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**UNCLASSIFIED - INFORMATION ON SOVIET
BLOC INTERNATIONAL GEOPHYSICAL COOPERATION
- 1959**

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August 28, 1959

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INTERNATIONAL GEOPHYSICAL COOPERATION PROGRAM--
SOVIET-BLOC ACTIVITIES

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I. ASTRONOMY

Giant Radiotelescope Probes Center of Galaxy

Using infrared techniques, Soviet scientists A. A. Kalinyak, V. B. Nikonov, and V. I. Krasovskiy discovered a large astral cloud in the mass of dust at the center of our galaxy during 1948-1949. However, no definite conclusions could be made as the cloud was not clearly discernible. More concrete results were forthcoming with the construction and activation of the largest radiotelescope in the world at the Main Astronomical Observatory in Pulkovo. This telescope operates in the centimeter radio wave range and consists of 90 flat panels 3 meters high and 1.5 meters wide placed side by side to form an arc with a radius of curvature of 100 meters. Each panel reflects radio waves to a receiving antenna set on a carriage transported on rails. By changing the position and tilt of each panel and the location of the receiving antenna according to a preset program, observations can be conducted on any portion of the southern hemisphere of the sky. By increasing the number of panels and completing the circle, the entire firmament could be covered.

Even larger radiotelescopes are considered possible by using the design proposed by Khaykin and Kaydanovskiy even and incorporated in the telescope at the Pulkovo Observatory. Strength and material problems are not as difficult as in the case of parabolic reflectors. Construction of panels for the Soviet radiotelescope is considered very simple, and with proper alignment they produce the same effect as a continuous mirror. It is noted that deformations caused by weight and wind in the English 76-meter parabolic reflector made it entirely unsuitable for operation at 10-centimeter or longer wave lengths.

A few months ago, the young scientist, Yu. N. Pariyskiy, directed the invisible ray of the new radiotelescope at the mysterious center of our galaxy.

Following are some of his remarks:

"When the 'knife' of the telescope cut like a scalpel through the coat of cosmic dust it revealed behind it, in the very center of our galaxy, a small, dense nucleus entirely interwoven with hot ionized gases. We say 'small' on comparing it with the dimensions of the entire galaxy. Its dimensions are 1/4,000th that of the diameter of the Milky Way. However, it is so large that light could transverse it in only about 20 years. The entire region occupied by the sun and stars nearest to us could fit in this space."

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The density of ionized atoms of hydrogen within this nucleus, according to calculations by Pariyskiy, is one hundred times greater than the mean density of cosmic matter. According to observations of Dutch radio-astronomers, there is present, in addition, a large quantity of neutral atoms of hydrogen racing at random in all directions at speeds up to 200 kilometers per second. The average temperature in this cosmic 'bonfire' is close to 10,000 degrees Centigrade. Evidently, such a high temperature is maintained by radiation from a large number of hot stars concealed within this unique nebula. Pariyskiy calculated that merely the ionized atoms of hydrogen within this cloud have a mass equal to that of 10,000 suns. Also present are the great masses of neutral particles and multitude of stars.

As observations indicated, the nucleus is the brightest point (in relation to radio emissions) in the center of the galaxy. This center is enveloped by a cloud of electrons which race within the strong magnetic fields of the nebula with speeds approximating those of light. These also produce radio waves and light. Pariyskiy says:

"I observed this 'bonfire' on 3- and 10-centimeter waves with the equipment we constructed jointly with the postgraduate student Apushinskiy, whereas my colleague worked in the 30-centimeter wave range. We compared observation data and established that the region occupied by these relativistic particles has a diameter ten times greater than the central portion of the nebula. 'Brightness' of the radiation gradually diminishes toward the periphery."

Applying his new original method for measuring distance between thermal cosmic sources of radio waves, Pariyskiy and his colleagues were able to confirm the opinion that the 'bright detail' is the center of the galaxy.

