CIA/PB 131632-119

UNCLASSIFIED - INFORMATION ON SOVIET BLOC INTERNATIONAL GEOPHYSICAL COOPERATION - 1960

MAY 20 1960

PB-1119

PB 131632-119

INFORMATION ON SOVIET BLOC INTERNATIONAL GEOPHYSICAL COOPERATION - 1960

May 20, 1960

U. S. DEPARTMENT OF COMMERCE
Business and Defense Services Administration
Office of Technical Services
Washington 25, D. C.

Published Weekly
Subscription Price $12.00 for the 1960 Series

Use of funds for printing this publication has been
approved by the Director of the Bureau of the Budget, October 28, 1959

Approved For Release 1999/09/08 : CIA-RDP82-00141R000201190001-1

INTERNATIONAL GEOPHYSICAL COOPERATION PROGRAM--

SOVIET-BLOC ACTIVITIES

I. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Method of determining Satellite Positions

A method of finding the position of the trajectory of a satellite or meteor by simultaneous observations of the Rumanian Academy of Sciences. The method is based on the variation of the satellite's position on the trajectory observed at the first station prior to the finding of the identical height of the satellite above the Earth at both stations. A correction, ΔA_B, is given for the azimuth of the preliminary position on the trajectory leading to the correction ΔZ_B for the zenith distance on this trajectory, and two corrections for altitudes A and B, h_A and h_B, and Δh_A and Δh_B in particular are calculated. ΔA_B is determined from the condition $h_A + \Delta h_A = h_B$. An example is given using the 17 March 1958 observations of the second Soviet artificial earth satellite made at Cluj and at Bucharest. ("The Determination of the Geocentric Location of an Artificial Earth Satellite based on the Observations at Two Stations," by Calin Popovici, Bucharest, studii Si Cecetari de Astronomie Si Seismologie, Academia Republicii Populare Romine, No 2, 1959, pp 299-304).

II. UPPER ATMOSPHERE

Study on the Origin of Lunar Craters

An article by P. F. Sabaneyen on the origin of lunar craters which appaered in a 1953 Soviet scientific periodical is reviewed below because of its timely interest in the light of today's events.

The author describes his experiments of throwing lumps of loose material (cement) onto a layer of loose material laying on a flat, hard base. Figure 1 shows the result - a model of a lunar crater in a layer of cement. It shows the characteristic features: a circular wall, in some places with folded structure, a steep inner slope and a gentle outer slope, a depressed inner region with the central peak, and rays of ejected material outside the circular walls. Some ejections not shown in the figure had lengths 10-12 times the crater diameter.

Figure 2 shows two falls onto a layer three times thicker. The crater diameter here is smaller, the central peak less developed, the inner slope nearly vertical, the amount of ejected material quite limited and the length of the ejected rays not more than 5-6 crater diameters. Figure 2, I, refers to a layer of compressed cement, and II, to a naturally loose layer.

Figure 3 shows the result of two throws, (I) as usual and (II) onto the same layer so that its impact point would be less than the predicted radius from the rim of the first crater. (This was to imitate the pair Theophilus and Cyrillus).

Figure 4 shows simultaneous falls of two lumps of cement close together. Such structures are not found on the moon (footnote by Editor questions correctness of this remark).

Figure 5 shows a throw of compressed tooth-powder onto a cement layer; here the tooth-powder completely fills the crater (like Wargentin). Ejections from the crater are negligible and chaotic. Increasing the height of fall of the tooth-powder shows the first appearance of a central peak of irregular shape.

The author has attempted to discover the relations between the forms and dimensions on one hand, and the physical factors of the fall on the other. The results are summarized as follows.

1) Density of the impacting object. Experiments showed the best resemblance to the lunar features when the lumps were made from pulverized matter with negligible cohesion between the particles. If the cohesive forces are increased the regularity of the forms is destroyed. Compression of the cement powder increases the cohesion of its particles very little but it changes the pattern of the figures: the central peak is higher, its pointedness greater, and the crater diameter smaller; and there are no ejections outside the crater. By using nonhomogenously compressed lumps of cement, the figures become irregular, often similar to Figure 4.

Slightly wetted calcinated soda, dried afterward, forms lumps of negligible strength but are not loose bodies. Such lumps thrown forcibly onto a cement layer create different forms. Near the impact point there are large splinters; the central peak is sharply pointed; and the wall is never a regular circle.

If a steel ball is thrown forcibly, it will deform not only the cement layer, but also the solid clay or sand surface below it. Transverse cross sections of these forms are similar to those of meteoritic craters and explosive funnels on the Earth but quite dissimilar to the profiles of lunar creters, which have no deepening in the center, but a peak.

In all further experiments the author has used an impacting object composed of loose material of naturally uniform density.

2) Shape of the impacting object. The author used several different shapes. The objects were dropped from a glass plate; by a quick movement of the hand they were made to fall freely. The greatest similarity with lunar craters was obtained by using figures of revolution (Figure 6, 1) (sphere, hemisphere, cylinder, cone, rotational ellipsoid), with their axes of symmetry parallel to the direction of impact. The falls of a vertical circular lens-shaped object are interesting to note (Figure 6, 5). They produced a vertical wall inside the crater and the outside ejections were oriented at right angles to the wall. On the moon Copernicus resembles this form. A. Wegener[1] erroneously explained this feature by oblique impact.

3) The impact angle. The author placed two wooden strips, 8 mm high, on a glass plate and between them poured a layer of cement. He smoothed the surface of the cement by putting another glass plate over it. This ensured the layer to be always of the same thickness and density. He then inclined the layer so prepared as shown in Figure 7. The cement layer was stable for inclinations $\beta < 30°$; if a rough wooden board was used instead of a glass plate, for all $\beta < 35°$. Cement (10 grams) was dropped from point A, 100 cm above the plate. The angle α, $(90° - \beta)$, was necessarily always larger than 55°. To obtain smaller values of the lumps were thrown from point A_1 (Figure 7). Figure 8 shows the result of impact at an angle $\alpha_1 = 5°$; Figure 9 for $\alpha_1 = 25°$; Figure 10 for $\alpha = 65°$; Figure 11 $\alpha = 80°$. When $\alpha = 90°$ the impact figures are found to be not stable in dimension or regular in form. Only perpendicular impacts give symmetrical cross sections in all directions. On the moon there are no features like those shown in Figures 8 and 9.

4) The layer density. Increase of cohesion in the layer changes the impact structure (Figure 12). For equal masses and equal velocities of the falling lump but increasing density of the layer, the diameter of the creater decreases, the inner slopes are less steep, the floor depth is less, and the ejections outside the crater walls, which consist of material from both the layer and the lump, are increasingly from the impacting material.

Ejections derived from the layer material are usually less splintered and are longer than those from the falling mass. They may form folds and conglomerations just outside the crater wall; or rays, which are moreor less continuous chains of lumps and patches. Rays derived from the falling mass itself, on the other hand, are continuous flat strips of finely dispersed matter.

5) the Layer depth. Figure 13 shows the change in crater cross section with the depth of the layer. Figure 14 shows the dimensions as they depend on the depth of the layer. The ejected mass is small for a deep layer and consists of the material from the layer itself. If the layer becomes thinner the ejected mass increases and the relative contribution from the impacting mass increases also.

6) The impact velicity. The author dropped lumps from different heights, 10-300 cm. The height could not be increased further, because air resistance started to destroy the lumps. Figure 15 shows the dependence on the velocity of impact of the crater diameter d, the crater area f, and the length of the ejections l_{max}. The velocity of the ejections increased with the velocity of impact. Table 1 shows the ejection velocity v_B and the impact velocity v_p (computed from H) in their dependence on the height H of the fall; v_B is calculated from $v_B = \sqrt{g l_{max} / \sin 2 O_1}$, where O_1 is the angle of the ejction with respect to the horizon and g is gravitational acceleration (O_1 is taken as 45°). Actually the impact velocity v_p is less than computed from H in Table I because of air resistance

Approved For Release 1999/09/08 : CIA-RDP82-00141R000201190001-1

TABLE 1

EJECTION VELOCITY v_B vs. VELOCITY OF FALL, v_P

H(m)	v_P(m/sec)	v_B(m/sec)	$n = \frac{v_B}{v_P}$
0.10	1.4	2.1	1.50
0.25	2.2	2.4	1.10
0.50	3.1	2.7	0.88
1.00	4.4	3.2	0.73
1.50	5.4	3.5	0.65
2.00	6.3	3.8	0.60
2.50	7.0	3.9	0.56
3.00	7.7	4.1	0.53

Also, in experiemental conditions Θ_1 is always different from 45°. That means that the actual initial velocity is always greater than the v_B in Table I and the relation $n = v_B/v_P$ is also greater than in the table.

7) The impacting mass. The crater diameter and the length of the ejctionsincrease with increasing impact mass.

In order to study the trajectories of ejections the author put onto the cement layer a vertical piece of thick blotting paper radially from the impact center (Figure 16). Then the ejections left traces on the wall of blotting paper. The angles of ejection appear the same for all trajectories, but the velocity is highest at the center where the ejection starts and smallest at the rim. By increasing the impact velocity or the mass, the angle of ejection decreases and approaches the angle of repose of the material used, being 45°.

By dropping cement onto a bare glass plate, the author obtained features resembling central peaks; but when the plate was covered with a layer of cement a circular crater was formed (cf. Figure 13). This appears to prove that crator formation and particle ejection at the rim are caused by the radial horizontal flow of the falling materials. There is no ground for comparing the formation of lunar crators with the wave pattern set up in a liquid as caused by an impacting body.

Figure 17 shows the formation of a model crater. A compact flux of falling particles is compressing the surface near the impact point and is pushing the cement layer sideway elsewhere. Part of the falling material forms a compressed control peak on which the residual material slides radially outward, thus forming a circular crater. The particle flux pressed on the inner wall of the crater with a pressure P. This pressure causes local demolition of the crater rim. The rim fragments may either pile up and cause folds in the crater rim, or break through and cause ejections. Against the lower part of the crater slope the pressure has a downward component. This component causes compression of the sub-surface material while the horizontal component continues to increase the crater diameter. As the crater grows the moving material is used up, the pressure on the crater wall decreases. The growth of the crater is arrested when the pressure P of the sliding material equals that of the resistant force caused by the crater walls. Ejection beyond the crater walls is possible only if the horizontal force exceeds a limit which is the higher the thicker the layer of cement. Intensive ejection is facilitated by an increase of density of the base layer.

Conclusions

1) Lunar craters were formed by the impact of dense, homogenous, definitely circular masses of loose material, though lens-shaped masses are possible also.

