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7 November 1957

MEMORANDUM FOR: Deputy Director/Intelligence

THROUGH: Assistant Director, Research and Reports

SUBJECT: Trip Report of [redacted] 25X1A9a
to Toronto, Canada, 2-13 September 1957

I. Purpose of Trip

The undersigned attended the XIth General Assembly of the International Union of Geodesy and Geophysics (IUGG) held at Toronto, Canada, 2-13 September 1957. The purpose of attendance was as follows:

A. To observe Soviet and Bloc participation in geodetic and gravimetric discussions, particularly with respect to (1) IUGG programs calling for disclosure of triangulation and gravimetric accomplishments and data, and (2) Soviet interest in Free World geodetic and gravimetric activities.

B. To observe and evaluate Soviet methods of establishing rapport with Free World geodesists and gravimetrists.

C. To observe relationships between Soviet and Bloc delegates in order to identify personalities and evaluate their importance and loyalties to discover clues that might be useful in the collection of intelligence regarding Soviet Bloc maps and information on geodetic activities.

D. To note from technical discussions developments in triangulation, celestial methods of establishing intercontinental geodetic ties, determination of the geoid, gravimetry, and electronic distance measurement. (Brief summaries are given in the Technical Annex.)

E. To obtain information on Soviet Polar activities.

II. Introduction

The International Union of Geodesy and Geophysics consists of seven international associations concerned with the major subdivisions of the complex field of geophysics. These Associations, in turn,

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facilitate international cooperation in scientific research on a number of problems through more than three dozen commissions, committees, joint committees, or sections, many of which are further subdivided into study groups or subcommittees.

A General Assembly is convened every 3 years to formalize research projects in progress, initiate new studies, and present papers on recent developments. The XIth General Assembly convened in Toronto Canada, 3-13 September 1957. According to the revised list of national delegations, 1,186 scientist from more than 40 countries were registered as delegates, associates, and guests. More than 1,500 however, probably attended the meetings. This was the first General Assembly in which a Soviet delegation participated as a member of the IUGG. The Soviet Union joined the IUGG after the Xth General Assembly, convened at Rome in 1954 to which it sent a delegation for the purpose of announcing the Soviet intention to participate in the International Geophysical Year. The announcement, followed shortly by the adherence to the IUGG, represented an emergence from seclusion in fields (geodesy and geophysics) in which some risk of exposure of classified information might occur. The Soviet delegation at Toronto was one of the largest in attendance. Canadian sources reported a total of 55 persons -- 23 as delegates and 32 as visitors. The final official registration based on a Soviet classification of the membership of the delegation, however, indicated that it consisted of 40 delegates, 1 guest and 2 associates. The reason for those differences is not entirely clear. It may be explained in part, however, by a current Soviet policy that permits "tourist" trips at relatively small cost (7,000 rubles) for scientists who attend scientific meetings. Such tourists would technically have no delegation status of any kind. This policy may also account for the unusual presence of an Intourist representative at Toronto.

Soviet Bloc nations that sent delegations included Czechoslovakia (2 delegates), Germany (5), Hungary (3), Poland (9), and Rumania (2).

III. Activities

Our activities were concentrated on the meetings of the International Association of Geodesy (IAG) because of its greater urgency and importance of geodetic problems to our intelligence functions. The IAG meetings were organized by sections (triangulation, precise levelling, geodetic astronomy, gravimetry, and geoidal studies), which were further subdivided into commissions and study groups. Meetings were held from 9:00 to 12 noon and from 2:00 to 5:00 although meetings of

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groups often conflicted, section meetings were so arranged as to avoid conflict. Early in the period, it was decided not to develop personal contacts with the Russians. This was based on a preliminary observation of other attempts to establish contacts with Soviet Bloc delegates--including an early, determined, and fruitless effort by Army Map Service representatives to interrogate Dr. A. A. Izotov, the leading theoretical geodesist in the USSR. It was decided that the cost of exposing ourselves and our interests would not have been worth the meager results that could have been expected at best. This decision was subsequently justified by the discovery that the Soviets were under instructions to conduct extended professional discussions only through an official interpreter, whose technical incompetence appeared to be designed to obstruct communication. Effort, therefore, was limited to the observation of the Soviets and the Bloc delegates.

