photographs accompany the article. One captioned, "The Launching of Meteorological Rockets at a Soviet Polar Station," shows a rocket being launched from an enclosed launching tower. The other captioned, "Polar Workers Examine the Nose Cone of a Rocket Which Was Lowered by Parachute," shows two heavily clothed men (one with a rifle slung on his back) bending over a rocket nose cone which appears to have just been landed by parachute. ("Rockets Study the Ionosphere," by Engr-Lt Col N. Loginov, Candidate of Technical Sciences; Moscow, Sovetskaya Aviatsiya, 24 Sep 58)

II. UPPER ATMOSPHERE

First Ozonometric Observations During IGY, at Alma-Ata Reported

The following is a complete translation of an article entitled "First Results of Ozonometric Observations During the IGY," by Sh. A. Bezverkhniy and P. M. Broytman, which appeared in a Soviet scientific periodical.

In July of 1957, the ozonometric station of the Alma-Ata Hydrological Observatory began observations according to the IGY program. Measurements were made with the aid of the new automatic ozonograph OFET-3, the design of which was developed by the Physics Institute of Leningrad State University (LGU) together with the Kazakh Scientific Research Hydrometeorological Institute. A detailed description of the instrument and its characteristics appeared in Fotoelektricheskiy Trekhkanal'nyy Ozonograf OFET-3, (Photoelectric Three-Channel Ozonograph OFET-3,) by Sh. A. Bezverkhniy, A. L. Osherovich, and S. F. Rodionov, Izd. LGU, Leningrad, 1957, and in an article in Vestnik LGU, Seriya Fiziki i Khimii, 1958, (in printing) by the same authors.

A comparison of the readings of the OFET-3 No 9 and the Dobson spectrophotometer, to which all network ozonographs of the USSR are "tied-in," is shown in Figure 1, where along the y axis the "masses" of ozone are laid out in the direction of the Sun (μ) and along the x-axis the magnitude of the reduced thickness of the ozone (x) is given. The results of the comparison, obtained in the Main Geophysical Observatory, are reduced to the empirical formula

$$x = \frac{S_0 - S}{1.12\mu} \qquad (1)$$

for calculating the general content of atmospheric ozone. Here $S = \log \frac{I_{\lambda_1}}{I_{\lambda_2}}$, where I_{λ_1} and I_{λ_2} are the intensities of solar radiation measured by the instrument in spectral parts with maximums having wave lengths λ_1 and λ_2 respectively; S_0 is the value of S beyond the limits of the Earth's atmosphere. The value of the coefficient 1.12 takes into account the constant terms of the formula of the calculation and the "reduction" of results to the readings of the Dobson instrument.

The results of measurements in Alma-Ata during the first 9 months of the IGY are presented in Figure 2. Approximately 42,000 points were obtained during this time on the tape of the EPP-09 (output unit of the OFET-3) electron potentiometer which automatically recorded the intensity of radiation on three independent channels every 10 seconds. According to these, 352 hourly values of the reduced thickness of ozone were calculated. Each point in Figure 2 is the mean value of a large number (not less than 100) of observation points.

(Figure 2 caption: Variation of the thickness of ozone during the first 6 months of the IGY. Alma-Ata: 43°15' N, 76°56' E; 850 meters above sea level).

At present, extensive material of observations has been obtained. After detailed processing of the material, the possibility will be presented of considering, in particular, problems of the structure with time of the ozone content, not only on an annual scale but also by the hour and day. However, the results already obtained show a well-expressed annual variation of the thickness of ozone, although there also is a significant scattering of x values arising because of the accuracy in measurements. Detailed information on the fields of temperature, pressure, and wind up to altitudes of 30 kilometers was obtained simultaneously with ozonometric data of repeated radiosonde measurements of the atmosphere. Results of measurements of ozone thicknesses are sufficient for the calculation of the vertical distribution of ozone by V. A. Ambartsumyan's method. Other important data for the solution of problems on ozone (solar activity, the structure, temperature and pressure of the upper atmosphere, the intensity of the Sun's ultraviolet radiation) are determined during the IGY with the aid of rockets, artificial Earth satellites and other observations. Such a valuable complex of data creates favorable possibilities for the analysis of the physical connection of the dynamics of ozone with the overall circulation of the atmosphere for concrete thermobaric conditions and for extensive theoretical investigations of the mechanics of the formation of ozone and changes in its thickness.

Measurements conducted during the IGY at our station make it possible to obtain with high accuracy the intensity of the Sun's ultraviolet radiation in absolute units in three parts of the spectrum, including also the biologically active spectral region. The mean monthly values of ultraviolet radiation obtained on clear days or with a small amount of clouds in the northern part of the sky (principally after midday) are presented in the table.

Mean Monthly Intensity of Direct Ultraviolet Radiation on a Perpendicular Surface in the 295:330 millimicron Region of the Spectrum
(10^{-4} Cal/Cm^2Min)

Year	Month	Sun's Height in Degrees 10	15	20	30	40	50	60	No of Days of Observations	Mean Visibility (V in km) and Cloudiness
1957	VIII	0.85	2.14	3.56	10.62	18.39	23.58	29.60	3	V 12 Cl %, -1/0 Ci
	IX	0.82	2.23	4.69	10.85	18.29	27.10		18	V 15-35 Cl % -3/OCi
	X	0.68	1.97	4.88	12.10	19.36			12	V 15-50 Cl % -1/0 Ci
	XI	0.68	1.89	4.11	12.74				6	V 15-20 Cl %
	XII	0.37	1.97	2.83					7	B 7-10 Cl % -3/0 Haze
1958	I	1.31	2.04	4.50					2	V 15 Cl %
	II		1.46	4.97	9.88				7	V 10-20 Cl %
	III		1.97	4.86	9.57	20.26			4	V 10-15 Cl %

The intensity of radiation in the 295-330 millimicron region undergoes significant fluctuations in relation to the transparency of the atmosphere not only in the yearly variation but also diurnally. Intensity values of ultraviolet radiation for low altitudes of the Sun especially differ, while lower values are observed principally after midday. This is obviously connected with the well-expressed mountain-valley circulation which, in the Alma-Ata region, smoothly decreases the transparency of the atmosphere during the day.

Final processing of the results of the measurements of the Sun's ultraviolet radiation shows that for the correct determination of x values, it is necessary to improve the accuracy of the formulas used in the calculations. For example, the content of ozone calculated according to formula (1) needs at least two corrections.

