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Paris

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B U L L E T I N   D ' I N F O R M A T I O N

Mars 1972

N°28

T A B L E   des   M A T I E R E S

1ère Partie

2ème Partie

Prof. P. TARDI

Dr. S. CORON

- I -

A - NOTICE NECROLOGIQUE

Professor Weiko A. HEISKANEN

Weikko Aleksanteri Heiskanen, died in Helsinki on October 23, 1971 at the age of 76, after a long illness.

Weikko Heiskanen was born on July 23, 1895, in Kangaslampi, Finland. He passed his first academic degree, Candidate of Philosophy, with highest honours in 1917, and gained his Ph.D. at the University of Helsinki in 1924.

In 1920 and 1921 Heiskanen studied at the universities of Göttingen and Berlin in Germany.

In 1921-1928 he was employed by the Finnish Geodetic Institute as state geodesist.

In 1926 he was appointed Docent in geodesy at the University of Helsinki.

In 1928 Heiskanen became Professor of Geodesy at the Technical University of Helsinki, where he was Director of the Department of Surveying in 1935-1949.

In 1949 Heiskanen was appointed Director of the Finnish Geodetic Institute. From 1950 onwards he was several times absent on leave from his post for international research. He retired in 1961.

Professor Heiskanen made a significant contribution to science through his work abroad and in the international organizations. He was general reporter on isostasy in the IAG 1930 - 1967 and Director of the International Isostatic Institute from its establishment in 1936.

In 1950-1965 Heiskanen worked at the Ohio State University, where he was Director of the Institute of Geodesy, Photogrammetry and Cartography. A worldwide international study was directed by him viz, computation of the form of the geoid from the measured gravity anomalies. He was president of Section V, Physical Geodesy, in the International Association of Geodesy for two periods between 1957 and 1963.

In 1957-1960 he was second Vice-President of the International Union of Geodesy and Geophysics and President of the Arrangements Committee for the XII General Assembly in Helsinki 1960.

Heiskanen worked in many fields of geodesy, but concentrated his efforts on physical geodesy. The international gravity formula, accepted by the General Assembly of the IUGG in Stockholm in 1930, was based on Cassinis' theoretical investigations and Heiskanen's extensive computations.

On the initiative of Heiskanen the gravimetric geoid was computed several times, first by Hirvonen (1934), then by Tanni at the Isostatic Institute (1948) and for the third time "the Columbus geoid" at the Ohio State University. Heiskanen's idea of a uniform "World Geodetic System" was based on these geoid computations, and was the only possible way of unifying the separate geodetic systems around the world before satellites.

It is amazing how much one man can accomplish in a short time. As a professor at the Technical University he totally renewed the teaching of geodesy, wrote new textbooks on surveying and mapping and in geodetic astronomy, a 1000 page book on popular astronomy, and personnally made large gravimetric and isostatic studies ; as a Member of Parliament in 1933-1936 he worked eagerly and effectively for the creation of the "Cultural Fund of Finland".

As a foreigner in the USA he directed worldwide international research work and contributed significantly to geodetic education. Thus many of his pupils now serve as Professors of Geodesy in various universities around the world.

The textbooks "The Earth and its Cravity Field", in collaboration with F.A. Vening Meinesz, and "Physical Geodesy", with Helmut Moritz, are well-known.

Professor Heiskanen received many acknowledgements of his merits. He was a member of the Finnish Academy of Science and Letters, Norwegian Academy of Sciences, Academia Nazionale dei Lincei, German Academy of Sciences, American Academy of Arts and Sciences and Pontificia Academia Scientiarum. He was given an honorary doctorate by the Technical University of Bonn, Technical University of Helsinki, Uppsala University and Ohio State University. He was asked to be Honorary President of the Nordic Geodetic Commission and an Honorary Member of the Council of the International Association of Geodesy. The Bowie Medal of the American Geophysical Union was awarded to him and the honorary prize of the Wihuri Foundation.