IV. Findings

A. Although only 5 of the 55 Soviets delegates attended the IAG meetings with any degree of regularity, the attendance included some of the leading Soviet figures in geodesy and gravimetry: Dr. A.I. Baranov, Director of the Chief Administration of Geodesy and Cartography; Dr. A.A. Izotov, the leading geodesist in the USSR today; Yu. D. Bulanzhe, one of the leading field directors for gravimetric surveying; V.V. Fedynskiy, head of the Geophysical Institute in the Petroleum Ministry; and A.I. Bogdanov, his superior. The others in attendance included B.K. Balavadze, a leading theoretician in the study of the vertical gradient of gravity, and Yu. A. Meshcheryakov, a young scientist who has specialized in crustal movements and earth tides. On the other hand, M.S. Molodenskiy, the leading gravimetrist in the USSR, was one of 3 on the original list of delegates who failed to appear. Of the Polish 9-man delegation, 5 attended the IAG meetings. Similarly, the 5 East German representatives who attended the IAG meetings comprised more than half of the total delegation. Although 2 Czechs were registered as delegates, and both were seen frequently at the IAG meetings, neither registered at the geodesy meetings.

B. The Soviet delegation presented a national report on triangulation, precise levelling, geodetic astronomy, gravimetry, and 14 individual papers. Of the latter, however, only 2 were disseminated in full text; the remainder were disseminated in brief abstract form only. None of the papers gave any information that was significant to our intelligence problems. The national report, did provide a selected bibliography of principal geodetic literature, including titles of sources not now held in the US. These will be checked out in detail, and requests for them will be initiated through "front" scientists.

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The requests will incorporate references to the spirit of international cooperation that underlies the activities of the IUGG.

C. Although the Soviet delegates attending the IAG sessions appeared friendly and were occasionally seen talking to non-Bloc people, there was no genuine fraternization except with 3 of the 5 Poles and the Czech (Broz). Of the Soviet delegation, Bulanzhe (Boulanger) talked most freely with non-Bloc personnel, conversing in his slow German and even more halting English. He succeeded in conveying an earnest desire to cooperate and adroitly avoided committments to supply classified data and detailed accounts of Soviet activities. His success in avoiding committments was based in part on the general ignorance of Free World delegates concerning Soviet geodetic and gravimetric data and achievements. In one case, this success was achieved by Bulanzhe at the cost of deliberate falsification, which passed unrecognized by the applauding delegates. The Soviet success in evading its obligation of international cooperation, however, was by no means complete. There is little doubt that many delegates recognized the obvious refusal to provide information on the extent and location of Soviet triangulation, on details of a Soviet 1936 geoid determination, and on the extent and location of Soviet submarine gravity surveys.

D. The most obvious Soviet truculence became evident in section meetings on the Geoid and on Triangulation. On several occassions, Brigadier Bomford (U. K.) pointedly but tactfully called for information on Soviet triangulation data for the determination of the Geoid by astro-geodetic means to incorporate the vast area of the USSR. The Kremlin-like silence was eloquent. The same heavy silence greeted the efforts of Mr. Whitten (US) and Dr. Marussi (Italy) in the Triangulation section to obtain (1) information for the compilation of a map of world triangulation and (2) Soviet Bloc triangulation data for the Free World European Datum adjustment. There was no participation by the Soviets in the discussions on the Geoid, even though they have the single largest triangulation system and have adopted a distinctive and unusual projection method for the adjustment of triangulation observations. Consequently the discussion meetings were deprived of the benefit of the unique Soviet experience. Without this, no significant discussion could develop because no other country has had so much experience with the projection method. Similarly, the Soviets did not volunteer any discussion on triangulation. When a question on Soviet triangulation was raised, the Soviets requested deferment of an answer to a later date. The response given 3 days later, however, completely avoided the original question and, instead, developed into a critical analysis of the European adjustment. With this diversionary maneuver the Soviets again avoided disclosing classified information. At the same

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time, the gratuitous criticism of Western datum unification added another stroke in the Soviet policy of demonstrating their knowledgeability in geodesy and possibly helped lay the groundwork for eventually making the Soviet Datum appear as a superior scientific accomplishment. This performance, however, had some intelligence value because the detailed criticism disclosed an intimate knowledge of European triangulation, which could only have come from a comparison of the results of the European Datum adjustment and the Soviet incorporation of the Potsdam system into the Soviet Datum.