In the first place, the difference in the amount of Rayleigh scattering arising from a comparison of the coefficient of scattering at the moment of measurement and of the calculated moment in (1) should be taken into account. This correction can be introduced using the value of atmospheric pressure at the level of the instrument. It is a value of the order of 10^{-3} centimeters of the reduced layer of ozone.

The second correction is connected with the introduction, from the beginning of the IGY, of new values for the coefficient of absorption of ozone α, obtained by E. Vigroux [Ann. Phys., 8, 709, 1953] instead of the well-established tables of Nu and Chung [Nu Tse-se and Chung Hsin-piao, Chin. J. Phys., 1, 38, 1933]. Vigroux succeeded in obtaining a detailed structure for the curve $\alpha = f(\lambda)$ in the region where the Shafer band is superimposed on the Hartley band. Owing to this, and also in connection with the use of comparatively wide spectral bands (~100 - 200 Å) in the ozonograph, the selection of a singular coefficient K for the transition from the old values of α to the new becomes difficult. During the recalculation of ozonometric data for the coefficient of α according to Vigroux we used K= 1.33, which is not a strict method if we take into account the dependence of the value α on the temperature. The difficulty is the correct calculation of this dependence and the selection of the temperature itself. We note also that the coefficients of α, obtained in the laboratory are not always identical with the values of absorption in the atmosphere. The temperature layer of the ozone differing, generally speaking, from the temperature of the stratosphere depends, besides other reasons, on the concentration of gas. It was shown [Atmosfernyy ozon Atmospheric Ozone), by I. A. Prokof'yev, Izd. AN SSSR, M.-L., 1951] that in the middle latitudes the temperature of ozone fluctuated in the limits -25 to -50°. At the same time, the yearly variation of stratospheric temperatures in the region of maximum ozone concentration (20-30 kilometers) and at altitudes (12-18 kilometers), which it seems are responsible for nonperiodic variations of the thickness of O_3 [I. A. Khvostikov, UFN, No 2, p 51, June 1956], is such that in summer it varies from -65° at an altitude of 13-15 kilometers to

-40° at an altitude of 30 kilometers, and in winter in the 15-30 kilometer layer, temperatures are approximately identical (about -55°) [R. J. Murgatroyd, Quar. J. Roy. Met. Soc., 1957, 83, 358,417]. The incorrect choice of the value α, all other conditions being equal, leads to an error of $\sim 10^{-3}$ in the temperature interval -40 to -60° and 10^{-2} centimeters of ozone thickness in the limits $+$ 18 to -60° Centigrade (The Nu and Chung tables were compiled for $t = 18^{\circ}$C. They are usually used in calculation for x. Reduced estimates of error are given for values of α during temperature extremes accepted by Vigroux in comparison with calculations using α with $t = 18^{\circ}$.). Recent measurements in the Federal Republic of Germany indicate [H. K. Paetzold and Z. Schorner. Meteorol. Rundschau, 8, No 5-6, 1955, p 92] that the mean temperature of the ozone layer is closest of all to the temperature of the air at an altitude of 30 kilometers. It was established that the error in the calculation of x during the final processing of IGY materials could be considerably reduced if values of α, corresponding to the negative temperature -44°, used by Vigroux, were employed.

The second correction relates to any ozonometric formula. The final processing of observations is necessary in the substitution of formula (1), which satisfactorily presents the variation of the thickness of ozone with time, but not its absolute value, in the correct expression. In calculating x according to given measurements of OFET-3, a formula should be selected which would retain the calculation of Rayleigh scattering. It is expedient therefore to use the expression

$$x = A_1 \frac{S_o - S - (\beta_1 - \beta_2)m}{(\alpha_1 - \alpha_2)\mu} \qquad (2)$$

in the case of using only the first two channels of OFET-3 or for not too great zenith distances of the Sun---

$$x = A_2 \frac{S_o - S + K(L_o - L)}{\mu\,[\alpha_1(k-1) - \alpha_2]} \qquad (3)$$

in the operation of the instrument in three parts of the spectrum. A_1 and A_2, are the experimentally determined coefficients of the "tied-in" results of OFET-3 measurements to the readings of the processioned ozonometric instrument,

$$L = \log I_{\lambda 2}/I_{\lambda 3}, \quad L_o = \log I_{\lambda 2}/I_{\lambda 3} \text{ with } \mu = 0.$$

According to Vigroux [Ann. Phys., 8, 709, 1953] for the second spectral part of OFET-3 $\alpha \neq 0$.

One of the advantages of formula (3) is that in using it, it is not necessary to calculate changes of Rayleigh scattering between measurements.

Molecular scattering of light is considered constant for a given instrument with a value of

$$K = \frac{(n_{\lambda 1}-1)^2 \lambda_1^{-4} - (n_{\lambda 2}-1)^2 \lambda_2^{-4}}{(n_{\lambda 2}-1)^2 \lambda_2^{-4} - (n_{\lambda 3}-1) \lambda_3^{-4}}$$

where n is the index of refraction of air for wave lengths of λ_1, λ_2, and λ_3, corresponding to 1, 2 and 3 maximums of the effective spectral bands of the instrument. For the Alma-Ata ozonograph, K = 1.783.

The correct processing of materials of the ozonometric network, the efficient use of the complex of observations characterizing this or any processes with a thickness of up to 100 kilometers and beyond the limits of the atmosphere, makes the all-around study of the ozone problem possible for the first time. One of the principal tasks of the IGY consists in the use of the great store of various observations to study the role of ozone in the physics of the atmosphere and to proceed from a comparison of correlation data to the construction of a strict and comprehensive theory of the ozonosphere." ("First Results of Ozonometric Observations During the IGY," by Sh. A. Bezverkhniy and P. M. Broytman; Vestnik Akademii Nauk Kazakhoy SSR, No 8, Aug 58, pp 27-31).

Fesenkov Discusses the Nature of Zodiacal Light

The Committee for the Conduct of the IGY under the Academy of Sciences USSR selected a location near Aswan, Egypt, as the most desirable place for the study of Zodiacal light. Here extraneous influences are much weaker or even fully equalized with the perpendicular position of Zodiacal light in relation to the horizon at a certain time of the year. The expedition was organized by the Astrophysics Institute of the Academy of Sciences Kazakh SSR. Having prepared original scientific equipment, the expedition left for Egypt on 21 September 1957. One of the expedition's parties conducted observations of Zodiacal light at night, the other studied the optical properties of the terrestrial atmosphere by day. An idea of these properties is necessary in the processing of zodiacal observations.