2) The lunar surface layers differ from the deeper layers by having lower rigidity.

3) The size of the craters and the great distances of ejection indicate falls of large masses rather than high impact velocities.

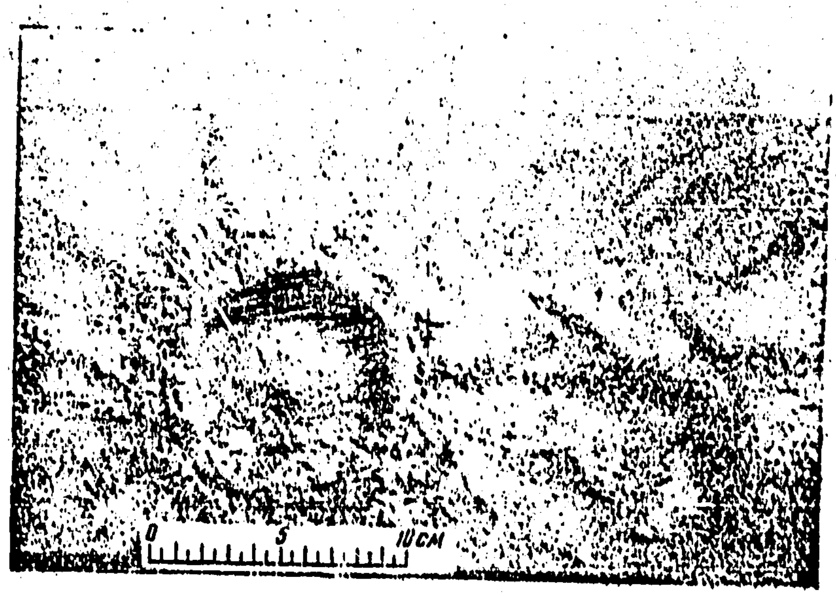
4) The circular shape of the craters suggests vertical falls. Ocassionally oval shapes of craters, irregularities of their inner structure, and the orientation of their ejections are proofs that cases of oblique falls do exist. All this suggests that the falls were the result mainly of the moon's gravitation. In case of vertical fall, the velocity was not higher than 24 km/sec; and, if there were no falls with an inclination less than 60°, the velocity was not higher than 2.75 km/sec. These velocities are too small to cause explosions on the site of the impact, for which 4 - 6 km/sec are needed.

5) Simultaneous falls of two adjacent masses near to each other occurred only once in many thosand cases. Consecutive adjacent falls on the moon are frequent. This shows that the masses that fell were common in space before they were attracted by the Moon. Clustering of craters may be taken as evidence of the attraction by the Moon of masses moving in the same direction. These preconditions suggest the existence in the past of a significant number of Earth satellites other than the Moon, causing their falling onto the lunar surface, with formation of the lunar cirques and craters.

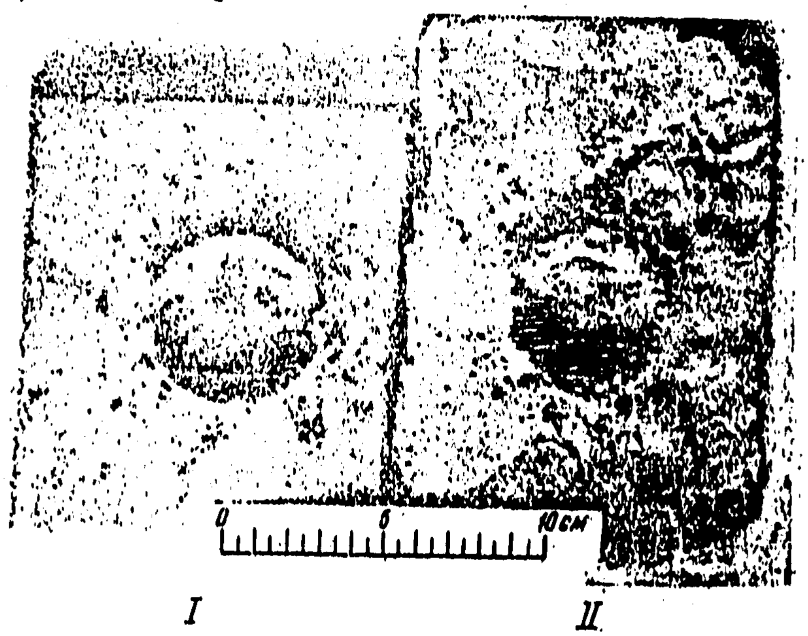
It is possible that cirques can be found on the satellites of other planets and on Mercury. There is no reason to assume thaton the Earth mountainous formations similar to lunar cirques could have been formed even if the stratigraphic conditions in the external layers of the earth's crust were favorable at the time. The mechanism would have been different because of the higher velocity, of the order of 11.1 km/sec. Then the change from the solid to the gaseious state [2] will interfere with the horizontal radial flux on the surface of Earth and with the structure of the deeper rocks. ("On the Origin of Lunar Craters," by P. F. Sabaneyev; Moscow, Byulleten' Vsesoyuznogo Astronomo-Geodezicheskogo Obshchestva, No 13 (20), 1953, pp 7-20). ✓

Figures

1) A typical model crator showing the pattern or the "figure of fall" in a cement layer.
2) Craters made in a layer 3 x as thick as in Figure 1. I - in compressed, II - in loose cement.
3) Combination of two patterns from different impacts. I - creater formed earlier, II - the later one.
4) Combination of patterns at simultaneous throwing of two lumps of cement.
5) "Mesa" formed by dropping lumps of compressed tooth-powder into a layer of cement.
6) Shapes of falling bodies used and resulting crater forms: 1-rotational figures; 2-square slab; 3-prolonged slab; 4-triangle slab; 5-lenses.
7) Impact angles: 1) layer of cement, 2) lump of cement dropping vertically, 3) lump dropping obliquely.
8) Impact at $\alpha_1 = 5^\circ$.
9) Impact at $\alpha_1 = 25^\circ$.
10) Impact at $\alpha_1 = 65^\circ$.
11) Impact at $\alpha = 80^\circ$. The arrows give the impact directions.
12) Crater forms in layers of different density. I - gypsum dropped into loose layer of cement; II - cement dropped into compressed layer of cement.
13) Cross sections of craters for different thicknesses of ground layer.
14) Rim diameter (d), rim height (h), central-peak height (h_o), and length of ejections (l_{max}) versus thickness of ground layer.
15) Geometrical properties of craters versus impact velocity.
16) Directions of ejection (vertical cross section).
17) Scheme of the formation of a crater wall.



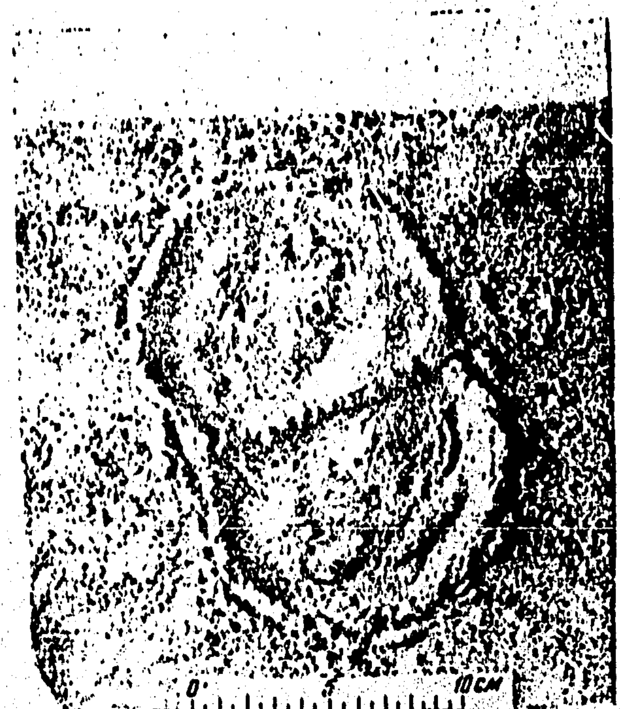
1. A typical model crater showing the pattern on the "figure of fall" in a cement layer.



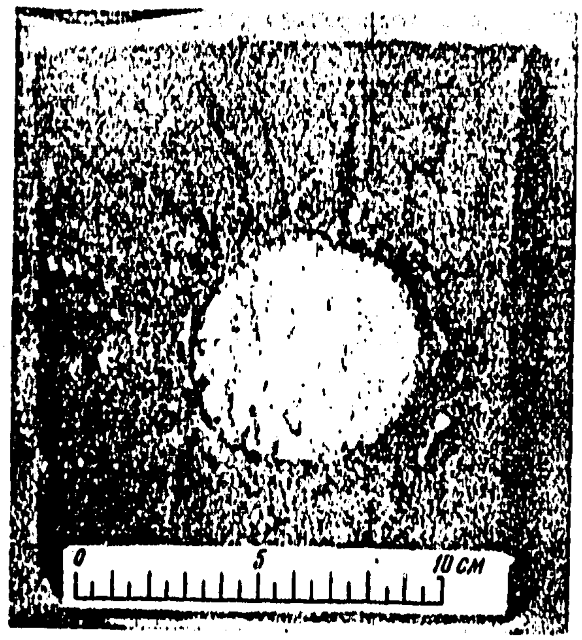
2. Craters made in a layer 3 x as thick as in Figure 1. I - in compressed, II - in loose cement.

Approved For Release 1999/09/08 : CIA-RDP82-00141R000201190001-1

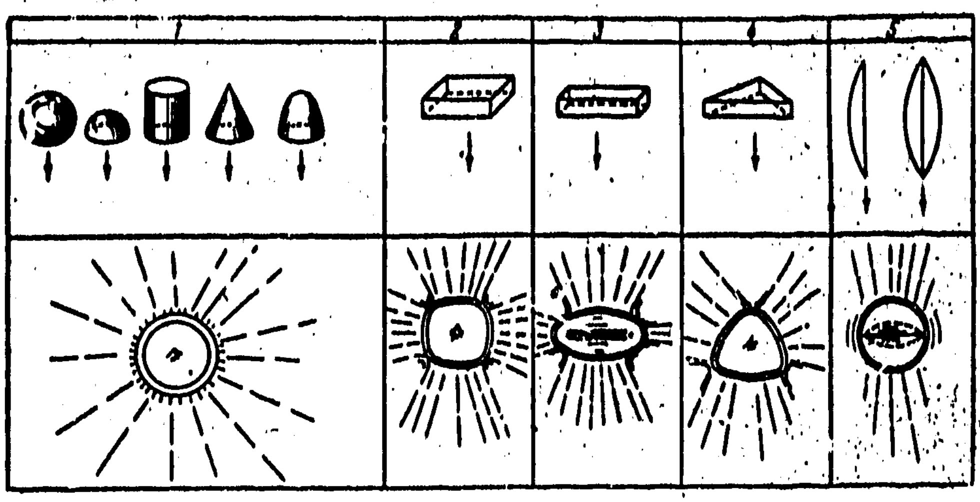
3. Combination of two patterns from different impacts. I - Crater formed earlier, II - the later one.