E. In the section on Precise Levelling, two papers were presented for the Soviets by the Czech delegate, Dr. Broz, who read the English translations of previously-disseminated abstracts, with supplementary remarks translated extemporaneously from Russian notes handed to Broz by A. A. Izotov a moment before. No significant technical information was provided. The use of Dr. Broz as middleman reflected in yet another way the intimacy of his association with the Soviets, which was obvious throughout the Assembly meetings.

F. The most active Soviet participation was in the section on Gravimetry. Bulanzhe attended all sessions except the one at which Dr. Heiskanen of Finland and The Ohio State University presented his major effort. Parenthetically, this abstention is believed to have been a boycott of Heiskanen, who at a previous meeting is reported (by O'Keefe, US. Army Map Service) to have made some general references to Bolshevism. In the section on Gravimetry--which together with Triangulation was one of the two most ticklish topics from the point of view of Soviet national security--the Soviets achieved their greatest success. On the one hand, explicit commitments to furnish data were forestalled by a lie (i.e., that Soviet postwar gravity data have not been published); and, on the other hand, the Soviets conveyed an impression of capable scientific research on the determination of absolute gravity and on the Soviet testing of an instrument for the measurement of gravity at sea.

At the resolution-drafting session of the Gravimetry section, Bulanzhe gave the impression of going out of his way to support Father LeJay, Director of the International Gravimetric Commission. This effort to establish support may not be without its sinister aspects. The Soviet geodesists have demonstrated keen interest in data of other countries and, in fact, are dependent on other countries to supply data of their respective areas. The most convenient method of securing these data would be through access to the files of the International Gravimetric Commission under Father LeJay. Last year, Bulanzhe magnanimously gave an obsolete so-called catalog of prewar date to Father LeJay, who promptly took this to mean that the Soviet policy of restriction had

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changed. Little did he know that the catalog was of limited value and had been available previously. The efforts at Toronto appeared to be aimed at establishing the impression that the Red Bear could be agreeable to a Jesuit. The regrettable part is that Bulanzhe may gain access to hitherto unavailable international gravity data from many Western nations unless Father LeJay can be made aware of Soviet duplicity and of the existence of published Soviet catalogs that the Soviets are not willing to release.

G. Bulanzhe, at a private luncheon with a US geophysicist, expressed regret that gravity data are not released by the Soviet Union. He went on to explain that the military apparatus having control over Soviet geophysical activities is being reorganized and it was hoped that some liberalization of this restriction would follow.

H. Observation of relationships between the Soviet and European Satellite delegates at the meetings disclosed that 3 of the 5 Poles and the Czech delegate were such constant companions of the Soviets that they appeared to form a single delegation. Broz (Czech) and Borys Szmielew and Stanislaw Krynski (Polish) acted as interpreters and eagerly performed other general services for Barenov and Izotov. This was in marked contrast to the distant and decidedly cool relationship of the Soviet delegates toward Drs. Kamela and Czerski. Kamela, a geodesist of considerable stature in postwar Poland, was ill at ease in his limited contacts and almost obeissant in seeking the favor of the Soviets and of Krynski and Szmielew.

A check of Staff files after the Toronto meetings lent further support to the suspicion that (1) Szmielew and Krynski are high-level trusted Communist expediters in Polish mapping who are now engaged in the process of shifting the Polish mapping system to the Soviet system, (2) their stated affiliation with the Institute of Geodesy and Cartography (Warsaw, Jasna 2/4), which was officially abolished in May 1957, was either a cover or an indication that the institute continues to function under the little-publicized Military Geographic Institute or some other security organization associated with the geodetic surveying and mapping of Poland according to the classified Soviet program.

From observations such as those mentioned, we have obtained our first indication concerning the identity of some of the key personnel in the Polish mapping structure who could be developed into intelligence targets for the collection of new large-scale Polish topographic maps.

H. Among the information released by the Soviets on Antarctic operations was the confirmation of plans to make landings at 6 points

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on the continent, including 2 in the Unclaimed Sector where, only the US has conducted operations heretofore.

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V. Problems

A. The lack of readily available Russian interpreters significantly limited Soviet participation in the scientific discussions, necessarily diminished the scientific value of the meetings, and reduced the opportunities for additional collection of intelligence information. The importance of these losses cannot be overemphasized.