The observations were conducted with little interruption almost up to the end of November 1957. An enormous quantity of material of a diverse nature was collected. Detailed observations on conditions in Egypt were conducted for the first time, not only on Zodiacal light but also, in general on atmospheric optics. The expedition succeeded in establishing close ties with Egyptian astronomical circles. Two Egyptian scientific workers took part in the work. In addition, the Helwan observatory near Cairo undertook to continue the expedition's investigations after its departure using the electrophotometer left behind.

While the observations conducted in Egypt have not been fully processed, certain conclusions relative to the nature of Zodiacal light are made.

Zodiacal light, in all its details, is caused by the scattering of sunlight by fine cosmic dust occurring as a result of the continuous disintegration of asteroids and meteorites concentrated mainly between the orbits of Mars and Jupiter. The finest dust particles, with a diameter of less than one micron, resulting from similar disintegration, are at once swept out from the limits of the solar system as a result of light pressure exceeding the force of solar attraction in the given case. Larger particles are gradually braked by radiation pressure and settle on the Sun. It was thus theoretically established that the density of matter of Zodiacal light in steady-state conditions changes inversely to the distance from the Sun, and the deviation of the orbit of individual particles from the plane of the ecliptic is determined by the inclination of the orbit of asteroids.

The phenomenon of Zodiacal light directly indicates the presence of planetary, and in particular, asteroidal matter around the Sun. It is known that similar dust envelopes exist around various bright stars. These are the so-called diffuse nebulae which possibly have a similar origin.

To make appropriate calculations relative to the distribution of brightness in different points of Zodiacal light it is necessary to know beforehand, how light is scattered by its individual particles. Inasmuch as these particles, with which the studies are concerned, are just meteors constantly penetrating the Earth's atmosphere and gradually settling to the ground the same law of scattering of light which is characteristic for aerosols in sufficiently high atmospheric layers was taken in the nature of a first approximation for these meteoric particles. This law of scattering was well derived from observations of the daylight sky in the Sun's almucantar during the pre-evening hours when the atmosphere is already changing into a twilight state and the effective layer, responsible for the distribution of brightness in the day sky has already separated from the Earth's surface and is raised sufficiently high.

Under conditions of the Libyan desert, where, for years there has been no rainfall, it is possible to completely disregard the possible presence of liquid aerosols and to consider that dry aerosols, separated from the overall effect of atmospheric scattering of light, represent hypothetical meteoric particles in interplanetary space sufficiently well. Having obtained, in this manner, an expression for functions of the scattering of light it was possible to derive general formulas characterizing the outward appearance of Zodiacal light and its system of isophots resulting from the known distribution of the angles of inclination of asteroids in relation to the ecliptic. Similar, unwieldy calculations were conducted by members of the expedition with the aid of the Laboratory of Machine Mathematics, Academy of Sciences Kazakh SSR. Thus it was found that the obtained isophots correspond fairly well to the forms of Zodiacal light as were observed by the expedition under conditions in Egypt, normally toward the horizon when this phenomenon reached its greatest brightness.

It was now possible to carry out a controlled test, comparing the observed brightness of Zodiacal light with the known density of meteoric matter in interplanetary space. Actually through direct observations the number of meteors which strike the Earth daily, and their distribution according to size or according to mass down to the smallest still possible in the solar system are known. Hence, it is possible to deduce that the density of meteoric matter in the solar system, in the space from the Earth to the Sun, must be approximately $5 \cdot 10^{-24}$ gr/cm^3. If it is assumed that meteoric particles completely scatter sunlight, then a value of 10^{-24} gr/cm^3 is obtained as the lower limit of the density of the matter of Zodiacal light.

Calculations were conducted for three different functions of the scattering of light -- spherical, typical atmospheric and aerosol scattering. In all of these cases the form of Zodiacal light remained similar, and only with an increase of the asymmetry of the function of scattering a change in its brightness with the angular distance from the Sun was increased in a certain degree.

The polarization of light can also be explained on the basis of the dust theory of the nature of Zodiacal light calculations agreed with that of other authors by 20-25 percent. Up to now, there was insufficient basis to consider that dust matter could produce any substantial polarization and an explanation of it would have to include the particular presence of free electrons, which at an angle of 90 degrees produces full polarization of light. Necessary data in this connection was obtained as a result of observations on the degree of polarization of the day sky in the Sun's almucantar at the most divergent angular distances from it which were conducted by Ye. V. Pyaskovskaya-Fesenkova and her associates in the Libyan desert.

The color of Zodiacal light which differs very little from sunlight, can also be explained by the kypothesis concerning the dust composition of its particles with a diameter of more than one micron. The smallest particles selectively scattering the Sun's rays must be swept from the limits of the solar system by the action of light pressure and even particles of an order of several microns are very quickly slowed by radiation and corpuscular braking and fall onto the Sun. Therefore, the observed scattering of light must have an almost neutral character, as this was also observed. Thus, it is possible to consider that all the observed pecularities of Zodiacal light, its outward form, its location in relation to the ecliptic, the observed absolute brightness, the degree of polarization, and its color, can be deduced purely theoretically with good agreement with the actual in the hypothesis of its origin from an asteroidal ring by means of the continuous disintegration of asteroids and meteors..

The other viewpoint on the nature of zodiacal light, which is supported by many, ascribes a considerable role to free electrons. It can be accepted that gas in interplanetary space must be almost wholly ionized and consist of a mixture of ions and electrons. The latter are distinguished by a very great scattering capability, regardless of the wave length, and strongly polarize light as according to Rayleigh's law.

The main basis for assuming that large mixtures of free electrons are present in zodiacal light is that without free electrons it would be impossible to explain polarization in zodiacal light.

The other basis is the presence of [radio] whistlers, as though indicating a considerable condensation of free electrons along the lines of force of the Earth's magnetic field, far distant from the sphere of the Earth and actually passing in interplanetary space.