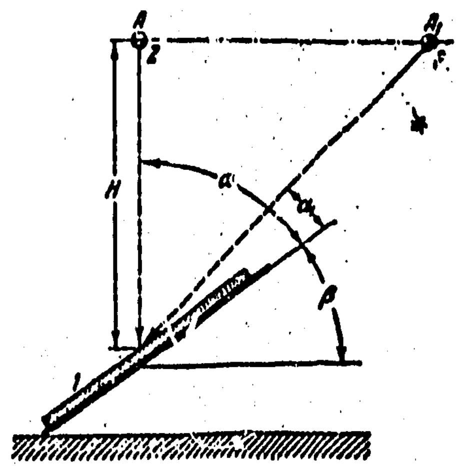
4. Combination of patterns at simultaneous throwing of two lumps of cement.



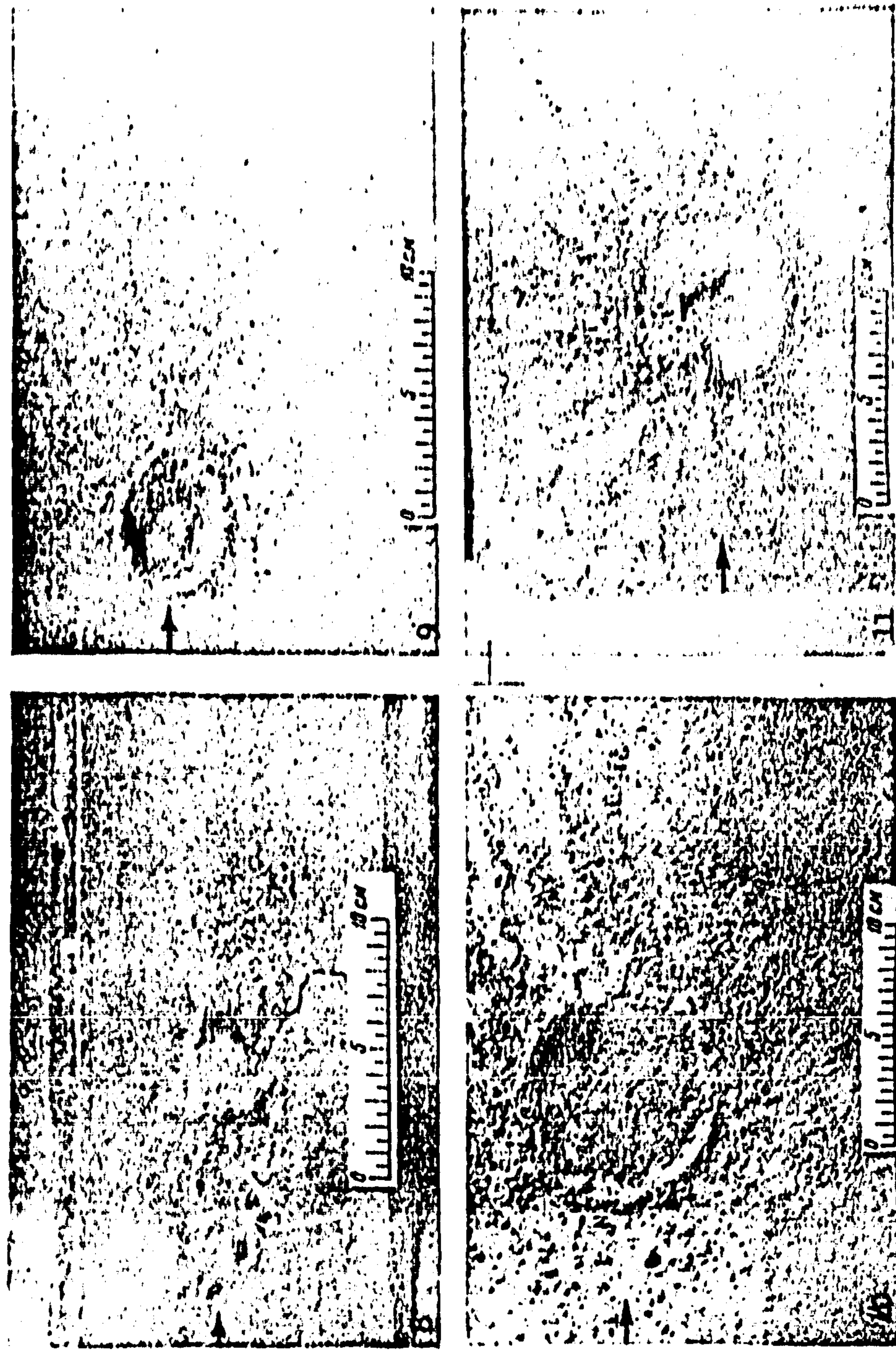
5. "Mesa" formed by dropping lumps of compressed tooth-powder into a layer of cement.



6. Shapes of falling bodies used and resulting crater forms: 1 - rotational figures; 2 - square slab; 3 - prolonged slab; 4 - triangle slab; 5 - lenses.



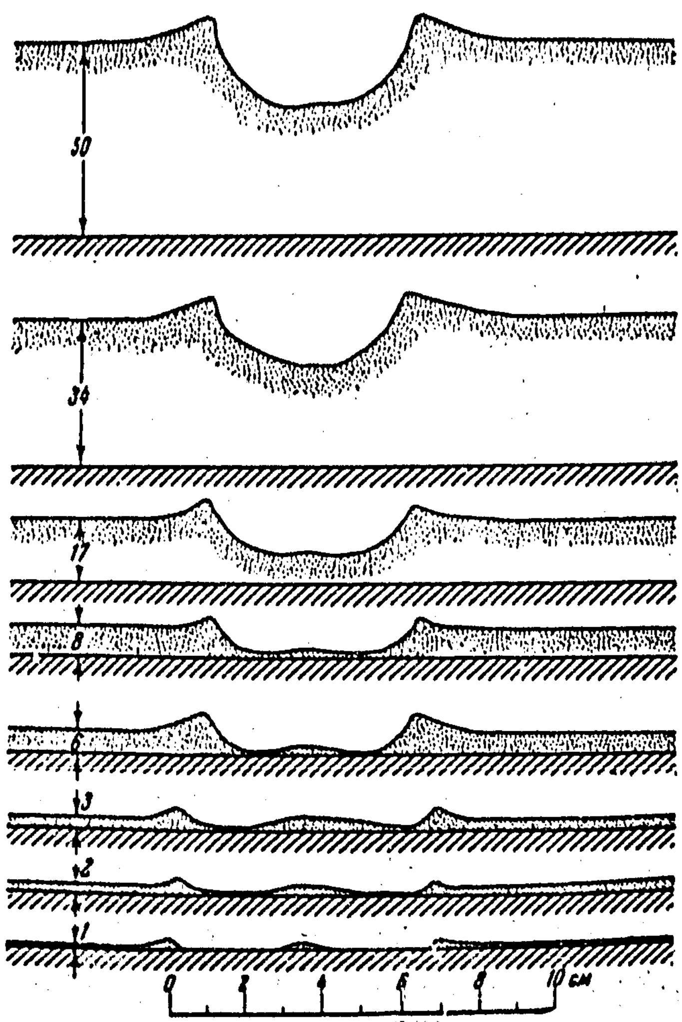
7. Impact angles: 1 - layer of cement, 2 - lump of cement dropping vertically, 3 - lump dropping obliquely.



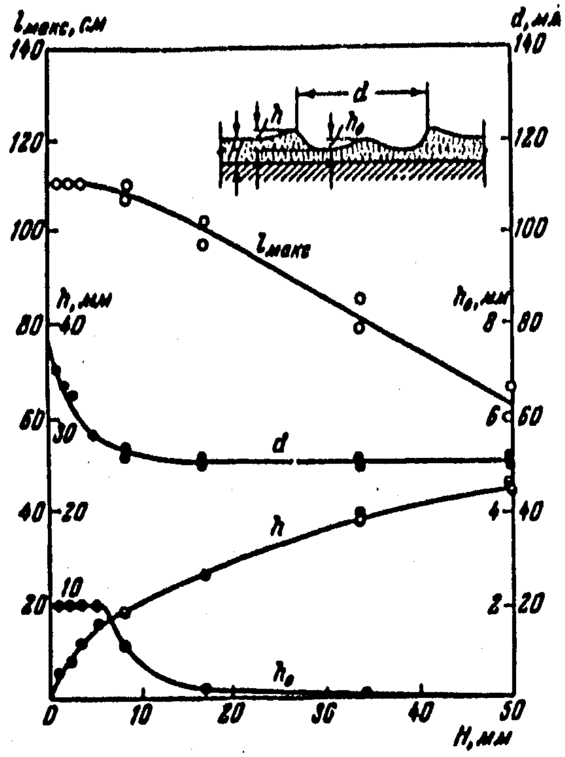
8. Impact at $\alpha_1 = 5^\circ$. 9. Impact at $\alpha_1 = 25^\circ$. 10. Impact at $\alpha = 65^\circ$. 11. Impact at $\alpha = 80^\circ$. The arrows give the impact directions.

Approved For Release 1999/09/08 : CIA-RDP82-00141R000201190001-1

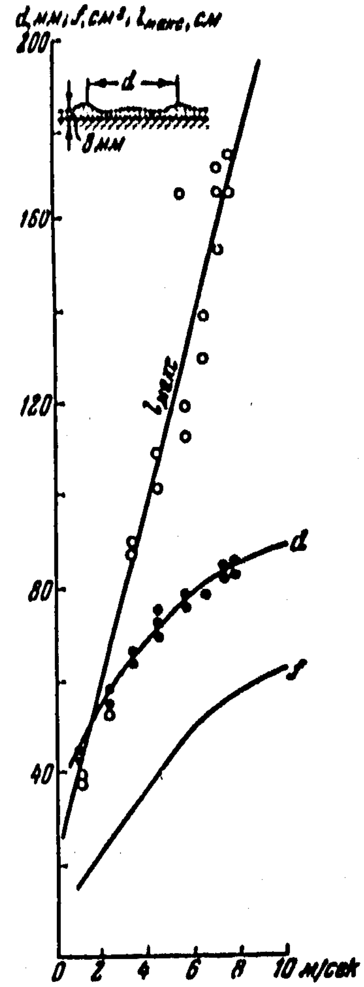
12. Crater forms in layers of different density. I - gypsum dropped into loose layer of cement; II - cement dropped into compressed layer of cement.