Recently the US scientist, Baade, succeeded by optical methods in disclosing a nucleus consisting of separate stars in the Andromeda Nebula. Dimensions of the Andromeda nucleus coincide with amazing accuracy with the dimensions obtained by Pariyskiy for the nucleus of our stellar system. ("Breakthrough to the Center of Our Galaxy," by I. Radunskaya; Moscow, Izvestiya, 12 Aug 59, p 3)

II. SEISMOLOGY

August 1958 Earthquake in Buryat ASSR

On 10 August 1958, the seismic stations of the Baykal Expedition recorded an earthquake with a force of 5-6 near the regional center of Kyren in the Buryat ASSR. The Baykal Expedition of the Institute of the Physics of the Earth, Academy of Sciences USSR, established four seismic stations at Kyren, Zhemchug, Arshan, and Mondy to study the mechanism of

the seismic regime in this area. This area is listed on the seismic chart as an 8-9 ball zone. The seismic stations of the Baykal Expedition are equipped with the VEGIK seismograph, with a magnification of 23,000-25,000, which affords the possibility of recording, with negligible distortion, ground waves in the frequency range of one to 25 cycles per second.

The quake on 10 August occurred at 34 minutes and 25.8 seconds after 1100 hours; the coordinates of the epicenter were 51 45 N and 101 57 E; the centrum was located at a depth of 10 kilometers. The earthquake was evidently connected with motions along a fault extending northwest through the edge of the Tunkinskiy depression. ("Kyren Earthquake, 10 August 1958," by S. V. Puchkov, and R. I. Khovanova, *Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya*, No 6, Jun 59, pp 891-894)

III. ARCTIC AND ANTARCTIC

Work of Fourth Antarctic Expedition of USSR Described

The following is a complete translation of a report on a recent Soviet expedition to the Antarctic.

The Fourth Soviet Expedition was sent at the end of 1958 to continue investigations in the Antarctic. It fell to this expedition to conduct the year-round operations in Mirnyy, at the Vostok Station, and at the newly organized Soviet Station at 12° East Longitude. It was decided to name this station after M. P. Lazarev, one of the Russian discoverers of the Antarctic. Here, at a distance of 100 kilometers south of the shore, there is a large, high mountain range. It is very important that this range be studied to determine whether mineral resources are located in the region.

The Fourth Expedition was to make a snow-tractor trip along the route Mirnyy - Geomagnetic Pole - South Geographic Pole (the US Station Amundsen-Scott) - the pole of relative inaccessibility. From this point, depending on conditions, the Soviet investigators were to head either for the Lazarev Station or for Mirnyy. The chief purpose of the trip was to make complex glaciological, aerometeorological, and magnetic observations. The expedition was equipped with three new powerful tractor - laboratories which were developed especially for the purpose.

It was intended that oceanographic observations would be made only enroute, while stopping at the banks of Antarctica (while seeking a location and constructing the Lazarev Station), and during the return to the Soviet Union through the Atlantic Ocean.

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The expedition left for the voyage on two ships. The dieselelectric ship Ob' left Kaliningrad on 28 November with the first group and supplies. The second ship, the Steamship Mikhail Kalinin, the chief purpose of which was to carry home the various components of the Third Expedition wintering in Mirnyy, left Riga on 19 December. It carried on board the second group of those who were to spend the winter and scientific workers heading for the Antarctic to participate in the summer season operations. These were chiefly geologists who were to carry out the first observations in the mountains of Queen Maud Land.

The M. Kalinin is a modern passenger ship displacing about 5,000 tons. It is capable of developing a speed of up to 18 knots and is not of the icebreaker type. It arrived first at the Antarctic. Additional refrigerator compartments were installed on the ship to transport the large amount of perishable goods to those wintering at Mirnyy. At Gdynia, the M. Kalinin took on board a group of Soviet scientists who were to take over and begin work at the Antarctic Station Oasis, given to Poland by the Soviet Union.