Instead of this, the ionized corpuscles ejected by the Sun, as well as the free electrons connected with them, must be oriented in relation to the plane of the solar equator and not to the plane of the ecliptic, as is the case with zodiacal light. Consequently the distribution in space of scattering electrons must be altogether different from that found for particles of zodiacal light. Besides, corpuscular radiation of the Sun is not uniform as is seen in the aurorae. Consequently, it would be possible to expect fluctuations in the brightness of zodiacal light, especially in the periods of sharp eruptions on the Sun and during intensive aurorae. However there are no proved indications with regard to fluctuations of the brightness of zodiacal light and its connection with the aurorae. Thus, although there undoubtedly are ionnixed gases and, consequently free electrons in interplanetary space, their role in the phenomenon of zodiacal light is obviously completely insignificant.

In conclusion, it is definitely stated that the interplanetary medium through which the interaction between the Sun and the Earth occurs, consists mainly of dust particles and only in an insignificant measure of gas components. ("The Nature of Zodiacal Light," by V. G. Fesenkov; Vestnik Akademii Nauk Kazakhskoy SSR, No 8, Aug 58, pp 3-9)

III. OCEANOGRAPHY

First Soviet Hydrostat Under Construction

The design of the first Soviet watertight apparatus made of light steel -- a hydrostat for underwater sea observations at depths of up to 600 meters -- has been developed by a collective of engineers of the Leningrad Design Institute of the State Institute for Design and Planning of the Fishing Fleet, under the supervision of P. I. Seryuk, chief designer. Working drawings have already been completed and the manufacture of parts has already begun in the shops of the Baltic Shipbuilding Plant imeni Ordzhonikidze.

The new original apparatus weighs about 2 1/2 tons. Its illuminators are made of especially strong glass, and it is equipped with a powerful deepwater searchlight capable of withstanding great water pressure, and a flashlamp for photographing. With such a hydrostat it will be possible to study the features and color of the ground, the camoflauge colors of submarine animals and many other animals. The utilization of this apparatus will also be of aid to the fishing industry organizations in studying the behavior and movements of schools of fish, in observing trawl structures in underwater conditions, etc.

It is proposed to lower the hydrostat from a research ship at sea by means of steel cables. Constant telephone communication will be maintained with the ship during operations. In case of need, the craft can surface itself. ("Hydrostat for Underwater Sea Observations;" Moscow, Promyshlenno-Ekonomicheskaya Gazeta, 19 Sep 58)

Equation Obtained for Motion of Wave "Front" Across Ocean

In an article entitled "The Exact Solution of the Field Equation for Wind Waves on the Ocean and Its Physical Meaning," Academician V. V. Shuleykin observed that recent development of the theory of quasilinear equations makes it now possible to give an exact solution to the equation for ocean waves

$$\partial \eta / \partial \tau = 1 - \eta - \eta^{1/2} \cdot \partial \eta / \partial \xi \, .$$

In the above equation η is the height of the waves, τ is the time, and ξ is the distance from the windward shore or the windward boundary of a storm zone on the ocean, all dimensionless quantities.

It is shown that the exact solutions obtained earlier to two problems are an exact solution of the wave equation. These problems are (a) the distribution of the heights of steady waves at various distances from the windward shore and (b) the increase in wave height η after a time τ of wind action at great distances from the windward shore. These two solutions are given as

$$\text{(a)} \quad \xi = 2 \tanh^{-1} \eta^{1/2} - 2 \eta^{2/2}$$

$$\text{(b)} \quad \eta = 1 - e^{-\tau}.$$

The author shows that in the ξ, τ-plane there must exist a line of separation ξ (τ), on one side of which case (a) holds and on the other side, case (b). The differential equation for this line is given as

$$\frac{d\xi}{d\tau} = \frac{2}{3} \frac{\eta(\tau)^{2/3} - \eta(\xi)^{2/3}}{\eta(\tau) - \eta(\xi)}.$$

On the basis of physical considerations, it is noted that this line of separation begins to move over the surface of the ocean from the windward shore. The physical changes in this "front" are used to construct the curve ξ (τ). It was found to coincide with the curve obtained by numerical integration.

A graph of the surface η (ξ, τ) is constructed, representing geometrically the exact integral of the wave equation. The physical significance of this surface is discussed. The graph indicates that the region of steady wave formation will be at a greater distance from the bank, the longer is the duration of wind action.

The actual velocity of the front is then determined after assigning measurable quantities for the dimensionless quantities. It is found that

$$dx/dt \quad 0.625 \ c,$$

where $c = f_\infty V$, V is the wind velocity, and f_∞ is the quotient of the phase velocity of the largest waves possible for a given wind velocity divided by the wind velocity. The author notes that no particular significance should be attached to the factor 0.625 and explains why it differs from 1/2. The conclusion is then drawn that the velocity of the "front" is equal to the group velocity of the waves and that the "shore effect," the action of the windward shore on the wave development, advances toward the ocean with this same group velocity. ("The Exact Solution of the Field Equation for Wind Waves on the Ocean and Its Physical Meaning," by Academician V. V. Shuleykin, Moscow State University imeni M. V. Lomonosov; Moscow, Doklady Akademii Nauk SSSR, Vol 121, No 6, 21 Aug 58, pp 1005-1008)

IV. ARCTIC AND ANTARCTIC

Artic Workers Supplied by Kooperatsiya

The Soviet ship Kooperatsiya arrived in Vladivostok after a through passage of the Northern Sea Route. The ship delivered supplies to the Arctic workers on Dikson Island and at Tiksi. ("From Every Corner of the Country"; Moscow, Pravda, 12 Oct 58)

Physicogeographical Characteristics of the Antarctic Region Explored by Soviet Expedition in 1955-1957 [Conclusion]

The area of operations of the Soviet Expedition, as well as all of Antarctica, is characterized by the sharp contrast between survival conditions for organisms on the continent and in the coastal waters. Almost all the antarctic continent represents an ice-covered desert, where permafrost prevails, where there is no water in liquid form, and life is practically impossible. On the other hand, the waters surrounding the continent have rather favorable conditions for the development of organisms. The temperature of the sea water is almost constant and does not go below minus 2 degrees centigrade in winter, and in the summer it rises to 0 degrees centigrade, or slightly higher, in the surface layers, which makes it possible for an enormous quantity of marine organisms to exist. In addition, the extensive connection of the coastal waters with the world ocean promotes migration of a number of organisms from lower latitudes.