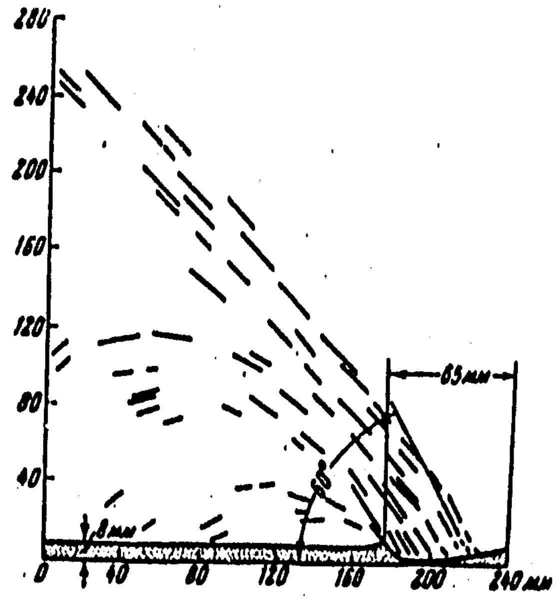
13. Cross sections of craters for different thicknesses of ground layer.



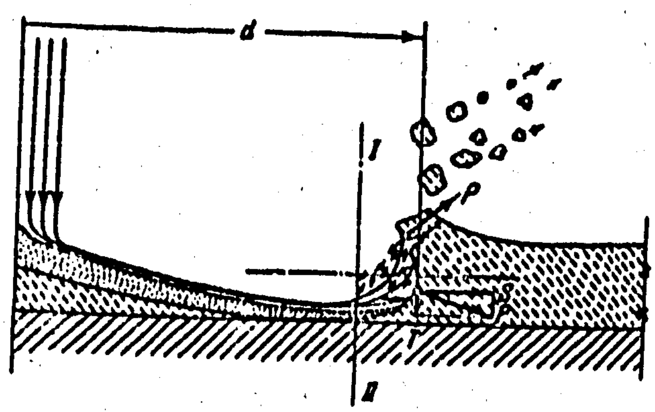
14. Rim diameter - d, rim height - h, central-peak height - h_o, and length of ejections - l_{max} versus thickness of ground layer.



15. Geometrical properties of craters versus impact velocity.



16. Directions of ejection (vertical cross section).



17. Scheme of the formation of a crater wall.

Approved For Release 1999/09/08 : CIA-RDP82-00141R000201190001-1

Study on Scattering and Polarization of Light in the Surface Layer

Some results obtained in determining the absolute and relative scattering functions of light in the ground layer of the atmosphere and also the degree of polarization at different angles of scattering are given by T. P. Toropova. The observations were conductied at the mountain observatory at the Astrophysics Institute of the Academy of Sciences, Kazakh SSR (height above sea leve, 1,450 meters) using a photoelectric photometer equipped with two light filters (495 and 520 millimicrons) and a polaroid filter.

The method for measuring the scattering function of light consisted in recording the intensity of light scattered from a searchlight beam directed at various angles. The degree of polarization of the scattered light was determined by using a polaroid placed before the photoemeter's lens. The polaroid could be rotated in three positions with 60° intervals. The absolute indicatrix of scattering was determined by measuring the brightness of a standard screen, the albedo of which is known, illuminated by the searchlight beam.

Results showed that the coefficient of scattering of a real atmosphere exceeded the coefficient of scattering of a Rayleigh atmosphere from 1.5 to 15 times. Thus, if the coefficient of scattering in the ground layer obtained from the observation data is taken as 100%, then aerosol scattering must be from 60 to 94%. Knowing the absolute scattering function the intensity of scattering can be divided into two components which are polarized in two mutually perpendicular directions. (Some Results of Measuring the Indicatrix of Scattering and the Polarization of Light in the Ground Layer of the Atmosphere," by T. P. Toropova; Alma Ata, Izvestiya Astrofizicheskogo Instituta, Akademiya Nauk Kazakhkoy SSR, Vol 9, 1960, pp 108-117)

Study on the Color of the Zenith Twilight Sky

The results of photoelectric observations of the energy distribution in the spectrum of the twilight sky at zenith are presented in an article of a recent Soviet astrophysical journal. The observations were conducted by N. B. Divari on the Kamensk plateau (43.2 N, 76.56 E, 1,450 meters above sea level) from 9 October to 1 November 1956. A photoelectric photometer in combination with interference filters centered in the following wave lengths 367, 369, 405, 437, 554, 580 and 593 milli-microns, was used. It was found that the observed energy distribution in twilight radiation is due to ozone absorption inthe Chappuis band.

A comparison of calculated values of brightness with those observed shows that the intensity of observed twilight illumination in all wave lengths of the visible spectrum is rather close to the intensity of first order scattered radiation only in the interval from 0° to 6.5° of the setting Sun. It greater depths of the Sun below the horizon the observed intensities exceed the calculated intensities of first order scattering. The color temperature for the 440-600 millimicron region of the spectrum changes in relation to the dip of the Sun below the horizon and has a maximum value when the Sun is about 10° below the horizon. These changes are almost absent in the blue part of the spectrum (370-440 millimicron). The change in the color of the twilight sky are caused principally by the 440-600 millimicron region, i.e. the absorption in the chappuis band, and the hieghts of the so-called effective twilight rays for various positions of the Sun below the horizon and the different wave lengths. ("The color of the Zenith Twilight Sky," by N. B. Divari; Alma Ata, Izvestya Astroficheskogo Instituta, Akademiya Nauk Kazakskoy SSR, Vol 9, 1960, pp 96-107)

Observations of Zodiacal Light by Soviet Expedition in Egypt

Observations of Zodiacal light were made in Egypt in 1957 by an expedition headed by Academician V. G. Fesenkov, Institute of Astrophysics, Academy of Sciences Kazakh SSR, Visual observations on the polarity of Zodical light were conducted using a binocular photometer equipped with two polaroid screens. Measurements were made for every 60 degrees during the counter-clockwise rotation of the screens. Tables given in the article present averaged data on the degree of polarization, the direction of the vector of polarization, and different additional values characterizing the conditions of the appearance of Zodiacal light--the angular distance from the Sun of the point of the sky being observed and its altitude over the horizon, the inclination of the ecliptic to the horizon and the sinking of the Sun below the horizon.

It was found that the degree of polarization decreases with the angular distance from the Sun. This is especially apparent in the case of morning Zodiacal light. ("Polarization of Zodiacal Light according to Observations in Egypt," by V. G. Fesenkov, Alma Ata, Izvestiya Astrofizicheskogo Instituta, Akademiya Nauk Kazakhskoy SSR, Vol 9, 1960, pp 3-9).

Airglow Studies in the Visible Region of the Spectrum

The results of the spectrophotometric study of continuous and emission spectrum of night airglow in the visible region, 4,100-6,500 Angstroms, made by Z. V. Karyagina and L. N. Tulenkova on the GAISH nebular spectrograph located in the region of Bol'shoye Almatinskoye Ozero (H 3,000 M), are given. The energy distribution of the night sky contineus spectrum and the intensity of the 5,577, 5,893, 6,300, 6,400 Å emission lines were determined using stars for which the energy distribution was known as standards. ("Spectrophotometric Study of the Continuous and Emission Spectrum of the Night Sky in the Visible Region of the Spectrum," by Z. V. Karyagina and L. N. Tulenkova; Alma Ata, Izvestiya Astrofizicheskogo Instituta, Akademiya Nauk Kazakhskoy SSR, Vol 9, 1960, pp 86-95)

Method of Determining the Coefficient of Transparency

A method of determining instantaneous values of the coefficient of transparency according to Bouguers dependence and the simultaneous observation of a star near the polar region is proposed by A. V. Kharitonov in an article published by the Kazakh Academy of Sciences. ("Problem of Determing the Night Coefficient of Transparency," by A. V. Kharitonov; alma Ata, Izvestiya Astrofizicheskogo Instituta, Akademiya Nauk Kazakhskoy SSR, Vol 9, 1960, pp 53-55)

Method of Reducing Observations of Zodiacal Light

Academician V. G. Fesenkov, Institute of Astrophysics, Academy of Sciences, Kazakh SSR, describes the method he employs for the reduction of photometric observations of Zodical light, in one of the institute's publications. The problem is resolved by finding the proper system of isophotes characterizing the pehenomenon of Zodiacal light as it would be observed beyond the atmosphere and particularly the background presented by our Galaxy. (Method of Reducing Photometric Observations on Zodical Light," by V. G. Fesenkov; Alma Ata, Izvestiya Astrofizicheskogo Instituta, Akademiya Nauk Kazakhskoy SSR, Vol 9, 1960, pp 35-39)

Method of Determining the Radiants of Meteor Showers

A method making it possible to determine the radiants of meteor showers is proposed by Ion Corvin Singorzan in an article published by the Rumanian Academy of Sciences.

The method consists in the construction of a celestial map in a stereographic projection with its central point in an approximate radiant. On such maps, meteorites belonging to the appropriate meteor shower, will be located approximately along meridians of the projection. Thus, it is possible to indicate them in the form of segments of straight lines. The intersection of the straight lines will give the location of the radiant. For a more precise determination, a new map, having as a central point a previously determined radiant, is constructed. The advantage of this method lies in the method of stereographic projection (in contrast, for example, to a gnomonic projection) which retains the angles and similarity of the figures, whereupon the constellations plotted on this projection are not distorted. The article also contains an application of the method for 41 Geminids meteors observed by direct visual means. Also included in the article is a table giving the rectangular coordinates of 37 stars, the use of which aided in constructing a map for observations of the Geminids. ("Determination of the Radiants of Meteor Showers," by Ion Corvin Singeorzan; Bucharest, Studii Si Cercetari de Astronomie Si Seismologie, No 2, 1959, pp 407-413)

More Information on the Secret of the Tunguska Catastrophe

Additional reports continue to emanate from the Soviet Union concerning the intriguing mystery of the Tunguska meteorite of 1908. The following is the full text of a Priroda feature article:

More than 50 years have elapsed since the day of the fall of the Tunguska meteorite, and the problem of what happened to the body of the meteorite and of what elements it was composed, has still remained unsolved. Until now, despite careful research, no one has succeeded in finding even a single, even the most insignificant particle of matter known to have been part of the meteorite.