T. HONKASALO

– B –

VARIOUS INFORMATION

I) INTERNATIONAL GRAVITY STANDARDIZATION NET 1971

According to Resolution n°11 approved by the International
Union of Geodesy and Geophysics at the General Assembly in Moscow
1971, the International Gravity Standardization Net 1971, establi-
shed by a Working Group of the SSG n°5 (Prof. C. Morelli, President),
will be published in a special issue of the Bulletin Géodésique in
1972.
This publication (authors : C. Morelli, C. Gantar,
T. Honkasalo, R.K. McConnell, B. Szabo, J.G. Tanner, U.A. Uotila
& C.T. Whalen) will contain the description of the final adjustment
as well as that of the preliminary works and investigations that
led to the establishment of the IGSN71.
Gravity values will be given for the stations of the net.

Station descriptions and gravity values are available
through the IGB, Paris.

II) REPORT ON THE SYMPOSIUM ON COASTAL GEODESY

In July 1970 a joint symposium of Special Study Group 2.22
of the International Association of Geodesy and the Advisory Com-
mittee of the International Association of the Physical Sciences
of the Ocean (IAPSO) took place in Munich.
This symposium was attended by about a hundred scientists
and delegates from twenty-four countries. More than 40 papers were
presented.
These papers and informations about the other sessions are
now published in full in the :
"Report on the Symposium on Coastal Geodesy".

R. SIGL
Technische Universität München
(Letter March 1972)

III) PENDULUM OBSERVATIONS : TOKYO - CHRISTCHURCH

We made pendulum observation at Christchurch, New Zealand in February 1971. The gravity station at Christchurch is in old Magnetic Survey in botanical garden. This site is fundamental gravity station of New Zealand.

Results are as follows :

Station	:	Number of Obs.	:	Period (second)	S.D.	M.E.	:	Period	S.D.	M.E.
					$(10^{-8}$ second)					
Set A	:		:	Pendulum n°1-3			:	Pendulum n°2-3		
Tokyo I	:	10	:	1.01722509	22	7	:	1.01722608	23	7
Christch. I	:	10	:	1.01684563	30	9	:	1.01684710	37	12
" II	:	10	:	1.01684576	22	7	:	1.01684764	16	5
" III	:	10	:	1.01684582	17	5	:	1.01684726	32	10
Tokyo II	:	10	:	1.01722473	21	7	:	1.01722603	26	8
Set D	:		:	Pendulum n°10-11			:	Pendulum n°12-11		
Tokyo I	:	10	:	0.99961152	28	9	:	0.99961426	30	9
Christch. I	:	10.	:	0.99923908	28	9	:	0.99924204	44	14
" II	:	10	:	0.99923909	27	8	:	0.99924191	28	9
Tokyo II	:	10	:	0.99961237	24	8	:	0.99961453	27	9

gravity difference   730.6 + 0.3 mGal

gravity value   980.507 6 + 0.0003 gal

H. ISHII
Geographical Survey Institute, Tokyo
(Letter December 1971)

IV) GRAVITY SURVEY IN NORWAY

With reference to our correspondance in the past concerning gravity measurements in Norway, we like to inform you about the following progress of our field operations :

1. A land gravity re-survey of Norway has been completed south of 69°N., with a uniform coverage of one station per 100 square /km.

2. A marine gravity survey has been completed this year along the NorWegian coast. The spacing of the marine gravity profiles is generally 5 nautical miles and 7 1/2 nautical miles off south coast.

The reduction and processing of the above mentioned land and sea gravity data will be undertaken by U.S. Army Topographic Command, Washington, D.C.

Norges Geografiske Oppmåling, Oslo
(Letter December 1971)

V) INFORMATION AT SEA

        a) Research Cruises 1971 - 1973 (GERMAN FED. REP.)

        During the METEOR cruises Nos 14 (1968) and 20 (1970), the Iceland-Faroes Ridge was surveyed geophysically.

        Geophysical surveys of the area north of Iceland, as far as approximately 70°N and between 22°W and 7°W, were started in 1971 and will be continued in 1972/73.