Between these two entirely different regions is a coastal belt, characterized by transitional conditions. In this zone life on the mainland is possible. However, it is to a certain degree closely connected with the sea and does not penetrate into the interior of the continent.

To gain a better understanding of the survival conditions for organisms, a comparison with arctic regions is given below.

The coast of East Antarctica is located near the polar circle, and its climate is more severe than that of the highest latitudes on the arctic land. The most frigid regions of the Arctic, near the Arctic Circle (south coast of Greenland, Baffin Land, and the Chukot Peninsula), have a temperature of about 5 degrees centigrade during the warmest month. In several regions of the Northern Hemisphere near the Arctic Circle (Igarka, Zhigansk, Medvezh'ye Ozero) the temperature reaches 15 degrees centigrade. However, in the area of operations of the Antarctic Expedition the temperature of the warmest month is below 0 degrees centigrade, and only in the "oases," which cover small areas, is the temperature above the freezing point. Even the most frigid regions of the arctic land (Peary Land, Franz Josef Land, and Severnaya Zemlya), which are between 80 and 83 degrees northern latitude, i.e., 10-15 degrees nearer to the pole than the antarctic regions explored by the Soviet Expedition, have a temperature above 0 degrees centigrade during the warmest month.

Therefore, judging by the summer temperatures, which in the end determine the abundance of vegetation in polar regions, the coast of East Antarctica has a more frigid climate than the highest latitudes on land areas of the Northern Hemisphere. If we add to this the short duration of the vegetation period, and the strong winds and extreme dryness of the air (the relative humidity is up to 10-15 percent), as well as the almost complete lack of snow cover in winter, it will be evident that any plants growing on the rocks projecting from the ice must have exceptional adaptability and endurance.

The remoteness of Antarctica from other continents is also unfavorable to the development of organic life. If any parts of the land surface become free of ice, they may receive germs of life only from thousands of kilometers away, from countries with a much warmer climate, where neither plants nor animals would be adaptable to the severe climate of Antarctica.

The only "bridge" which would enable organisms to travel overland would be the chain of islands from South America to Graham Land, but this region is situated several thousand kilometers from the area of operation of the Soviet Expedition and is separated from it by vast expanses of ice.

There is less difference with regard to conditions of life in the sea [i.e., between the Arctic and Antarctic]. However, as a rule, during the summer the sea in the corresponding latitudes of the Arctic is free of ice and the temperature of surface water reaches 5 or even 10 degrees centigrade, whereas in the Antarctic some ice near the coast remains all through the summer, even though in small quantities, and the water temperature is close to 0 degrees centigrade.

The vegetation is exceptionally poor. At first glance, the brown surface of the "oases" and nunataks is completely devoid of any vegetation. On looking closer, one distinguishes black and gray patches of lichens on the rocks, and occasional green turf patches of moss in some of the damper places. No flowering plants of any kind were discovered in the area of operation of the expedition.

In the corresponding latitudes of the Northern Hemisphere there are dense forests, such as around Igarka and Zhigansk, and large shrubs grow in the more frigid regions, such as Greenland. Even at the extreme points of northern land areas, for example on Zemlya Frantsa Iosifa [Franz Josef Land] and Severnaya Zemlya, there are about 40-50 different kinds of flowering plants, while mosses and lichens are fairly well developed.

In the area of the Soviet Antarctic Expedition, only about 20 kinds of lichens and about 10 kinds of mosses were discovered. In addition, there are nonaquatic and fresh-water algae. The basic types of lichens are epilithic, growing in the form of patches on rocks. There are several types of crustlike lichens, 2-3 types of thallophytic lichens, such as Gyrophora, and some bunch lichens, such as Neuropogon (especially, Neuropogon antarcticum), which form little "bushes" up to 5 centimeters high, of black or yellowish color.

In some places, epilithic black and gray lichens cover the rocks with an almost continuous crust. However, these are only small areas. Continuous carpets of thallophytic and bunch lichens cover similar areas; for example, the Greerson "oasis" small black bunches of Neuropogon grow in large patches on flat summits and terraces, covering areas with a diameter of 10-12 meters. The total area covered with plant life is not more than 1-2 percent, since vast portions of this region are almost completely without life.

Mosses, principally of the Trichostomaceae family, and of the Bryum and Grimmia varieties, are found in small patches only in damper places. On Haswell Island, patches of moss (Sarconeurum glaciale and Grimmia antarctica) reach 2-3 meters in diameter. They play an insignificant part in the general vegetation cover. The nonaquatic algae, the most common of which are the Stratonostoc commune and especially the green Prasiola crispa, are also of little significance; they grow in places where bird droppings have accumulated.

The algae in fresh-water ponds are of slightly more importance. The bottom of certain ponds is covered with an almost continuous, thick film of scum, which represents a colony of various plants, mainly algae of the Stratonostoc, Oscilatoriaceae, and Seitonema varieties, and bacteria. Sometimes mosses of the Mniaceae family also form part of the structure of these films. When the plant films die, they form a thick layer of black silt on the bottom of the ponds.

Survival conditions become more rigorous as one approaches the interior of the continent, and already at 80-100 kilometers from the coast only isolated small patches of lichens and nonaquatic algae are found on the nunataks, in crevasses between rocks. At a distance of 200 kilometers from the coast, on Mount Brown, no traces of vegetation whatsoever were found.

However, not only the decrease of heat has an adverse effect on vegetation. In the "oases," in the warmest areas located in valleys protected from the glacier winds, the vegetation is poorer than on individual small nunataks at the base of the Shackleton Ice Shelf, which are surrounded by ice. The air temperature of such areas of the "oases" rises above 10 degrees centigrade on warm, sunny days, and the temperature on the rock surfaces reaches 35 degrees centigrade. The ground in these places thaws out as deep as 50-60 centimeters, and sometimes even 100 centimeters. It would seem that the vegetation here should reach a maximum stage of development; however, it is just in these valleys that one can walk for tens of kilometers without seeing a single plant. Such an area, for example, is the "Valley of Death" in the Vestfold "oasis." The absence of vegetation in this place is caused by the extreme dryness of the air and soil. Humidity is so low that even the hardiest lichens cannot survive.

This scant vegetation on the land areas, naturally, cannot provide the necessary food for herbivorous land animals. The almost complete absence of such animals, of course, is also explained by the low summer temperatures. Only the most minute, almost microscopic rotifera and small crustaceans (Isopoda) were found among mosses, but even they were very rare.