In 1957 A. A. Yavnel', a member of the Committee on Meteorites of the Academy of Sciences of the USSR, discovered the presence of small particles of ferronickel in soil samples that had been taken by L. A. Kulik at the time of his research; the composition of these particles correspond to the material typical of iron meteorites. It therefore appeared that the problem of the composition of the Tunguska meteorite had finally been solved.

Yavnel's data formed the basis for an expedition organized in the summer of 1958 by the Committee on Meteorites. The purpose of the expedition was the conduct of a metallometric survey in the region in which the meteorite had fallen. However, in not one of the numerous soil samples taken in the different sectors of that region did they succeed in finding a single particle of ferronickel.

The results of the expedition of 1958 have shown that the Tunguska meteorite was not of iron, but of some other composition. In respect to Yavnel's observations, we must take into consideration the fact that he conducted his research in the same room where, over a period of years, a general study was being made of numerous specimens of the Sikhota-Alin iron meteorite, These specimens, subjected to mechanical processing, yielded a considerable amount of dustlike particles which probably could have become mixed with the material studies by Yavnel' and distorted the results of his research (at the present timethe Committee on Meteorites is conducting additional research in order to clarify the true composition of the specimens that had been collected by L. A. Kulik). At the time of the expedition in the summer of 1959 I and V. I. Petrov, a student at the Irkustk Agricultural Institute, conducted a check on the report of the biologist and hunter K. D. Yankovskiy that he had discivered a stone block resembling a meteorite in 1929-1930 in the region of the Central Basin. Unfortunately we did not succeed in finding this mysterious stone because during the 30 years that had elapsed Yankovskiy had completely forgotten the precise location of the stone.

In addition to our small group, in the summer of 1959 three other independent groups worked in the area in which the Tunguska meteorite had fallen. Of the four groups working in 1959 in the region in which the Tunguska meteorite had fallen, only one, made up of A. V. Zolotov and I. G. Dyad'kin (they spent three days there), established that the trees there had been subjected to radiation burning and they determined the height of the nuclear explosion (5 km) from the character of the charring of the trees.

In respect to radioactivity, the group working under the direction of engineer-doctor G. F. Plekhanov of the Tomks Medical Institute discovered high beta-radioactivity of the upper layers of the soil in the central part of the basin. At the same time it should be noted that according to observations made by the group headed by the engineer B. R. Smirnov, outcrops of the principal igneous rocks -- traprocks, extensively developed in this region -- are characterized by a high level of natural radioactivity. These igneous rocks form the amphitheater of low mountains framing the basin.

Our observations completely disproved the idea of an instananeous radiation burning. Everywhere in the region where the meteorite fell and in the zone where the trees had been knocked over, we observed clear traces of a surface fire, as a result of which not only the trunks and branches had been burned, but also the exposed roots of fallen trees.

The principal "witnesses", completely disproving the hypothesis of a radiation fire as a result of a nuclear explosion, are the twin larches discovered within the south swamp; because of their size they stand out boldily among the other thinnly-scattered trees in the area. We have cut down one of these larches. A close study of the annual rings has shown that it is 104 years old. The age of the other trees in the south swamp does not exeed 25-30 years. The larches were situated in the epicenter of the supposed "nuclear explosion", at a point where the highest temperature would have occurred. These are healthy and completely normal trees without any traces of burning.

a surface fire raging in the region where the meteorite fell, destroying the vegetation within its range and charring branches, trunks, and roots, could not reach these twin trees because they grew in an isolated location far from the shore, in the middle of a wet swamp. The presence of these trees refutes the theory that the south swamp was formed as a result of the catastrophe occuring in this region in 1908. It is probable that with a more detailed investigation of the south swamp we will also find other living "witnesses" of the fall of the Tunguska meteorite.

Partisans of the hypothesis of a nuclear explosion, rejecting the theory of the falling of a meteorite, ask: "Well, where are the traces of it? They have never been found!"

Is this true? L. A. Kulik has already point out numerous depressions in the swampy sectors within the Great Basin. Their great number and their prevailing form, often in the form of a perfect circle, were so striking that Kulik had no doubt of their meteoric origin. He felt that such a flat and funnel-shaped depression amidst extensive areas of peat bogs must have been formed as a result of the falling of a mass of meteoric matter corresponding to the size of the funnel.

Within one of them -- the Suslov funel -- he performed laborious work in the form of draining and drilling and magnetometric and other research, vainly trying to find a large mass of meteoric iron buried deep in the funnel. This search was a failure and Kulik concluded that the main mass of the huge iron meteorite must have fallen within the limits of the south swamp and lay there at depth, amidst ooze and silt. (Priroda, No. 11, 1959, pp. 84-85, contains information on a discussion of the Tunguska meteorite. Unfortunately, the information was in part incorrect. In particular it indicated that meteoric debris should be sought in front of the zone of destruction. The conferees V. N. Rodionov and M. A. Tsikulin report that according to their hypothesis the flying meteorite causes a shock wave and therefore the falling of meteoric debris, if this should survive, could occur only beyond the epicentral zone in the direction of the meteorite's flight — Editor's note.)

After it had been established that these funnels were formed as a result of the thawing of permafrost (thermokarst), no further interest was shown in them and researchers no longer paid them heed, but, as it turns, out, they were wrong in so doing. If we examine aerial photographs of the area situated on the interfluve of the Chamba and Kimcha Rivers, we then see that there are extensive swampy areas there — peat bogs. However, only in the region of the Great Basin, that is, in the area of the presumed fall of the Tunguska meteorite, is there a widespread development of such thermokarst formations; in other sectors they are encountered in only very limited numbers.

What is thermokarst funnel like. Where and under what conditions is it formed?

It is known that thermokarst formations develop in areas of permafrost, in sectors made up of an alluvial material of a sandy-silty composition, containing layers and lenses of ice. They are formed in places where something has broken the layers of peat or moss that cover these alluvial deposits and protect them from the influence of positive temperatures in the summer season. The destruction of this insulating cover leads to a thawing of the ice-impregnated alluvial deposits, the collapse of the side walls, and the gradual development of the thawing process. In places where the thickness of the insulating layer is not great, the agent needed for the formation of thermokarst may be the accidental breaking of the peaty cover, for example, by the falling of an unrooted tree.

In 1959 I determined the thickness of the peat cover within the north swamp, the site of the most extensive development of these thermokarst formations. For the most part it exceeds 1.0 meters, sometimes extending as deep as 2.0 meters. Only near the Suslov funnel, where there has been a trampling of the peaty cover over an extensive period of time by the participants of the Kulik expedition during their work there, was the thickness of the cover as little as 0.8 meters.

Observations also show that the maximum thawing of the peaty covering attains a depth of 0.5-0.6 meter (at the end of August it ranges between 0.4-0.5 meter). The root systems of the few trees growing within these peat swamps also penetrate to this same depth.

Thus, the uprooting and the falling of trees could not break the peaty cushion and lay bare the frozen material underneath, that is, it could not cause the development of thermokarst. Neither could it be caused by fires in the taiga, since at a depth of 10 cm from the surface the peat mass is saturated with water like a sponge. How then can we expalin such a wide development of thermokarst formations in the very limited area identified with the site at which the meteorite fell?

A natural conclusion thrusts itself foreward -- the causative factor in the mass development of thermokarst formations in this part of the region was the falling of numerous fragments of a meteorite which, on breaking through the thick peat cushion, penetrated deeply, laying bare the ice-impregnated silty alluvium. Thus, the small meteorite fragments, in the process of development of thermokarst, could cause the development of a thermokarst funnel not corresponding to the size of the fragment.

From this point of view it is completely clear about the tree stump found in the Suslov funnel that caused such confusion among the participants of the expedition of 1929-1930. Kulik intuitively sensed a connection between these funnel-like depressions and the fall of meteoric masses. However, he regarded this phenomenon in a lifeless and static form; he felt that the size of the funnel should correspond to the mass of the meteorite causing it, which, in his opinion, was of iron.

The problem of the Tunguska meteorite is complex and if it is to be solved it requires painstaking work by different specialists directly in the field. The 1959 excursion by individual independent groups into the region in which the Tunguska meteorite had fallen can lead to imitation. It is sufficient that a forest fire develop in the area of the Kulik base (a probability with the influx of unorganized visitors) to completely eliminate the traces of this exceptional phenomenon that in many respects has still remained unstudied.

It is necessary that the Committee on Meteorites undertake the organization of a complex expedition for the all-around and detailed study of the circumstances of the fall of the Tunguska meteorite, because its traces each year become less and less clear.

("Secret of the Tunguska Catastrophe, the Fall of a Meteorite or a Nuclear Explosion?", by B. I. Vronskiy, Prioda, No. 3, March 1960, pp 88-91)

"Lunar Motion" -- A Full Translation from "Priroda"

Two heavenly bodies -- the Sun and Moon -- due to their brightness and apparent size, have the greatest importance in the life of Man and are the most important objects for observations by astronomers.

In order to study the motion of the Moon, it is necessary to know the laws of motion of the planets around the Sun. For the most part they are determined by attraction to the Sun, whose mass is many times greater than the mass of the individual planets, such as the Earth, which is exceeds by 330,000 times. The mutual attraction of the planets, however, only distorts the simple elliptical motion. All this can also be said of the motion of the Moon around the Earth; the Sun, however, plays the role of a perturbing body (changing the form and position of the orbit in the motion of the Moon). Since the Sun possesses a huge mass, the perturbations which it causes are very great.

The problem of two bodies. In order to more clearly represent the main characteristics of the Moon's motion, we first examine the so-called problem of two bodies applicable to the system Earth-Moon, that is, we examine the motion in the absence of perturbing bodies. Newton demonstrated that in this case the motion of body B (Moon) relative to body A(Earth), will occur along an elliptical route (Figure 1), one of whose foci coincides with body A. The larger axis of the ellipse, its compression and position in space, will remain unchanged during the course of the entire motion. The speed of motion along the elliptical route changes periodically in such a way that the areas described by the straight line connecting points A and B are equal to one another at equal times. This is Kepler's first two laws of planetary motion, derived by him from observational data. They are the mathematical consequence of Newton's formula expressing the law of universal gravitation.