        This is a cooperative programme of :

        Deutsches Hydrographisches Institut, Hamburg,
        Bundesanstalt für Bodenforschung, Hannover, and
        Institut für Vermessungskunde, Braunschweig,

sponsored by Deutsche Forschungsgemeinschaft.

        The s.r.v. KOMET has already carried out gravimetric, magnetic and bathymetric surveys (16/8 - 22/9/71) in the sea area between the ice limit (approximately 90 nm east of Greenland) and 15°W East-West profiles were run with a distance increasing from 5 nm (Icelandic Shelf) to 15 nm (70°N).

        During the METEOR cruise n°28 (11/9 - 25/10/72), the sea area between 15°W and 7°W and from the Iceland-Faroes Ridge as far as at least 67°N will be surveyed with a profile distance of abt. 6 nm. This area lies between the zones that had already been investigated in 1970 and 1971. Furthermore, seismic measurements north of Iceland are intended.

                                        Deutsches Hydrographisches Institut, Hamburg.
                                              (Information March 1972)

b) Campagne du N/O "Jean CHARCOT" - 1971 (FRANCE)

Le N/O "Jean Charcot", armé par la Direction des Câbles Sous-Marins pour le compte du CNEXO, a regagné le 20 Novembre 1971 son port d'attache de Brest après la fin de "Sudatlante 71", campagne de huit mois et demi dans l'Atlantique Sud.

La campagne "Walda" qui a été effectuée du 26 Mai au 24 Août a compris trois parties :
Abidjan - Walvis-Bay
Walvis-Bay - Moçamedes - Pointe-Noire
Pointe-Noire - Douala - Abidjan.

Un de ses principaux objectifs a été l'étude géologique et géophysique de la marge continentale africaine et de ses principaux accidents tectoniques (Walvis ridge, fracture du Chain, de la Romanche) afin de reconstituer l'histoire géologique et structurale du socle africain depuis la séparation de l'Afrique et de l'Amérique jusqu'à nos jours.

Les corrélations préliminaires faites à bord entre les données sismiques, magnétiques et gravimétriques ont permis de mettre à jour les traits principaux de la structure des marges continentales africaines, de la dorsale de Walvis et de l'axe Fernando Pôo-Annobon.

Les marges continentales présentent de nombreux accidents dont la direction a pu être établie et qui correspond généralement à celles de fractures qui ont affecté la croûte océanique lors de l'ouverture de l'Océan Atlantique. Une étude plus détaillée permettra de mieux définir le mécanisme de cette ouverture. Ces marges abritent également d'importants bassins sédimentaires et salifères dont l'origine pourra être étudiée grâce aux données recueillies.

c) Projet d'une campagne FRANCO-AMERICAINE d'exploration
de la dorsale Médio-Atlantique (Opération "Famous" - 1973).

Une exploration commune de la dorsale médio-atlantique a été inscrite comme l'un des thèmes de la coopération océanologique franco-américaine, gérée du côté américain par la National Oceanic and Atmospheric Administration (NOAA) et du côté français par le Centre National pour l'Exploitation des Océans (19 Janvier 1970).

Les grandes lignes d'un programme géologique et géophysique ont été définies au cours d'une réunion tenue du 30 Novembre au 26 Décembre 1971.

L'objectif principal de cette opération "Famous" sera d'identifier les phénomènes qui se produisent sur les marges de grandes plaques tectoniques, comme celles dont la zone de rencontre se situe à proximité des Açores dans l'Océan Atlantique (plaque américaine, plaque africaine, plaque eurasiatique).

Pour atteindre les objectifs scientifiques, le programme des submersibles sera d'établir trois profils géophysiques et géologiques continus et détaillés. Un premier profil intéressera longitudinalement le fond de la "rift-vallée". Un second partira de l'axe du rift et se terminera au sommet du versant de la vallée. Le troisième portera sur la partie active d'une faille de transformation depuis la base de l'un des versants jusqu'au sommet du versant opposé.