In the fresh-water and salt-water ponds, there are very small numbers of cyclopses Acanthocuclops mirny, worms Nematoda, and crustaceans Cladocera, especially Daphnia Daphniopsis studeri, as well as other types of crustaceans Cyclopoida and Harpacticoida, and rotifera Philodina.

The vegetation of the sea is much more abundant. It was less studied by the Soviet expedition members. It may be noted only that the coastal waters are rich in phytoplankton. On the bottom of the sea are large brown, green, and red algae (Phyllogigas grandiolius, Enteromorpha gunniana, Rhodumenia antarctica, and others). The most developed algae are near the coast of Vestfold "oasis" and the Rauer Islands.

The relatively rich marine vegetation favors the development of marine animal life. Zooplankton develops in connection with the growth of phytoplankton; and the former provides food for larger marine animals.

At the bottom of the coastal sections of the sea and in the bays, one frequently finds echinoderms, including starfishes, brittle stars Ophionotus victoriae, echini Sterechinus antarcticus, and various mollusks. Various plankton crabs, mainly Euphausia superba, are the basic food of fish as well as of other larger marine animals, including whales and seals, and fish-eating birds.

The fish in the coastal waters have their own peculiar features. They differ from the fish of the Arctic not only with respect to their system, but also in their way of life. Almost all of them are benthonic and do not form large shoals, although they are encountered frequently. The most common are of the Tremotomus genus. These are small fish (those caught were not larger than 25 centimeters), living, as a rule, at depths of not more than 50 meters. The most frequently found type was Tremotomus bernacchii, and somewhat rarer was the Tremotomus hansoni. In addition to the Tremotomus genus, there were fish of the Gymnodraco genus, which are slightly larger. All these fish are edible; however, in view of the fact that they do not form large shoals and are small in size, they would not be significant for the fishing industry.

Whales, especially the small rorqual (Balaenoptera acutorostrata) and the killer whale (Orcinus orca), approach the coast only at the end of the summer, when the ice belt becomes scattered. These animals are encountered singly or in small groups and have no industrial significance in the littoral regions of the sea.

In the area explored by the expedition, seals were encountered all the year round. The Weddell seal (leptonychotes Weddelli) is the most common. These seals, as a rule, stay in small groups near the coast, coming out in the winter through holes which they make in the ice. This is a large animal, up to 290-300 centimeters long, with brightly spotted dark fur. They feed mainly on fish, but also eat crustaceans, cephalopods, holothurians, and other small animals.

During the antarctic spring, in the last 10 days of October, the first Weddell seal pups appear; the breeding period ends in the first 10 days of November. At first the gray, downy pups lie on the ice, and after molting, they go into the water.

The crab-eating seal (Lobodon carcinophagus) is somewhat lighter and smaller than the Weddell seal. Its fur is almost a solid gray color, sometimes with a yellowish tint, the back being darker than the belly. It feeds mainly on plankton crustaceans. This seal remains in the open water and among the drift ice. Therefore, it is hardly found in the winter near the coast, where the shore ice belt is wide (in the area of Mirnyy), but is encountered only in the summer, after the shore ice breaks up. Near the "oases" of Greerson and Vestfold, these seals are found in small numbers near the coast even in the winter, since in some places the belt of shore ice is almost absent.

A larger type of seal, the sea leopard (Hydrurga leptonyx), is rarely encountered even in the summer, and in the winter the sea leopard, as well as the crab-eating seal, travels to the drift ice and was found only once at the edge of the shore ice.

Two more types of seals are found near the shores of Antarctica, although very rarely: the elephant seal (Mirounga leonina) and the Ross seal (Ommatophoca rossi). The Ross seal is the smallest type found in these regions (170-180 centimeters long) and has a lighter color; it was observed in mid-November on the ice near the Mirnyy settlement.

No doubt, the most noticeable animals along the coast are the birds, which form numerous colonies in the shore cliffs. There are eight types of nesting birds, including five types of storm-petrels, i.e., the silver-gray petrel (Fulmarus glacialoides), snowy petrel (Pagodroma nivea), antarctic petrel (Thalassoica antarctica), cape pigeon (Daption capensis), and Wilson's petrel (Oceanites oceanicus); one type of jaeger (Stercorarius scua); and two types of penguins, the Adelie penguin (Pigoscelis adeliae) and the king-penguin (Aptenodites forsteri). Single specimens of the giant storm-petrel (Macronectes giganteus), the Dominican gull (Larus dominicanus), and the antarctic penguin (Pygoscelis antarcticus) were also encountered.

The storm-petrels fly to the coast at the end of September, begin laying eggs at the end of November and the beginning of December, hatch their young in mid-January, and leave the shores of Antarctica by mid-March.

The most widespread types of birds, which live everywhere except on the nunataks far removed from the coast, are the snowy petrel and Wilson's petrel; they do not form closely knit colonies, but build their nests in the cracks of cliffs in small groups or singly. The most widespread of the typically colonial storm petrels is the silver-gray petrel, which forms tight colonies of several hundred birds, living on the cliffs. These colonies were found in Greerson "oasis," on the Haswell Islands, and on the Rauer Islands.

The antarctic storm-petrel was found only on Haswell Islands, in a small colony of several hundred birds.

The large antarctic jaeger is as widespread as the snowy petrel, but its nest are found mostly in areas of penguin colonies, where the jaeger finds its food. The jaegers arrive in mid-October, begin to lay their eggs in the last 10 days of November, and hatch their young early in January, The young fledglings begin to fly at the end of February and the beginning of March, and the birds fly away at the end of March. The jaeger feeds mainly on carrion near the colonies of penguins and petrels, but it also attacks healthy birds; especially in regions where there is little other food, the jaeger destroys many snowy petrels. It also feeds in the sea, but less willingly.

The penguins are the most interesting and characteristic birds of Antarctica. Adelie penguins form 1,000-bird colonies on the cliffs of Greerson and Vestfold "oases," as well as on the Haswell Islands. For their nesting grounds they choose flat surfaces with fine pebbles, of which they build their nests. They appear here about 20 October, and begin to lay eggs about 10 November. Usually they lay two eggs each, less frequently just one egg, and very rarely three eggs. The young birds begin to hatch by mid-December. The molting period ends in late February and early March, and the birds leave the shores of Antarctica and go out into the sea. They feed mostly on crustaceans.