The Moon's elliptical orbit is determined by three values: the larger semi-axis of the ellipse, eccentricity and the longitude of the perigee. (Eccentricity e is the name given to the ratio of the distance between the center of the ellipse and the focus to half the length of the large axis a; for the Moon $a = 384,395$ km; $e = 0.0549$. The longitude of the perigee is the angle between the direction from the center of the Earth to the perigee and the selected initial direction.) In the absence of perturbations these values remain constant and are called the elements of the orbit. Their value depends on the initial conditions of the motion. In order to compute the position of the Moon in the ellipse for a given moment, determinedby the angle BAP, there should also be known the longitude of the moon at the initial moment and the period of its full revolution, that is, the length of a month. To determine the position of the Moon in the heavens we should also have the position of the plane of the orbit in space. It is given relative to the plane of the Earth's orbit, that is, the plane of the ecliptic. In the celestial sphere the ecliptic is given as a great circle, along which there occurs the apparent annual motion of the Sun. In Figure 2, let AA' represent the great circle, that is, the ecliptic. The great circle BB' corresponds to the plane in which the Moon's orbit is situated. These planes intersect along the line ON, if O is the common center of the Earth and the celestial sphere. We then select some initial direction OE in the plane of the ecliptic. Then the position of the plane of the Moon's orbit is completely determined by the angle EON between the initial direction OE and the line of the nodes ON and the angle of inclination of the plane of the Moon's orbit to the plane of the ecliptic. (The nodes of the Moon's orbit are points of intersection of the orbit and the ecliptic. The mean inclination of the Moon's orbit to the ecliptic is $5^{o}8'43''$.) These two angles together with the four earlier named elements constitute the six elements which are constant in the problem of two bodies. They enable us to compute the corrdinates of the Moon for any given moment of time from not very complex forumulas for the elliptical motion.

Influence of the Sun. However, the motion of the Moon is actually distinguished by extraordinary complexity due to great perturbations from the Sun. The problem of developing a theory of the motion of the Moon, based on the law of universal gravitation, attracted the attention of the greatest mathematicians, such as Lagrange. All the elements of the elliptical motion change under the influence of these perturbations; some, such as eccentricity and the larger semiaxis of the orbit, only in narrow limits, whereas others -- the longitude of the node and the longitude of the perigee --- have secular inequalities, that is, they constantly increase or decrease. Thus, the line of the nodes moves in the plane of the ecliptic in a direction opposite that of the Moon's motion and makes a full turn in 18.6 years; the larger axis of the ellipse constantly rotates in the direction of the Moon's motion and makes a full turn in 8.85 years. Both these motions are irregular, since small periodic variations are superimposed on them. Besides the perturbations caused by the Sun there are numerous perturbations caused by the attraction of the planets. The direct influence of the planets on the Moon is insignificant, but the planets perturb the motion of the Earth and this is indirectly reflected on the motion of the Moon. In particular, the eccentricity of the Earth's orbit slowly decreases over the millennia and this results in a decrease in the period of revolution of the Moon and, as a consequence, the so-called acceleration of the Moon.

Brown's tables. The precise computation of the Moon's motion is the most difficult problem in celestial mechanics. The best modern tables for the motion of the Moon have been compiled by Brown. They fill three large-format volumes. These tables were compiled on the basis of a theory in which the longitude of the Moon is expressed in the form of the sum of periodic terms. The Moon's coordinates are computed by using Brown's tables; these are given in astronomical yearbooks for each hour of the year for several years in Advance.

Do such carefully computed tables of the motion of the Moon agree with observations, which have now attained a high degree of perfection? The use of photography for the determination of the corrdinates of the Moon enables us to measure then with an accuracy up to 0.1"-0.2"; in the Moon's orbit this corresponds to 360 m. Small deviations between observations and the tables have been discovered; the problem in question is interesting from two points of view.

Firstly, the Moon is a wondrous object, enabling us to solve the problem of the accuracy of the Newtonian law of universal gravitation. In actuality, the slightest error in the Newtonian law would be discovered due to the Moon's closeness to the Earth and the rapidity of its motion. Attempts have been made in this direction to slightly refine Newton's law in order that there be greater agreement between theory and observations, but these attempts have been unsuccessful. No one any longer believes that from the position of classical mechanics any change in Newton's law is required. In this respect the theory of the Moon's motion served as a key test of the accuracy of the Newtonian formula for universal gravitation.

Approved For Release 1999/09/08 : CIA-RDP82-00141R000201190001-1

Secondly, during the last half-century of lunar observations there have been noted small deviations of lunar longitude from that shown in the tables. It has become clear that these deviations in the longitude of the Moon are not the result of any errors in theory, but are due to irregularities in the diurnal rotation of the Earth. For several reasons the angular velocity of the Earth's rotation experiences changes, and as a result the length of day also changes. Detailed investigations of this phenomenon have shown that this irregularity in the rotation of the Earth consists of three parts: of the secular deceleration of the Earth, manifested in the so-called acceleration of the Moon (in addition to the acceleration mentioned before); of erratic change in the velocity of rotation of the Earth, sometimes having an intermittent character; of recently discovered seasonal changes in velocity with a period of one year.

As is well known, astronomical clocks are checked by observations of the diurnal rotation of the heavens; this means, in essence, that they are compared with the rotation of the Earth. Since the latter is irregular, the computation of time suffers from the same inadequacy. As a result, astronomers have ascribed an incorrect moment of time to a given observation of the Moon; this has led to an erroneous conclusion about the inaccuracy of lunar tables. This, the theory of the Moon and the lunar tables compiled on the basis of this theory, are extremely perfect, but the reckoning of time, based on the Earth's rotation, is inexact.

The reason for the irregularity of the rotational motion of the Earth should be soughtin geological processes taking place in the hard crust of the Earth or even in the Earth's core. Seasonal movements of air masses may be of significance. Here the science of astronomy is contiguous with geology. Lunar observations and the drawing up of tables of lunar motion have led, as we can see, to the discovery of a new phenomenon of geophysical character.

Rotation of the Moon on its axis. Up to this point we have spoken of the motion of the Moon around the Earth, that is, about its orbital motion. But the Moon also has a rotational motion around its axis. It is generally known that the period of this rotation is equal to the period of revolution of the Moon around the Earth -- 27.321661 days. Both these motions are made in the same direction; as a result the same face of the Moon is always turned towards the earth. Judging by several descriptions that have come down to us, so it was in deep antiquity. It has been difficult to imagine when and in what manner Man would be able to learn what is located on the unseen side of the Moon. The daring ideas of K. E. Tsiolkovskiy about interplanetary flights indicated that it was essentially possible, but how great is the gap between "essentially possible" and actual accomplishment:

On 7 October 1959 the reverse side of the Moon was photographed during a period of 40 minutes from the space laboratory launched in the Soviet Union. Seas, mountains, and craters were discovered and have been named (see <u>Prioda</u>, 1959, No 11, pp 3-15).

The rotation of the Moon around its axis differs only insignificantly from even rotation, but the motion in its elliptical orbit is accomplished, as we have seen, with a variable velocity -- the velocity is greatest at the perigee, and least at the apogee. As a result, the arrangement of spots on the Moon's face, visible even with the naked eye, changes somewhat during the course of a month in relation to the edges of the Moon. In Figure 3, where the eccentricity of the ellipse is highly exaggerated for the sake of clarity, the positions of the Moon are shown at equal intervals of four months. Since the Moon rotates at an even rate, the radius Oa associated with it turns 90° every time during these intervals and assumes the positions Oa_1, Oa_2, Oa_3, and Oa_4; these are mutually perpendicular. The center of the Moon's disk, observed from the Earth T, coincides with the points a_1, b_2, b_3, and b_4 on the surface of the Moon. For this reason it will seem to the observer that the Moon's sphere turns at some angle during the course of the month, as if making pendulumlike oscillations, alternately eastward and westward. This phenomenon is called optical liberation in longitude. Its maximum value is 7°45'.

In addition to longitudinal liberation, there is a latitudinal liberation but its cause is completely different. The axis of the Moon's rotation is inclined to the plane of the ecliptic so that the lunar equator forms an angle of 1°32' with this plane, while the plane of the lunar orbit is inclined 5°9' to the plane of the ecliptic. As a result, in the course of a month first the northern and then the southern pole of the Moon appears on the visible side of the Moon and the spots on its disk apparently shift first to the south, then to the North, Such a phenomenon is called latitudinal liberation. Its extreme values are ± 6°41'.

Everything that has been said is on the assumption that observations are conducted, as it were, from the Center of the Earth. For observers situated at different points on the Earth's surface, the Moon is observed at several different angles; this causes a phenomenon called parallactic libration.

All three forms of libration, acting jointly, serve as a reason for the center of the visible disk of the Moon to move across the Moon's surface in the limits of a small circle with an angular radius of about 10° and explain why we can see a total of up to 60% of the Moon's surface.

In conclusion, we note that the Earth, together with its satellite, the Moon, is in some sense an exceptional phenomenon in the solar system: many planets have satellites, but their size is alwys very small in comparison with the corresponding planet. The diameter of our moon, however, is one-quarter that of the Earth. We could even speak of a double planet in our case. In the course of a month the Earth and the Moon rotate around a common center of gravity; the Earth describes an orbit similar to that of the moon, but it is 81 times smaller in size -- such is the ratio of the mass of the Earth to the mass of the Moon. Such motion by the Earth is reflected in the apparent position of the planets of the solar system closest to it. By knowing the radius and mass of the Moon, we can compute what velocity we must impart to a space ship in order to launch it from the Moon's surface for an interplanetary journey. We find that the "second cosmic velocity" for the Moon is a total of 2.4 km/sec.

The problem of the motion of the Moon has been fully developed and perfected in our time; it satisfies all practical requirements of the science of astronavigation. ("Lunar Motion", by Professor A. A. Yakovkin, Prioda, No. 3, March 1960, pp 47-50) ✓

III OCEANOGRAPHY

Review of Book on Undersea Research

The book Pokoreniye Glubin (Conquest of the Depths) by M. N. Diomidov and A. N. Dmitriyev, is reviewed, by L. Chernous'ko engineer-captain in the March issue of Tekhnika Molidezhi.

The means of conducting underwater research, diving bells and chambers, diving suits, aqualungs, bathspheres, hydrostats, bathyscafs, and television and photographic apparatus, are considered in detail.

Operations with the Soviet GKS-6 hydrostat, which is designed for work at depths down to 400 meters are described. Since the publication the book the GKS-6 has been replaced by the hydrostat produced by the State Institute for the Planning of the Fishing Fleet.

The book has its shortcomings, says Chernous'ko, one of these is the brief treatment given the scientific operations conducted by the "Severyanka," the world's first research submarine. However, he considers that it is well written as a whole and can be recommended for a wide group of readers. ("Path to the Sea Depths," Book review by L. Chernous'ko; Moscow, Tekhnika Molodezhi, No 3, March 1960, p 39).