B. Soviet contributions to the XIth General Assembly were no more than had been expected. No significant information was made available (except for an admission of research on gravity at sea), and no data were provided, even though avoidance necessitated a lie to forestall embarrassment to the Soviets. Such action, of course, is in opposition to the fruitful functioning of the IUGG, which is dependent on a voluntary sharing of basic information. If the Soviets continue their truculence for 3 more years -- until the next General Assembly, scheduled for Helsinki in 1960 -- they will have scored a real psychological advantage and made a net data gain. The USSR will have gained wider access to geodetic and gravimetric data without having to share its own classified information. This raises the problem -- what, if anything ought to be done to rectify this one-sided state of affairs? It is our observation that Western geodesists are not attuned to the consideration of a problem such as this, even though failure to act will have adverse effects to the security of the Free World as well as on the development of science on an international scale. The problem will be of even more vital concern as Soviet development of the earth-satellite vehicle and the ICBM progresses. Western geodesists (US included) are not disposed to place any pressure on the Soviets on the grounds that political and military considerations ought not interfere with or prejudice international scientific cooperation. This attitude was clearly evident at the XIth General Assembly, where the Free World scientists leaned backward to avoid embarrassing the Soviets by pressing for data sharing. As a matter of past policy the IUGG does not consider resolutions affecting a country without prior clearance with the delegation of that country. In two instances the Soviets expressed a preference not to formulate resolutions calling for Soviet cooperation in data exchange and research programing.

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C. The US had no cohesive delegation functioning as such, although there was a nominal head. As a result, there was no delegation planning of strategy vis-a-vis the Soviets to secure a greater participation of the USSR in the sharing of information and data.

VI. Recommendations

A. It would be advantageous to intelligence as well as to science to have a small staff of interpreters (one for each member Association of the IUGG) at the XIIth General Assembly at Helsinki who would be available at all times to facilitate improved communication with the Soviet delegation. Unless adequate provisions are made the Soviets will either hide behind a curtain of poor communication or we will have to depend on security conscious Soviet interpreters who screen out significant comments.

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C. In the next 3 year period it would be highly desirable to disseminate through appropriate channels all unclassified translations in the field of geodesy and gravimetry to selected leading Free World scientists to (1) make them aware of Soviet scientific developments, (2) reduce the ignorance upon which Soviet duplicity thrives, and (3) develop resources for eventual intelligence exploitation.

D. It is strongly recommended that steps be taken to develop a closely knit US delegation to the Helsinki meetings in 1960 in order to be fully prepared to cope with (1) possible Soviet propaganda maneuvers and (2) Soviet continued unwillingness to submit data to IAG studies and projects.

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TECHNICAL ANNEX

Principal Developments in the Triangulation, Celestial Methods, Determination of the Geoid, Gravity, and Electronic Distance Measurement.

Triangulation

At Toronto there was indication that the West had finally caught on to the Soviet method of projecting control points of horizontal triangulation upon the ellipsoid of reference. Reactions to the Soviet method were positive. Marussi of Italy was strongly against reducing triangulation to the ellipsoid for reasons which were not altogether clear. However, he did say that if projection was used, then the adjustment of observations should be carried out before projection onto the ellipsoid. This is particularly relevant to base lines, which are used primarily to insure a constant scale throughout a triangulation net. The Soviets reduce their base lines to the Krasovskiy ellipsoid immediately. The US reduces its base lines to the geoid. Apparently the British are inclined to leave the base lines on the earth's surface where they had been measured.

The question of what to do with a triangulation network after the field observations are made still perplexes geodesists. If eventually an ellipsoid of reference is employed, it seems awkward to reduce the net to the geoid, as the US does. If one attempts to reduce the observations immediately to the ellipsoid, however, it is also necessary to make an extensive gravity survey of the area in order to establish the anomalies and geoidal elevations. This might be done for a limited area, even for a country as large as the USSR. The question arises then as to whether the orientation of the ellipsoid which may be suitable for the USSR is valid over the rest of the earth.