The Ob' went to the Antarctic by the ordinary route through the Atlantic Ocean, with a stop at Capetown. The M. Kalinin which had a smaller capacity, had to stop to replenish fuel and fresh water at two ports, Dakar and Capetown.

The whole trip was made under favorable meteorological conditions. From the southern extremity of Africa to almost 50° South Latitude, there was experienced extraordinarily quiet weather for these parts, a moderate wind blew from the south quarter of the horizon, and the sea was very quiet. Probably as a consequence of this, the first icebergs in the zone of convergence of the tropical and Antarctic waters at the time of the voyage was noted to be more northerly than in all previous voyages. The M. Kalinin deviated somewhat from the course to Mirnyy to verify the existence of shallow waters observed during previous voyages and named the Ob' bank and the Lena bank. The coordinates of the waters are approximately 44-45 S and 47-48 E. Two banks with depths of 200-250 meters were detected in the region with the aid of a sounding device. The Lena bank extended 14 miles over the ship's course and the Ob bank for 15 miles. The depths surrounding these banks reach 4,000-5,000 meters. The banks, which are similar to sharp peaks, rise from the bottom of the sea, their sides on the sounding graph almost vertical. Both banks are obviously part of a chain of individual rises which come to the surface in the form of islands in this region of the Indian Ocean. The Ob' met the M. Kalinin at the southern boundary of the floating ice, and on 21 January, both ships made fast to shore ice several kilometers from Mirnyy.

Immediately after arriving in Mirnyy, the group of Polish scientists was put on planes for the Scott Glacier and then on a helicopter to Oasis. The first Polish station in the Antarctic was opened on 23 January. The station was named after the famous Polish geophysicist A. Dobrowol'skiy.

The program of the Polish station, several phases of which have already begun, has been laid out for several years and includes ionospheric observations, observations on Earth magnetism phenomena and polar auroras, the study of Earth currents, the radioactivity of fallout, the determination of carbon-dioxide and ozone content of the atmosphere, and seismic, gravimetric, and meteorological observations. In addition, the verification of certain theories and hypotheses advanced by the Polish scientists is foreseen, particularly with regard to propagation of radio waves and certain special forms of magnetic storms. The activities of the Polish scientists in the Antarctic are of particular interest since an analogous program of observations will be conducted during the same period at the Polish tropical station located in Vietnam and situated on approximately the same meridian as the Oasis Station in the Antarctic.

Among the scientific problems before the participants in the Fourth Soviet Antarctic Expedition was that of determining the absolute heights of the ice cap of the Antarctic. A knowledge of these heights is necessary to solve the problem concerning the actual pressure fields of the atmosphere in the interior regions of the East Antarctic. This field, together with the pressure field over the Southern ocean causes the air circulation in these regions of the globe. A study of the relief of the Antarctic, particularly the relief of the ice cap of the eastern part is important in making a hypsometric map, which, in turn, is necessary to the solution of all geophysical problems of the Antarctic: geological, glaciological, meteorological, and others. The difficulty of determining the absolute heights of the ice pack of the Antarctic is that ordinary methods of barometric leveling are not suitable here, since the great ice sheet causes a constant anomaly in the pressure field of the atmosphere, and this leads to errors in determining the heights. This is why such serious attention was devoted at all stages of the expedition to the development of barometric leveling methods which would, if only to some degree, eliminate the effect of these anomalies on the value of the altitudes and profiles determined for the localities along the routes of the journeys and long-distance flights.

A very fruitful method for determining the heights of the ice cap was from a plane located beyond the limit of distorting pressure of the cold air layer. In this method, the altitude of the plane was determined by the ordinary barometric formula with a correction for the difference in temperature observed at the altitude of the flight and at the point relative to which the height was determined (the height of this point above sea-level must be known). The distance from the plane to the cap over which it flew was determined with a radio altimeter. The difference in the two values is the height of the cap at a given point above sea level.