IV SEISMOLOGY

Stereographic Projection of European Seismic Stations Centered on Vrancea

$$\text{Values of } S = \frac{R \sin \Theta}{\cos \Theta \neq \cos \Delta} \text{ and } p = \frac{R \sin \Delta}{\cos \Theta \neq \cos \Delta}$$

that is the stereographic projection of a circle with a radius Δ around a station Σ, depending on the argument Δ, are calculated for 20 European seismic stations in an article appearing in a Rumanian scientific publication. From the viewpoint of a stereographic projection, the author considers a point diametrically opposite a point 0 with the coordinates 45.8 N and 26.5 E which corresponds to the mean value at the Vrancea epicenter. ("Stereographic Projection of European Seismic Stations with its Center in the Epicenter at Vrancea," by A. Serian; Budapest, Studii Si Cercetari de Astronomie Si Seismologie, No 2, 1959, pp 435-445)

Eruption of Mud Volcano on Sakhalin

The eruption of a mud volcano which occurred on 20 March 1959 on the island of Sakhalin is described in the Soviet scientific periodical Sovetskaya Geologiya, No 2, 1960. The mud cone is located in the vicinity of the city of Yuzhno-Sakhalinsk some 23 kilometers from the Yuzhno-Sakhalinsk--Kholmsk railroad.

According to eyewitnesses, powerful explosions threw mud mixed with gases as high as 120 meters. These explosions were recorded by the seismic station of the Sakhalin Complex Scientific Research Institute (SakhKNII) during the first 11 minutes. Thereafter, the intensity of the eruption abated though the volcano continued its activity.

The total volume of ejected mud, consisting mainly of diluted and later of dehydrated agrillites, covered an area of about 6 hectares and in volume equalled about 200,000 cubic meters. In samples of the mud taken by associates of SakhKNII, metaboric acid and iodine were detected. In the gaseous products of the eruption, methane, carbon dioxide, oxygen, nitrigen and rare elements were noted. ("Eruption of Mud Volcano on Sakhalin," by L. F. Kratkovskiy; Moscow, Sovetskaya Geologiya, No 2, February 1960, pp 145-146).

V ARTIC AND ANTARCTIC

Report on the Glaciers of Novaya Zemlya

The following is the full text of an article in the March 1960 issue of Priroda. The author, N. M. Svatkov, Candidate in Geographical Sciences, was a participant on the Novaya Zemlya Glaciological Expedition of the Institute of Geography of the Academy of Sciences of the USSR.

The largest ice sheet in the Soviet Union is situated on the northern island of Novaya Zemlya; its area is about 19,000 square kilometers. The size, composition, structure and conditions of preservation of this mass of continental ice has long been of interest to scientists. The glaciers of Novaya Zemlya were first investigated by V. A. Rusanov in 1907. A year later, with Rusanov participating, a group of scientists of the French Polar Expedition, headed by Charles Venaire, first crossed the ice sheet at 74° N. V. A. Rusanov was the only one to make the difficult trek to the Kara side and back. The glaciation of the northern island was studied by participants of the G. Ya. Sedov expedition and by O. Holtedahl of the Norwegian expedition in 1921. The information collected by these expeditions, together with cartographic data for the coasts, laid the necessary basis for a detailed study of the ice sheet of Novaya Zemlya during the Second International Polar Year (1932-1933). A special glaciological expedition headed by M. M. Yermolayev investigated the Shokal'skiy glacier in Russkaya Gavan' (Russian Harbor) and the area feeding the glacier. In addition to meteorological observations at the face of the glacier, the glaciologists made many excursions over the ice, including several crossings of the island with dogs and aerosledges, and a trip to Cape Zhelaniye. The meteorological station established by this expedition continues its observations to the present day.

The work accomplished by the expedition and subsequent observations at the polar station of Russkaya Gavan' have established that the Shokal'skiy glacier is a short (5 km long), broad (somewhat more than 3 km wide) northwestward curving glacial current, extraordinarily dissected by the large crevasses. The flow is formed from the ice of an extensive field situated to the north of the escarpment of the Somneniye Barrier where the glacier surface abruptly drops down from 430 to 320 m. Seismic observations made by K. Vel'ken revealed a subglacial terrace here with an elevation of about 350 m, whose foot is situated below sea level. On the Somneniye Barrier the glacier surface is cut by gigantic crevases, hundreds of meters long, with depths of several score meters, and sometimes with a similar width. Above the Somneniye Barrier the surface of the ice sheet itself rises gently; 35 km to the south of the face, in a weakly expressed depression between two cupolas (880 m on the west and 900 m on the east), it attains maximum elevations of 776 m. The ice divide of the ice sheet is displace d some what to the eastern (southern) shore of Novaya Zemlya.

Winds exercise an enormous influence on the formation of the strata of continental ice on Novaya Zemlya. In the vicinity of the polar station at Russkaya Gavan' they sometimes attain hurricane force (especially in winter, when the bora is blowing), and they transport large quantities of snow. Southerly (winter) and westerly (summer) winds predominate, with a mean annual velocity of 6.5 m/sec. However, a complete calm often occurs. After finding solid blue glacial ice on the surface of the sheet in the area of the ice divide, M. M. Yermolayev came to the conclusion that extraordinarily strong winds blow all the snow into the sea and that normal feeding of the glacier does not occur.

Despite the extremely high latitudes, the mean annual air temperature (-8.2°) in the region of Russkaya Gavan' is considerably higher, due to the Barents Sea, than at these same latitudes in the Soberian or eastern sectors of the Soviet Arctic. The mean annual January temperature drops from -17.4° at Russkaya Gavan' to -20.4° in Blagopoluchiye Gulf, situated only 70 km away! In the warm season of the year the mean monthly temperature does not rise above 3.9° (July) and is above 0° for a period of four months; on the other hand, frosts are possible on any given day and thaws may occur at any time in winter.

Frequent fogs and low, dense cloudiness, especially in the summer months, bring a great deal of moisture to the glacier. Supposedly the total annual precipitation is 400 mm, but in actuality the measured precipitation is approximately 160 mm.

In the region of Russkaya Gavan' there are ice-free sectors of rocky coastal plain with elevations less than 100 m above sea level, bounded on the south by mountains.

Approved For Release 1999/09/08 : CIA-RDP82-00141R000201190001-1

In these sectors, in depressions between cracked polygons and under the protection of large rock fragments, there are individual specimens of saxifrage, whitlow grass, polar poppy, dryadaceae, creeping willows, several other kinds of flowering plants, and the mosses and lichens typical of the Arctic deserts. The latter are the only inhabitants of the "nunataks", ice-free eminences rising above the ice fields.

The animal life at Russkaya Gavan' is meager. Polar foxes and polar bears may be seen from time to time. On the cliffs along the coast there are groups of guillemots of several types (kayra and chistik) and sea gulls, while the nests of eiders and stilt-birds (kulik) are found at the lakes. Seals and walruses enter the waters of the gulf -- in the past they were very numerous. Gudgeons (golets) live in the lakes.

New investigations of a varied character were made of the Shokal'skiy glacier and its feeding area during 1957-1959, in accordance with the program of the International Geophysical Year. The Institute of Geography of the Academy of Sciences of the USSR organized a Novaya Zemlya glaciological expedition consisting of 17 men. They arrived at Russkaya Gavan' on 16 July 1957 aboard the steamship "Msta". For a base they reequipped the buildings of the former factory in Volod'kin Bay. At the time of a detailed reconnaissance of the region of the forthcoming research the sledge-tractor train did not reach the ice divide of the ice sheet until its third trip -- on 25 August 1957. It became clear that the glacier now has a region of normal firn feeding at elevations greater than 570 m and is broken by crevasses right up to the ice divide. The 1½-meter thick snow bridges that cross these crevasses often will not support the weight of an S-80 tractor. However, the main impediment to movement across the ice sheet at elevations greater than 400 m is the extremely limited visibility due to the frequent occurrence here of a dense and persistent cover of stratus clouds (when there are weak winds) or snow storms.

Repeated trips across the glacier at different seasons of the year have enabled us to refine our knowledge to the surface structure of the glacier between the Somneniye Barrier and the ice divide. It has been found that between these two features there are two sharp breaks in the glacier surface, at distances of 7 to 8 km and 14 to 15 km in a straight line from the Somneniye Barrier; at these two points the elevation changes from 500-520 m to 570 m and from 670-m to 710-720 m respectively. The first of these changes is very clearly expressed inthe area in the form of a huge, steep semicircular escarpment; it was named the Yablonskiy Barrier in honor of a participant on the expedition who suffered a tragic death. On the west this ledge joins a north-south ridge that is concealed beneath the ice; it evidently connects the Yablonskiy Barrier and the Bastion Mountains. On the east it connects a low ridge to the TsAGI Mountains (Central Aero-Hydrodynamical Institute Mountains). The Yablonskiy Barrier (local relief -- from 50 to 70-80 meters) joins on the south with a broad ice-filled basin. The surface of the glacier between the name barriers is a ridge with a predominantly north-south orientation. The ice-covered slopes of the ridge are broken by crevasses similar to those of the Somneniye Barrier and the ice in the trough between the TsAGI Mountains and the first ridge parallel to it. The troughs between the other ridges have few crevasses; this is due to the extremely dense network of channels intrenched by melt water that drain into "Wells" in the glacier. In the southwest, the part of the basin at the foot of the Yablonskiy Barrier is free of ice, forming a singular moraine-covered "oasis" several square kilometers in area. O. A. Yablonskiy has even reported outcrops of basement rock. The snow line of the ice sheet passes along the brow of the Yablonskiy Barrier at an elevation of 570 m; it separates the region with a permanent snow cover and the region which is snow-free in the summer.

The second clear rise in the surface of the glacier is considerably gentler than the Yablonskiy Range, but it is also dissected by crevasses which are completely hidden by the snow.

All three sharp breaks in the glacier surface are approximately parallel and it must be assumed that they are caused by identical factors — major irregularities in the form of ridges in the subglacial relief.

The Novaya Zemlya Glaciological Expedition of the IGY built two stations on the glacier for the accomplishment of its planned program of research; in the source region of the glacier at an elevation of 776 meters at 75°52' N., and 62°44' E. — the station Ledorazdel'naya (Ice Divide) and in the region of glacial thawing, at an elevation of 294 meters, at 76°07' N. and 62°39' E. — the station Somneniye Barrier. At each of these stations there is a meteorological installation with instruments for actinometric observations, a thermometric bore hole for the measurement of temperatures in the 15-30 meter stratum of the glacier, and an excavated pit for the removal of ice samples. In the summer of 1958 a special laboratory was built at Ledorazdel'naya station for the study of the structure and physical-mechanical properties of snow and ice. Two or three scientific workers were constantly at each station, conducting daily observations at 4-hour intervals.