The most amazing bird, not only in Antarctica but probably in the whole world, is the king-penguin. These birds, which reach a length of 115 centimeters and a weight of 45 kilograms, spend the winter at the shores of Antarctica, and go out to sea for the summer.

They are not as widespread as the Adelie penguins. In the area of operation of the expedition, only three colonies of king-penguins were recorded: near Mirnyy, at the northwest point of the West Ice Shelf, and on the coast of Ingrid Christensen Land. The colony near Mirnyy, where there are up to 20,000 birds, is the largest. The colony near the West Ice Shelf is somewhat smaller. The third colony has only about 3,000-5,000 birds.

The penguins begin to arrive in the area of Mirnyy early in April, and beginning in mid-April, when the shore ice is firm, they form a colony between the icebergs on the sea ice. The birds stand mostly in groups, close to each other. Early in May they begin laying eggs, and this continues for more than a month. They lay one egg each, with an average weight of 440 grams (between 335 and 544 grams). The fledglings begin to hatch in mid-July, and only then do the parent birds begin to go back and forth, carrying food. Until that time, they hardly move at all and live on the fat accumulated during the summer period.

Thus, the young birds are hatched during the coldest period of mid-winter. They have hardly any downy cover and do not leave their parents' pouch for a long time. Only in about a month, the fledglings grow a thick coat of down and run around freely on the ice, despite continuing frosts and purgas.

At the beginning of December, the molting of young birds begins, and later that of adult birds. After mid-December, the colony begins to disintegrate, and the birds finally leave at the end of January. However, individual king-penguins may be observed all summer on the ice in the vicinity of Mirnyy. These penguins feed on crustaceans and fish and can hold more than 5 kilograms of food in their stomach.

From the above, it appears that all land animals and birds, i.e., those reproducing their offspring on land, are actually connected with the sea and depend wholly on the sea as their source of food. They all stay near the shoreline and do not penetrate into the interior. Only the snowy petrel and Wilson's petrel penetrate a little deeper, but even they do not nest further than 20 or 30 kilometers inland. Very rarely they fly as far as 100 kilometers into the interior.

Thus, it may be pointed out again that the sea is the source of life on the land, either directly or indirectly. Approximately 100 kilometers away from the sea all traces of life disappear completely.

The different natural conditions prevailing in the interior coastal regions of Antarctica, which is located entirely within the zone of antarctic deserts, make it possible to differentiate between two subzones, i.e., the interior glacial desert and the coastal antarctic desert. The former is characterized by a solid, homogeneous, thick ice sheet (with the exception of possibly a few nunataks), a stable anticyclonic condition of the atmosphere, continuous frost, and complete absence of life, while the latter represents a complexity of various landscapes, and, although the ice sheet here too prevails, it is much thinner, is not uniform in nature, and is interrupted by rock outcrops in a number of places.

The vicinity of the sea, the lower absolute elevation, and as a rule, the more northern location of this subzone result in a less stable atmospheric condition than in the interior subzone, and considerably higher temperatures, which rise above 0 degrees centigrade in the summer. The existence of ice-free areas of land makes it possible for some vegetation to develop, even though it is extremely scanty (only microscopic algae can develop on the glaciers, and only in small quantities).

The fauna of this subzone consists mainly of birds which obtain their food from the sea and nest on the cliffs of the coast. It is true that the king-penguins and seals (the latter, especially elephant seals, Weddell seals, and Ross seals, may also be included in the fauna of the subzone) do not require any ice-free rocks, and a number of minute animals living in fresh-water ponds are not dependent on the sea, but the most important group of animals is connected both with the sea and with the rocks.

Which of the landscape forms of the coastal zone is more characteristic from a zonal standpoint; the glaciers, which cover almost the whole area of the subzone, or the infrequent outcrops of ice-free rocks? Apparently, each of these landscape forms is equally zonal in character: the former, because under present conditions the snow line in the greater part of the subzone is below sea level, and therefore the ice accumulates locally, and does not only flow down from the interior regions of the continent; the latter, because -- also under present climatic conditions -- the elevations of the relief at the edges of the ice sheet in a number of places rise above its surface, which causes a change in the radiation balance and a rise in the summer temperatures above these areas, a change in the wind regime, and the formation of permanently ice-free areas. How far is the name "oasis" justified for these areas? It would be simpler to give up the term "oasis" and to designate these areas by the generally accepted terms, such as islands, peninsulas, hills, and mountains (for example, Vestfold Hills, Bunger Hills, Windmill Islands, and Greerson Hills). However, in view of the fact that the ice-free areas are comparatively rare in relation to the whole glacial cover and differ sharply from the lifeless expanses of ice by a whole complex of natural elements, including the existence of organic life, this article has retained the term "oasis", especially since it has become well known in literature and is used to emphasize the basic peculiarities of these areas. Even if these antarctic "oases" do not correspond to the term "oasis" in the direct sense of the word, meaning a spot with growing trees surrounding a water source, in the midst of a burning desert, the antarctic "oases" do correspond to the figurative meaning of the word, as being something exceptional, i.e., something better in the midst of worse surroundings. Thus, in Soviet terminology, the term has come to mean ice-free areas of land in the midst of a region of glacial accumulation, which are characterized by a complex of elements of geographic environment (climate, hydrographic system, flora and fauna, etc.).

The islands situated near the coast, of the type of the Haswell Islands, have some distinguishing features. In the summer they are surrounded by open water. The vicinity of the open sea causes increased humidity and, apparently, a higher air temperature. In the winter, the strong winds blowing off the ice sheet have lost some of their force when they reach these islands. Moreover, the vicinity of the sea as the source of food attracts a large number of birds. As a result, the Haswell Islands, which are granite cliffs 91 meters high, covering an area of a little less than one square kilometer, have a greater accumulation of animal and plant life than any other area explored by the expedition. The islands become free of ice early in the season. The increased humidity promotes the development of lichen and moss vegetation, which covers about 5 percent of the whole area. There are numerous colonies of Adelie penguins, silver-gray, snowy and antarctic storm petrels, "cape" pigeons, and Wilson's petrels, amidst the rocks; nests of jaegers are also frequent.

Weddell seals are seen near the shores of Haswell Islands all the year round, and crab-eating seals and sea leopards come up to the islands in the summer. Even in the winter the area of the Haswell Islands is enlivened by a large colony of king-penguins and Weddell seals coming out on the ice.