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Attempts to determine the height of the ice cap of the Antarctic by this method were made by us, even during the first expedition. The height of the Pionerskaya Station, as determined by this method, was equal to 2,730 meters above the level of Mirnyy. Determinations of the height of Pionerskaya on the basis of pressure at the station itself gave values which were different but always lower by up to 150 meters than this figure for the value. In its improved form, this method of determining altitudes was widely used by the aerometeorological section of the Third Expedition. The use of radiosonde observations in determining altitudes at Mirnyy made it possible to introduce additional corrections to the altitude of the plane's flight. A considerable portion of the ice cap of Eastern Antarctica was encompassed with these observations. (These activities were carried out by V. A. Bugayev on an IL-12 plane, with V. M. Perov as crew.) The flight plan, as made by Ensign Navigator B. S. Brodtkin is shown in Figure 1 [not included herein]. Result of this work was a map giving a general picture of relief of the portion of the ice cap. Its peak is situated at a distance of about 400 kilometers South-Southwest from the Soviet station. The fixed maximum height above sea level in this region is equal to 3,960 meters, but it may be expected that the greatest height of the cap reaches 4,000 meters, or even somewhat exceeds this value.

In addition to the method described above, another method was used earlier to determine heights in the interior region of the continent. For example, the height of the Pionerskaya Station was determined by V. A. Bugayev by averaging the values for the atmospheric pressure for a month. As would be expected, these determinations had to give a somewhat lower height for the station; it was equal to 2,670 meters above sea level. In addition, these results indicate a constant, somewhat elevated pressure at this point in the Antarctic (in any case during the period of the observations.) One other method was used by V. A. Bugayev. It is based on comparing data from two radiosondes sent aloft at Mirnyy and Pionerskaya. It should be mentioned that in the case where there are no local perturbations in the barometric field between two points, the difference in the heights of which is being measured, this method can be highly accurate if the height of the sonde is determined by an absolute method, i. e., with the aid of a detector or by ordinary basis observations. The distance in this case from the horizontal isobaric surface to the surface of the cap whose height is being measured will be determined sufficiently accurately; consequently, the height of this point above sea level will also be accurately determined.

What may be considered to be the degree of accuracy in determining altitudes by the methods described above, considering the effect of the ice cap? It is confirmed that this accuracy is close to 50 meters. For many measurements, such an accuracy may be sufficient, in particular for determining the thickness of the ice cover, since the accuracy of seismic measurements is probably no higher than this value. Many problems, however, among them problems in gravimetry and meteorology, require greater accuracy

in the height determination. Instrument leveling, which can provide much greater accuracy is as yet practically impossible to accomplish on the scale now required in the Antarctic because of the very difficult climatic conditions.

This is why new methods must now be sought to determine heights in the region with a constant-anomaly pressure field, since absolute measurements which are not connected with measurements in the atmospheric pressure are even yet not very accurate. They do, however, permit an increase in accuracy as they are improved. This is impossible to achieve with any barometric methods, since all possibilities here have already been exhausted.

A new instrument and new method were applied by the Fourth Antarctic Expedition to determine absolute heights of the ice cap. These were developed at the Institute of Applied Geophysics, Academy of Sciences USSR, by A. M. Gusev, with the collaboration of N. I. Lozovskiy, A. A. Gus'kov, and I. D. Orobinskiy.