Calibrated rods were placed between the stations for measurement of the ice increment and loss over the entire surface of that part of the ice sheet feeding the Shokal'skiy Glacier. The rods were read periodically. Details of the surface structure of the glacier, the speed of movement of the ice, the variations in the thawing of the snow and ice and discharge of water into the rivulets on the glacier surface were determined during exploratory traverses on the surface.

New facts were discovered in respect to the Novaya Zemlya glacier and the conditions under which it exists. It was discovered that there is normal snow feeding of the glacier on the ice sheet at elevations greater than 570 meters. The thickness of the annual snow increment increases rapidly as the ice divide is approached; at the ice divide a 25-meter deep test pit revealed a 16-meter thickness of firn with interstratified milky-white and bubly ice. It is interesting to note that whereas during the 1957-1958 cycle the annual increase in firn was 20 cm (90.3 mm of water), in 1958-1959 not only did the annual supply of precipitation melt, but so did the increase that had occurred during the preceding cycle.

Instrumental measurements at the face of the glacier revealed that the ice moves irregularly -- in winter somewhat more slowly than in spring and summer. Changes in the speed are extremely sharp not only in the course of a week, but even the course of a day. The mean daily movement of the ice is 27-30 cm and may be as much as 90 cm; sometimes the direction of movement changes in the reverse direction, that is, the glacier can retreat without a decrease in its mass. Thus, during the year the face of the glacier should move 100-110 m into the sea. In reality, however, the face retreats -- less ice is brought down than the sea can destroy. The geodetic observations made by V. S. Koryakin for determination of the speed of movement of the ice at the Somneniye Barrier have still not been completely processed, but it is anticipated thatthe movement here is close to 70-80 meters per year.

The temperature of the glacier is of great interest. At the station Ledorazdel'naya moist horizons were discovered at depths of 8 and 18 meters during the drilling of a bore hole in November 1957. A temperature of 0° was maintained at a depth of 8 meters until February and to 15 meters -- until May; later it dropped to several dozen degrees below zero. At the station Somneniye Barrier Stable negative temperatures of the deep parts of the Novaya Zemlya glacier is the winter (February-March) discharge of melt water into the marginal valleys of the Chayev and Shokal'skiy Glaciers. Other evidence of the influx of heat from the Earth's crust into the bottom horizons of the glacier is the heating of masses of water in the 10-20 meter deep lakes on the Shmidt Peninsula; this phenomenon was discivered by O. p. Chizov.

Thus, despite the permanently frozen state of the uppermost layers of the lithosphere, whose temperatures are observed systematically, and the low mean annual temperature, there is no reason to expect the penetration of permafrost to great depths, at least on the western coast of Novaya Zemlya.

It is interesting to compare the air temperature at the surface of the glacier at its different points. It appears that the mean monthly temperature in winter at the Somneniye Barrier is 3-4° lower and at the ice divide is 6-8° lower than at the ice face. Thawing lags by approximately 3 and 5 weeks respectively and ceases 1 to 3 weeks earlier.

As the height of the surface of the glacier increases the amount and intensity of the precipitation increases; higher up the role of rime is extremely important in the feeding of the glacier. Thus, during the last five clear days in December 1957 4.9 mm of precipitation fell in the form of rime at Ledorazdel'naya station, whereas there was no such precipitation at the Somneniye Barrier or at the face of the glacier. Precipitation falls predominantly when there are westerly winds.

Due to the abundant snowfall of winter and spring, the thickness of the snow cover in the middle of June reaches 130-170 cm in the feeding region, while between the barriers it measures more than a meter; nevertheless, below the Somneniye Barrier the depth of the snow cover on the greater part of the glacier surface is 8-20 cm, while part of it (~30%) is generally free of snow. At the glacier face it is only found in thin spots, but it fills the crevasses to the south of the Yermolayev Mountains.

This irregular distribution of snow is due to strong southerly and southeasterly downslope winds.

By observing the migration of snow during blizzards, O. A. Yablonskiy discovered thatthe snow migrates chiefly along the ice divide, while the quantities of snow transported in opposite directions is approximately equal. ("The Glaciers of Novaya Zemlya", by N. M. Svatkov, Prioroda, No. 3, March 1960, pp 96-100)

Veterans of the Fourth Antarctic Expedition Awarded Medals

Workers of the Anarctic Aviation Detachment of the Administration of Polar Aviation of the Civil Air Fleet, who participated in the Fourth Complex Anarctic Expedition of the Academy of Sciences of the USSR, were received a day or two ago by the Deputy Chief of the Main Administration of the Civil Air Fleet, Lt. Gen. of Aviation G. S. Schetchikov.

The Chief of the Complex Expedition, A. G. Dralkin, told about the problems of the expedition and the conditions under which its participants had to work. He extended great praise to the activities of the fliers, navigators and engineering and technical workers of the aviation detachment.

The Commander of the Antarctic Aviation Detachment of the Administration of Polar Aviation of the Civil Air Fleet, B. S. Osipov, reported that the crews of the aviation detachment flew1,650 hours and transported 250 tons of freight and many expeditionary personnel during the course of the expedition. They provided the supplies and insured the normal operation of the scientific stations and sledge-tractor stations deep in the interior; they also rendered assistance to foreign scientific expeditions. An air route was blazed to the new scientific station "Lazarev".

Because of their selfless work and the successful accomplishment of their responsible missions, the Chief of the Main Administration of the Civil Air Fleet ordered that 15 fliers, navigators and engineering and technical workers be awarded the medal "Outstanding Worker of the Air Fleet" and that six men be awarded the diploma of the Air Fleet.

The following were awarded the medal "Outstanding Worker of the Air Fleet": A. G. Dralkin, Chief of the expedition, B. s. Osipov, Commander of the Anarctic Aviation Detachment, R. V. Robinson, detachment navigator, and others. (" For Work in Anarctica", by S. Yeremin, Sovetskaya Aviatsiya, 10 April 1960, p. 4)

"Priroda" Reviews Treshnikov's Book "Locked in the Ice"

The following is a partial text of a Priroda Review of a book by A. F. Treshnikov, Chief of the Second Soviet Antarctic Expedition. The reviewer is P. A. Gordiyenko, Candidate in Geographical Sciences:

The citizens of the Soviet Union are interested in polar countries and polar research because one-third of our country is situated above the Arctic Circle. Publishing houses should bear this in mind when planning the production of books and other publications.

The most typical features of Soviet "polar" literature are clearly embodied in a book by A. F. Treshnikov -- "Locked in the Ice". In this book the author accurately and graphically describes the southern continent, Antarctica. Treshnikov spent 14 months there, from the end of the south polar spring of 1956 to the end of summer in 1958, serving as Chief of the Second Soviet Antarctic Expedition. Although A. F. Treshnikov is not a professional writer, his book can be read with absorbing interest. Perhaps the animation and occasional passion of the book's language is due to the fact that it was written at the time of the described events, keenly experienced by both the author and his friends. A. F. Treshnikov prepared his book for the press on the way back from Mirnyy to the Motherland, while crossing the ocean aboard the "Kooperatsiya".

A. F. Treshnikov is a new polar specialist of the Soviet school. He is one of those scientific workers who visualize the main purpose of their investigations to be the collection of such data as society actually needs for its practical activity. An oceanographer by education, he devoted about 15 years to the study of polar seas and the Arctic Ocean. An experienced polar worker and a great scholar, A. F. Treshnikov was the head of a responsible and complex expedition to the Antarctic. Two hundred ninety polar specialists participated in this expedition -- scientific workers of all specialities, airmen, mechanics, radiomen, builders, cooks and doctors.

Based on the observatory of Mirnyy and the auxiliary stations of Pionerskaya and Oasis, the job of the expedition was the opening of new high-latitude stations deep in the interior on the ice sheet by the beginning of the International Geophysical Year.

At the time of the allotment of the area of Anarctica for study during the period of the International Geophysical Year our country was assigned the most severe and inaccessible regions. But difficulties did not stop our researchers, and in 1957-1958 the following new stations were opened and began to operate: Komsomol'skaya, Vostok-I, Vostok, and Sovetskaya.

The book tells colorfully and forcefully about the titanic efforts of the men on the sledge-tractor train trek to the south pole of relative inaccessability, about the daring flights of the airmen who supplied the train with fuel and made reconnaissance flights over the area, about the treacherous crevasses into which the tractors fell, and about the winds of hurricane force that knocked the men from their feet. The chief of the expedition, the author of the book "Locked in the Ice," personally participated in all of the first flights and surface traverses.

Simultaneously with the construction of the new stations and the organization of scientific work at them, an extensive complex of research unfolded, based on the observatory at Mirnyy. On reading the chapters of the book describing this work you are highly impressed with the power at the disposal of a team of workers if it is welded by a deep spirit of friendship and a single purpose of mind.

Respect, and, I would say, a fatherly feeling, colors the author's words when he speaks of individual fellow workers at Mirnyy. Sometimes this can be seen through the prism of the warm humor with which he describes the conduct and actions of the "citizens of Mirnyy". Sometimes this is outright admiration and sometimes a sparing and terse but human and informal evaluation of the actions of the men. That is the manner in which he describes the austere farewell scene of the men at the station of Mirnyy and the naval expedition aboard the diesel-electric motorship "Lena" and those comrades who had perished during a cave-in of the ice barrier on 3 February 1957.

The Anaractic continent and the waters surrounding it is a severe but delightful area, in the beauty of its natural attributes full of majesty and bewitching forms. I do not know a single polar specialist, even among the most dedicated to the study of the Arctic, who would not be delighted with the might of the icebergs and the unusual combination of colors of the ice, sky and sea. The new and abundant animal life among the shores of the Antarctic continent, unknown and amazing in its beauty, and the unusualness of the contours of the mountain ranges within the continent, are highly attractive to exploring geographers. The romance of the unknown and of discovery breathes from A. Treshnikov's book and this is what lends it its absorbing character, easily sensed during the reading.

The author tells about the extensive international contacts of Soviet polar specialists, about their meetings, and about the authority which Soviet science enjoys abroad.

But the most interesting part of the book is the stories he tells about Soviet people in Antarctica, about their courage in the struggle with the wind and cold and fire. (Yes, with fire! They had to cope with it at the time of the conflagration that destroyed one of the large hutments at Mirnyy). He also tells about the keenness of wit and the friendship existing among these people.

The book is published in a handsome format, with a large number of photographs, and is tastefully illustrated by the artist N. Zikeyev.

"Locked in the Ice", together with the merits of its artistic presentation, also possesses another positive quality. This is also a document in which the geographer will find scientific data and chronologically precise information about the course of one of the outstanding expeditions of our time.

("chronicles of Remarkable Journeys", by P. A. Gordiyenko, Priroda, No. 3, March 1960, pp. 118-120).

USCOMM-DC