The nunataks located at the base of the Shackleton Ice Shelf represent isolated peaks, or small groups of peaks, surrounded by glaciers. As a result of increased humidity following the thawing of ice and snow, the conditions for development of plant life here are somewhat better than in most of the area of the "oases," and therefore the total area covered by moss and lichen is about 5-10 percent.

The nunataks located at a distance from the coast (Mount Strathcona, Mount Amundsen, and Mount Sandow) are almost without life, with the exception of a few small patches of lichens and algae, growing in the crevasses. In these spots, the temperature of the air never rises above 0 degrees centigrade and only the surfaces of rocks heated by the sun have enough warmth for the existence of life.

The most frigid spot, undoubtedly, is Mount Brown, a rocky summit, which is located about 200 kilometers from the coast and is over 2,100 meters high. Its surface does not receive enough warmth to enable any kind of plants to survive. The temperature is always below zero centigrade, and even the surface of rocks facing the sun show only traces of the melting of snow.

The antarctic deserts are much more frigid than the arctic ones. There is no region in the Arctic corresponding to the interior glacial subzone of Antarctica. Comparable conditions exist on the glacial cover of Greenland, but they are not as definitely expressed as in Antarctica. It would be more correct to compare the glacial subzone of Antarctica with the Arctic Basin, which is covered with ice all the year round. However, the presence of the sea in the northern polar region makes the formation of an ice sheet impossible, which would probably form if there were dry land underneath. As a result, the natural conditions of the glacial subzones of the northern and southern polar zones are noticeably different.

There is also no region in the Arctic corresponding exactly to the second subzone, the typical antarctic deserts, developed on the coast of the antarctic continent. The regions in the highest latitudes of arctic land have more favorable conditions than the lowest latitudes of East Antarctica. However, a number of features characteristic for the coastal regions of Antarctica may also be observed in the regions of the Far North. In addition to the low summer temperatures, it is especially the lack of humidity which is very pronounced in the antarctic "oases," and which is also characteristic, although to a lesser degree, for a number of arctic regions, particularly the islands of Severnaya Zemlya. The scarcity of vegetation, caused by low summer temperatures and lack of humidity, and the enormous importance of the sea in the development of animal life are characteristic for both regions. ("Physicogeographical Characteristics of the Area of Operation of the Soviet Antarctic Expedition 1955-1957," by Ye. S. Korotkevich; Leningrad, Izvestiya Vsesoyuznogo Geograficheskogo Obshchestva, Vol 90, No 3, May-Jun 58, pp 220-242)

Oceanographic Research in Antarctic Ocean

The Soviet Antarctic Marine Expedition on the Ob' and Lena have conducted complex oceanographic research in an extensive area of the Antarctic Ocean.

Geomorphological studies of the ocean floor made it possible to establish its extremely complex nature and manifold structure. Soviet research in this field has refuted the former theory that the ocean floor had a fairly level or slightly undulate relief. About 75 percent of the explored portion of the ocean bottom between South Africa and Antarctica is characterized by a volcanic relief, with individual volcanic cones up to 3,000 meters high alternating with uplands and groups of fused volcanoes. Huge areas are covered by lava fields with terraced, block-shaped and hilly surfaces. The formations of the bottom relief enable one to assume that the submarine volcanic eruptions were comparatively recent, and in some cases even of a contemporary nature.

These data enable scientists to speak with greater certainty of the existence of the ancient continent of Gondwana, which at one time connected East Antarctica with Africa and West Australia.

The coastal shelf of Antarctica was thoroughly explored, beginning to the east of Davis Sea. The most interesting feature of it was a long trench, which apparently encircles all of East Antarctica. The trench is up to 1,400 meters deep. The Soviet expedition was able to explore this trench along its whole length from the Mirnyy observatory to Adelie Land. It may be assumed that it was formed by a coastal breakup, which occurred as a result of vertical movements of the antarctic continent. Apparently, the vertical movements along the trench, which represents a kind of seam, continue even at present. If we take into consideration that during the Quaternary period Antarctica probably went through several glaciation epochs, these vertical movements may be related to the shifts in the ice load on the antarctic continent. When the icecap accumulated, the continent sank deeper under its weight; and when it melted, the continent rose. ("Secrets of the Glacial Continent," by Academician D. Shcherbakov, Moscow, Komsomol'skaya Pravda, 10 Jul 58)

Antarctic Flights Resume

The spring in the Antarctic is becoming more noticeable: there are fewer snowstorms, and the nights are getting shorter.

Landing strips are being prepared at the interior stations for the arrival of planes from Mirnyy. In the past few days [second week of October], an Il-12 plane made a flight of many hours, flying a 1,300-kilometer distance to the west of Mirnyy. Along the coast, the plane flew over the Australian station Davis, where it dropped a note with greetings. Commander Perov made a landing at the other Australian station, Mawson, making a friendly visit to that station in response to the previous visit of the Australians of Mirnyy.

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On 1 October, two Il-12 planes piloted by Perov and Ryzhkov again made long flights. Perov conducted ice reconnaissance, flying as far as the edge of the ice. Ryzhkov's crew flew more than 3,000 kilometers over the antarctic icecap, passing over Pionerskaya, Komsomol'skaya, Sovetskaya, and Vostok.

On 9 October, the first spring sled-tractor train arrived at Pionerskaya. The 24 Soviet explorers traveled the route from Mirnyy to Pionerskaya, a distance of 375 kilometers, in 13 days. At Pionerskaya the train was divided into two columns. The members of the first column will travel further to the south to continue scientific explorations. The second column will return to Mirnyy. ("Spring in Antarctica," by Ye. Tolstikov, Moscow, Pravda, 12 Oct 58)

Belorussian Scientists in Antarctic

Workers of the Hydrometeorological Service of Belorussia are taking an active part in scientific research in connection with the IGY. Shimanovich, a Minsk aerologist, spent a long time in Antarctica, where he headed a research group. At present, Mayevskiy, technician-aerologist, who is employed by the Minsk Observatory, is stationed at Sovetskaya. He conducts aerological radiosonde tests and has proved to be a capable specialist.

Pilipovich, senior technician of the Brest Aerological Station, has left for the Antarctic to do research work. ("Scientific Workers of Belorussia in Antarctica," Minsk, Sovetskaya Belorussiya, 27 Sep 58, p 2)

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