Our method consists essentially of the following:

If an airplane flying from a certain point, the height of which above sea level is known, constantly records the velocity of its vertical displacement on a tape unwinding proportional to time, we will obtain the absolute altitude of the plane relative to the point of take-off by integrating the curve obtained. In this way, the trajectory of the flight over the area, the height of which is to be determined, can be constructed. If the distance from the plane to the surface of the ice cap or any surface of unknown height is determined periodically at the points of interest, or continuously with the aid of an altimeter, then by subtracting the value obtained on the altimeter from the altitude of the plane, we will obtain the height of the surface located below the plane. With a constant recording, it is possible to obtain the entire profile of the area over which the flight is made. Tying these observations to the map will produce a fix on the time of flight over the point placed on the map. In those cases when the altitude of the plane above the surface was determined with insufficient accuracy by the radio altimeter (as in the reflection of radio waves from a loose snowy surface, for example) the plane must drop to low-level flight and, if possible, make a landing. Actually the utility of the radio altimeter drops off under this situation. The velocity of the vertical displacements of the plane was determined by two methods: first, a variometer was used to determine it on the basis of the change in air pressure on the drop or rise of the plane. Experience and calculations have shown that the altitudes of the flight do not affect the readings of this instrument within limits of from 0 to 4,000 meters, and, consequently, anomalies in atmospheric pressure at the given locality and changes in it with time along the route of the flight are not affected.

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Since the forces on the indicator of a barometer existing design are not very large, a photoelement was installed in the instrument to provide a continuous electric recording of the readings. The illumination on it is changed with the turning of the indicator by a sector placed on its axis, which crosses a beam of light coming from a lamp. A drawback of this instrument is that there is a certain lag in the readings on a change of flight conditions.

A more exact and promising method of fixing the vertical displacements of a plane is to register these on the basis of the vertical acceleration with the aid of an accelerometer, specially constructed and designed for this purpose. In this case it is necessary to integrate the curve described by this instrument twice.

The accuracy of determining the heights of the ice pack by this method will depend on the accuracy of measuring the altitude of the flight on the basis of the vertical displacements of the plane and the distance from it to the surface of the ice cap, as determined by a radio altimeter. The accuracy of the first measurements can be reduced to approximately 10 meters, since it is possible to determine the value of the accumulated error by returning to the starting point of the flight. Measurements with a radio altimeter provide an accuracy up to one percent of the altitude of the flight; that is, for an ordinary flight of the plane over the cap, from 2-10 meters.

Equipment for measuring altitudes was installed in the IL-12 aircraft, and after test flights in the region of Mirnyy to calibrate the instrument, a flight was planned to Wilkes Land in the direction of Victoria Land.

Flights had not yet been made in this direction and the cap of eastern Antarctica was completely unstudied. A determination of its heights in these regions will make it possible to close the structure contours mapped out for the more westerly regions and thus obtain the first picture of the over-all relief of the greater part of eastern Antarctica.

The following route was planned for the flight:

From Mirnyy to Pionerskaya and from there on a course of 289° to the inner continent at an altitude of 1650 kilometers: then by a course of 130° and then to veer to the North and return to Mirnyy. The total length of the flight, which was calculated to last approximately 12 hours, amounted to about 3,500 kilometers. Because of the unsettled weather, the flight could be made only on 29 January. It was still cloudy at Mirnyy, but no serious threat was foreseen from the west, from where cyclones ordinarily move on Mirnyy. The inner continent stations of Kosomol'skaya and Vostok reported good weather. The plane, filled to capacity, took its altitude above the sea and set a course for Pionerskaya. At that moment, the observations began. The height of the Cap was measured by

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two methods: the absolute method described above, and the barometric (of B. A. Bugayev). In addition, a continuous recording was made of the total solar radiation and the solar radiation reflected from the surface, using an electronic oscillograph (V. I. Shlyakhov.)