The paper delivered by Izotov of the USSR at Toronto did not reveal any new data or methods used in the USSR that were not previously known to us. The reprint of the paper distributed at the meeting was rearranged before delivery by Izotov, via the USSR translator. In the delivered version, Izotov indicated a very intimate familiarity with the European readjustment of the first-order triangulation recently carried out by the Coast and Geodetic Survey and the US Army Map Service. Izotov said what he thought was the matter with the readjustment. The essence of his comment was that much of the field work should be rechecked or redone; no matter how elegant the methods of readjustment, a precise readjustment cannot be made from bad data.

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The need for correcting one European base line by 1 part in 30,000 was mentioned as indicating the deplorable inaccuracies in some of the European field work. It is quite evident that the Soviets are well abreast of all published work on the European Datum, since it is their goal to determine how to connect it with the Soviet Datum.

The Geoid

As geodetic experience grows and the range of inaccuracy in the measurement of angles and distances narrows, some geodetic concepts are seen to rest on shaky ground because of increased difficulty in defining them. The geoid is such a concept. No difficulty is encountered in conceiving a great calm over all the oceanic waters, the surface of which would then constitute part of the geoid. The remainder of the geoid would be the continuation of this surface under the continents. A tidal gauge might successfully smooth out the surface irregularities of a turbulent body of water, but its zero level depends upon the configuration of the coastal area in which it is placed. The zero level as determined in the Baltic Sea would reflect any tendency of the water to accumulate in that enclosed area caused by ocean currents or tides. Furthermore, any standard zero gauge may be affected over a long period of time by crustal uplift. The situation becomes even more complicated when we consider the level that water might attain in hypothetical narrow canals crossing the land and connecting the seas. Although the differences dealt with here are quite small, it is necessary to cope with them if we are ever going to establish a world basis for leveling.

Indicative of the confusion that exists when the concept of the geoid is applied to the earth as a whole and to the ellipsoid of reference, was the question of the geoidal tilt over the US, raised by O'Keefe of the AMS. Astro-geodetic computations seem to indicate that the tilt is one way, whereas gravimetric deflections seem to indicate a tilt in the opposite way. Heiskanen then pointed out that a gravimetric method encompassing the whole earth was needed to overcome such a dilemma. Actually, as we can readily see, the computed geodial tilts and elevations over the continents will have true significance only when the gaps across the oceans are filled in and when we have a complete geoidal section around the earth.

The meetings witnessed the emergence of increasing differences of scientific opinion concerning the development and projection methods of triangulation adjustment. The eventual resolution of this problem will be of intelligence significance since it will affect our evaluation of Soviet triangulation and its extension beyond Soviet lands. The

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Soviets have projected their computations along the normals to the ellipsoid of revolution and claim that this has increased accuracies significantly throughout the vast extent of the Soviet Union. If this is true, the Soviets will be able to extend these accuracies to other triangulation systems and so increase their target positioning accuracies.

Gravity

A number of papers presented before the gravimetry section at Toronto dealt with the taking of gravity observations on both land and sea by various countries. Papers on gravity measuring apparatus were also delivered, in which consideration was given to Worden, Graf, and La Coste instruments. One of the big problems today is the design and manufacture of gravity-measuring apparatus for use at sea -- apparatus more accurate and faster than the pendulum apparatus of Vening Meinez. The US, Germany, and the USSR are all working on this problem. The British repeatedly indicated that they relied upon American money and submarines to do the job of gravity determination at sea.

The Soviets were present at nearly all sessions at which gravity was discussed, but they shied away from any disclosures of plans, programs, or data. At one point, Bulanzhe was asked about the Soviet extension of a chain of gravity stations northward from India. It was an ideal time for him to tell something explicit about the Soviet program. In poor German, he indicated that it was a big piece of work and would take months to accomplish. On another occasion, Bulanzhe was asked where some 18 gravity observations at sea that he had referred to earlier had been made. He replied "in one of our seas" without stating which one. There were times when the handicap of language and the restraint that he was forced to exercise for political reasons did not seem to account fully for his hesitation and reluctance to speak. He probably sensed that he was among at least his equals in the field of apparatus design. He may have been hesitant to place Soviet gravimetric thinking in competition with that of Western nations.

Currently the great clamor is for more gravity data representatives of the areas that are now without any data. Most of these areas are in the great ocean basins of the southern hemisphere. It seems probable that impending improvements in seaborne gravimeters may be partly responsible for the recent curtailment of gravity programs at sea. Until the Graf and the US instruments are thoroughly tested and proved, the old pendulum apparatus would have to be used and progress would be slow and expensive.