It was cloudy almost all the way to Pionerskaya and at times, the surface of the Cap was not visible. However the plane passed exactly over the station, which by then had been supplied. Only the mast with the red flag was clearly visible, and the buildings in which I and my three companions lived during the first winter were buried under more than 4 meters of snow. At Pionerskaya, the cloud almost completely disappeared, the sky was cloudless to the farthest point of flight and only a weak fog made the line of the horizon unclear. Throughout the entire length of the flight over the as yet unstudied portion of the ice cap, we did not meet even one outcropping of rock. The snowy desert extending beneath us was covered with two systems of drifts, indicating two prevailing wind directions here, East and Southeast. The maximum height of the cap was at the farthest point in our flight (with coordinates 72 23 S and 130 30 E) which we reached 6 hours after taking off from Mirnyy. Further on, a drop in the area was noted. Turning to the Northeast, we flew approximately for an hour, meeting light cumulous clouds through which the surface of the cap was easily visible. The air temperature throughout the entire flight in from the shore oscillated around 20°. The next turn we made at a point with coordinates 69 40 in 124 25 E, from where we set a course for Mirnyy.

Cloudiness appeared as we approached the shore, becoming heavy over the Mount Strathcona. The plane flew blind; only at times were the rocky mountains and Amundsen Mountain visible through breaks in the clouds. The plane tossed considerably.

Descending to Mirnyy, the plane left the clouds and the landing proceeded under normal conditions.

On the last leg, approximately 3 hours before arriving at Mirnyy, the oscillograph motor, which was not intended for such a long flight went out of order, but the recording necessary to determine the total error could still be taken by turning the oscillograph by hand with more frequent time notations. Results of the variometer observations are given in the appended table.

The table shows the height of the cap at all turning points of the route and at certain intermediate points. The figure shows the profiles of the area on the Mirnyy- Pionerskaya, Pionerskaya-point 1, and point 1-point 2 segments, as obtained on the basis of variometer readings. Analysis of the recordings of the accelerometer, which is considerably more laborious, is still going on.

At every distance along the route from Pionerskaya to the point of the second turn, the altitudes determined by the instrument were greater than those obtained for the same points with the barometer; the difference for Pionerskaya was 79 meters and for the more distant points, 122 meters. The generally lower values for the altitudes determined by the former method probably follow some law, since air-temperature observations and the altitude of the flight indicate that the plane was still located within the limits of the cold air layer for the greater part of the flight. It is interesting that in flights high above the surface the discrepancies between the measurements given by the different methods diminished.

Thus the conclusion can be drawn that the new method of determining altitudes makes it possible to eliminate the effect of the pressure anomaly and consequently is more exact and convenient to carry out. Its drawback is the tedious analysis of the oscillograph tapes, the length of which for long flights is quite considerable. This is only a temporary shortcoming in design. In the new instrument designed by us, the integration will be carried out automatically and the absolute altitude of the flight will be constantly indicated by a dial on the instrument.

The time for our work at Mirnyy was limited by the fact the the steamship M. Kalinin was not equipped for voyages in ice and could not remain longer. Later it would not have been able to proceed by itself through the band of floating ice surrounding Antarctica. The diesel-electric ship Ob', which had aided its motion through the ice, was to go to the Queen Maud Land region to construct the new Soviet station, Lazerev. Therefore, we had to limit ourselves to one flight, but the instrument for the continuation of the altitude determinations by the new method was left in Mirnyy.

The weather was excellent during the last days of the stay of the ships at Mirnyy, but the land flow still remained motionless. The edge passed north of the Haswell Islands. It was not completely broken up and did not fall into the sea until 3 March. This was unusual and remarkable since one would have rather expected that the ice flow, having held until the beginning of autumn, would stay for another winter.

The group of Polish investigators returned by plane on 30 January to Mirnyy from Oasis, where the Polish Antarctic Station had been opened and the first round of operations had been completed.

In the evening of the same day, accompanied by the planes of Mirnyy, the ships left the shore of Antarctica. The Ob' lead the M. Kalinin as far as the limits of the floating ice and proceeded to Queen Maud Land, and we set a course for the Cape of Good Hope.