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Electronic Distance Measurement

The Bergstrand geodimeter and the Wadley tellurometer present the geodesist today with a means of rapidly determining line-of-sight distance to augment the usual determination of angles in field observations. Developed first in 1948, the geodimeter operates with a modulated light beam of a definite optical frequency that travels to a distant reflector and back to the source. The time for the return trip depends ultimately upon the distance between the source and reflector and upon the velocity of light in vacuo. A checking of the results of many trials with the geodimeter against previously measured base lines has been very fruitful in reducing the uncertainty connected with the velocity of light. The best value for this velocity indicated at the Toronto meeting was 299,792.5 ±0.5 km. per sec. Since the geodimeter operates on optical frequencies, it can be employed only at night. At distances of 10 miles and more, it is capable of accuracy to 1 part in 200,000 or better.

The tellurometer operates on modulated radio microwaves and consequently can be employed during the day as well as night. The path between the source and reflector need not be entirely free of obstruction. The tellurometer is most successfully used on 10-to 30-mile ranges, where it will give accuracy comparable to that of the geodimeter. The velocity of optical and radio waves varies with the density, temperature, and humidity of the intervening atmosphere. Correction for these factors is necessary along the path if an accurate determination of distance is to be obtained. Undoubtedly the checking of the results of many further trials with these instruments against base lines accurately measured by other methods will narrow still more the uncertainty in connection with the velocity of light. Distance-measuring instruments similar to one or the other of these two types will conceivably be part of the standard field equipment in future geodetic work.

Celestial Methods For Gaining World-Wide Geodetic Control

The two celestial methods that promise to contribute much to geodesy during the period of the IGY are the lunar-photographic method developed by Wm. Markowitz of the US Naval Observatory, and the use of earth satellites, which are to be launched by both the US and the USSR.

(a) At Toronto, Markowitz explained in detail the major astronomic and geodetic problems associated with the lunar-photographic method. The moon is photographed against a background of stars by a special camera mounted in a medium-sized telescope. Obviously the position of

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the center of the moon with respect to the star background will depend upon the position on the earth at which the photograph was made. It is the plan to make many lunar photographs during the IGY at each of some 20 or more stations widely dispersed over the earth's surface. The principal factors contributing to error are:

(1) The moon's surface is irregular, which makes the profile deviate slightly from a true arc; moreover, the section through the center of mass is not a true circle.

(2) The moon's orbit is not completely predictable, since the distance from the earth to the moon has not been determined with sufficient accuracy, nor has the earth's radius from which the lunar parallax must be calculated.

(3) The moon's orbital motion is a means of clocking time more uniformly than is possible by using the rotation of the earth. Nevertheless, this ephemeris time of the moon must be replaced by some absolute standard of time, which seems possible to obtain for short periods with crystal clocks or atomic standards.

(4) The small unavoidable errors in measuring the photographic plates are magnified many times and constitute possibly the greatest factor of error in the overall method.

Current estimates of the probable error in the lunar photographic method in determining long geodetic distances between points on the earth's surface now are on the order of 40 meters. This is a relaxation of earlier estimates and is probably still on the optimistic side.

(b) The Earth Satellite

The geodetic potentialities of an earth satellite were lightly treated at Toronto, probably in view of the conference later held in Washington (30 September to 4 October), which was concerned exclusively with earth-satellite problems. O'Keefe of the US Army Map Service expressed the opinion that we will have a much improved value for the earth's flattening soon after a satellite is in orbit. Other views, privately expressed, were less optimistic.

Even if we grant that a successful launching can put a satellite in an orbit that is not too elliptical and several hundred miles above the earth's surface, it is by no means certain how well nor how long the minitrack transmission of signals from such a satellite will

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continue. Optical tracking has its proponents and skeptics. Precisely timed photography of the satellite against a background of stars at dusk or in broad daylight has still to be demonstrated. Like other celestial methods employed for geodetic purposes, some years of tracking experience with the satellite will probably be required before its geodetic capabilities and limitations can be assessed. We have no doubt that ultimately earth satellites will prove to be of significant value in the study of the earth's size, shape, and exterior gravity field. It seems quite possible that the Soviets intend to rely upon satellite observations for eventual improvement in intercontinental positioning.

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