The 9-day passage to the shores of Africa was through disturbed conditions, the autumn storms were beginning. Then for the remainder, the greater part, of the journey the weather was favorable. Having replenished

supplies of fuel and water at Capetown and Dakar, the M. Kalinin arrived at the Polish port of Gdynia on 3 March. There, the Polish workers had organized a warm welcome for the participants of the Soviet and the first Polish Antarctic expedition. On 4 March, the M. Kalinin arrived at Riga.

During the voyage we constantly obtained information from the Ob'. On the way to Queen Maud Land, the Ob' stopped at the Australian station, Mawson. There it unloaded a supply of aviation gasoline needed for the flights of our planes from Mirnyy to the future station Lazarev. During the holdover, the Soviet and Australian scientists exchanged scientific information. Geologist P. S. Voronov announced that the Australian investigators found in the Prince Charles Mountains a "pikon" formation observed earlier in Antarctica by Soviet geologists.

From Mawson Station, the Ob' passed further to the west through stormy weather. A point with coordinates 69 58 N and 12 55 E was chosen for the construction of the new station. The shore of the continent here is shelf ice, with no rock protruding. The Ob' tied up to the edge of the flow adjoining the shelf ice. It was decided to establish the station buildings, about 1.5 meters from the barrier.

Research work began simultaneously with unloading the ship and constructing the station. A group of geologists under M. G. Ravich went by plane to a high mountain ridge situated approximately 100 kilometers from the shore. The extent of the ridge is very great and its height exceeds 3,000 meters above sea level. Certain regions of the ridge have already been investigated by expeditions from other countries, since many mineral resources have been observed. The organization of a Soviet station in this region will make it possible to return samples of the resources to Soviet geologists.

Reconnaissance work was done during February 1959. Bad weather so disturbed the the investigation and the station equipment that the geologists had to return shortly to the ship and construction was partially suspended. Construction of the station was not completed until 10 March, when it was officially opened. After this, the Ob' headed on its return voyage, leaving at Lazarev seven persons for the winter. On the Ob' was also a group of hydrologists under V. Kh. Buynitskiy. Their task was to study the ice patterns along the shores of Antarctica and in the vicinity of the new station. On the return voyage, this group carried on certain oceanographic investigations in the waters of the Atlantic ocean.

Thus ended the first stage in the work of the Fourth Antarctic Expedition. [Appended table follows.]

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Results of Aerial Observations

<u>Time</u>	<u>Distance from Mirnyy (in km)</u>	<u>Height (in meters)</u>	
		<u>Absolute Measurement by Variometer</u>	<u>Measurement by Barometric Leveling</u>
6:35	375 (Pionerskaya)	2769	2690
7:10	543	2820	2660
7:40	687	2850	2767
8:47	979	2772	2730
9:00	1072	2843	2790
10:10	1410	3191	3015
10:35	1530	3287	3110
11:00	1655 (Point of first turn)	3277	3155
12:14	2220 (Point of second turn)	2552	2530

("Fourth Antarctic Expedition Results of the First Stage of the Work,"
by A. M. Gusev, Doctor of Physico-Mathematical Sciences; Moscow,
Vestnik Akademii Nauk SSR, No 7, Jul 59, pp 43-51)

Meteorological Rocket Launchings in the Arctic

Meteorological rockets for the study of the stratosphere are launched at regular intervals from Ostrov Kheysa, one of the islands of Zemlya Frantsa Iosifa. These rockets are smaller and less pretentious than those of the geophysicists. They carry no live passengers and cannot boast conquering outer space. Their tasks are simpler, i.e., they ascend to heights of 80-90 kilometers, transmitting information on air temperature and pressure on the way up, and in the upper stratosphere, they "shoot" their head section, filled with various instruments, back to Earth.

The flight continues for several minutes. During this period, the radio station of the rocket continuously transmits signals to the Earth, which are recorded on tape. The deciphering of these signals takes several hours. During its ascent, the rocket is heated by friction, which has an effect on the readings of all instruments.

The return flight is more complicated. During the first few kilometers, the parachute does not slow down the descent but only guides its direction; the air is so thin that the parachute is unable to open. Only at a height of 60 kilometers does the parachute begin to fill out, and the normal parachute drop begins. Almost an hour goes by before the head section of the rocket reaches the Earth.

Exploration of the stratosphere with the help of meteorological rockets expanded particularly during the IGY. Under the international program during this period, 125 such rockets were launched from Ostrov Kheysa (on the 90th parallel), from the temperate zone of the USSR, and from aboard the Ob' in Antarctic waters.

At present, launching of meteorological rockets for research purposes is continuing under the program of the IGC-1959.

What new contribution have these rockets made to man's knowledge of the Earth's atmosphere? What is the scientific and practical significance of data collected with their help?

It must be said that scientists are still in the dark about many phenomena occurring in the upper atmosphere, since the penetration to these heights began only relatively recently. Each rocket flight brings new information. Sometimes they make it possible to verify some hypothesis, but in general the acquired information is still limited. However, some of the mysteries have already been revealed to man.

It is known that the Earth's atmosphere extends hundred of kilometers from the Earth's surface. However, the layer of the atmosphere at a height of 80-90 kilometers from the Earth is of special interest. In this layer, 95 percent of the whole mass of the atmosphere is concentrated. Here the air layers have preserved a relative density. Higher up, the air has a maximum degree of thinness; that is the zone of the ionosphere, where complex intra-atomic and intramolecular processes take place.

The weather of the Earth is formed in the 80-90 kilometer zone of the atmosphere. Airplanes have now begun to fly at these altitudes, and in the not-too-distant future, the greatest difficulties will be encountered here by space ships returning from distant flights. It is this layer which protects all living things on the Earth from the destructive short-wave radiation of the Sun, and from its piercing ultraviolet and roentgen rays.

After 10 years of rocket research, it has been definitely established that the composition of the air up to the lower limit of the ionosphere is the same as near the surface of the Earth. Over 99 percent of the air consists of oxygen and nitrogen. Ozone is present in the air only in millionths of one percent. However, it is the ozone which absorbs the harmful radiations of the Sun.

The temperature regime has also been clearly defined. In the temperate zone, up to an altitude of 10-11 kilometers (i.e., in the lower atmosphere, the so-called troposphere), the air temperature drops 6-6.5 degrees for each kilometer of increasing height. Then, up to a height of 35 kilometers, the air masses have fairly stable temperatures. From 35 kilometers up, the temperature rises, reaching a maximum of close to 0 degrees Centigrade at an altitude of about 50 kilometers. Above 50 kilometers, and as far as the upper stratosphere, the temperature drops again; at an altitude of 80-90 kilometers, the average temperature is minus 60 degrees Centigrade, and sometimes even as low as minus 90 degrees. This is the cosmic cold.

One of the most interesting facts discovered during the past few years concerns the seasonal fluctuations in the "climate" of the stratosphere. It seems the stratosphere also has its winter and spring, summer and fall. Geographic and latitudinal differences have also been discovered in the distribution of temperature and pressure. The farther from the equator to the north and south, the more pronounced are these characteristics. This means that even at tremendous altitudes there is an equatorial zone, temperate zones, and polar zones. All this has an influence on the weather conditions close to the Earth.

Until recently it was believed that the intrusions of air masses (polar or tropical), cyclones and anticyclones, occur only in the troposphere, at relatively low altitudes above the Earth's surface. Now it is known that these phenomena occur in a much higher layer of the stratosphere and bring into motion huge masses of air. The continental character of the climate above the mainland, and the influence of oceans, reaches high altitudes.

Far from all the discoveries of scientists have been fully explained from the standpoint of physics. The whole process of the interrelations of air masses at high altitudes has not yet been clarified. The exploration of the stratosphere continues. ("Explorers of the Stratosphere," Moscow, Pravda, 31 Jul 59)

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