Les zones retenues, comprises entre 35°5 et 36°6 de latitude nord, 33°5 et 32°7 de longitude ouest, situées au sud-ouest des Açores, ne comportent pas de profondeurs excédant 3.000 mètres, à l'exception de quelques endroits où la profondeur atteint 3.400 mètres.

Ces conditions bathymétriques permettront donc pratiquement à l'un ou à tous les submersibles de travailler en n'importe quel point.

Des informations géologiques et géophysiques adéquates, des compléments d'études bathymétriques et des relevés magnétiques seront recueillis par des navires français et américain, pendant l'été et l'automne 1972.

En particulier, il est prévu dans les programmes du J. Charcot deux campagnes pour l'étude géophysique du rift aux Açores et de l'axe tectonique Açores - Gibraltar.

CENTRE NATIONAL pour l'EXPLOITATION des OCEANS

Bulletin d'Information n°36, Décembre 1971.

d) Structure des fonds marins du Nord-Est de l'Océan Pacifique

Selon les observations effectuées au cours d'une campagne de cinq mois, réalisée par des chercheurs américains, canadiens et japonais, à bord du navire océanographique "Surveyor", des bouleversements importants doivent affecter dans les prochaines années les fonds de la zone Nord-Est de l'Océan Pacifique.

Deux montagnes sous-marines bien connues, situées dans cette zone les "seamounts Cobb et Bear" devraient à terme émerger et former deux nouvelles îles dans l'Océan Pacifique. De plus, d'importants dépôts sédimentaires ont été décrits au large de l'Etat de Washington et de l'Oregon, dépôts souvent associés à des gisements pétrolifères.

Menée dans le cadre de la décennie internationale d'exploration des océans et financée par la "National Science Foundation", la Campagne du N/° "Surveyor" était animée par une équipe de géophysiciens du "National Ocean Survey" de la NOAA "National Oceanic and Atmospheric Administration".

En effet, on a pu déterminer la limite Sud d'une grande plaine sédimentaire submergée, traversée par un réseau extrêmement complexe de vallées sous-marines (channels).

Cette zone plate présente seulement deux zones montagneuses : les "rides" de Juan de Fuca et de Gorda, dont les points culminants sont les "seamounts Cobb et Bear". Les observations montrent que les zones montagneuses connaissent une phase de soulèvement. Les "seamounts Cobb et Bear" sont amenés à devenir de nouvelles îles de l'Océan Pacifique, par surrection soit à la suite d'une poussée volcanique locale, soit du soulèvement général des "rides".

Le sommet du "Cobb seamount" est situé actuellement à 35 mètres de la surface de l'Océan.

Il est important de souligner que la zone étudiée est proche des parties sismiquement actives de la Californie.

Cinq grandes failles convergent en effet non loin.

"C'est dans cette zone que l'on enregistre la plupart des secousses au large des côtes situées de part et d'autre de la frontière américano-canadienne. L'étude des mouvements de la croûte sous-marine dans ces zones de fractures doit être poursuivie en liaison étroite avec celle de la grande faille de San Andreas (qui traverse la Californie).

CNEXO, Bulletin d'Information n°38, Fév. 1972.

VI - NEW GRAVITY POINT at SCHIPHOL, NETHERLANDS

A few years ago the Amsterdam airport "Schiphol" was rebuilt. Through that the old gravity point was not easily accessible any more. Now a new gravity point is established inside the arrival hall. (Details in the next Bulletin d'Information of the I.G.B.).

G.L. STRANG Van HEES
Technische Hogeschool Delft
(Letter March 1972)

- C -

INTERPRETATION OF THE GEOID SHAPE

by G. BARTA Ph.D.

C.M.A.S.

In my lecture on the Paris conference of the International
Gravimetric Commission in September 1970, I emphasized that the equatorial
cross-section of the geoid can be approximated by the sum of two mathemati-
cally rigorously symmetrical shapes. Further detailed computation led to
the fact that, by applying the data of the Smithsonian Standard Earth 1966,
the symmetry-axes of the best approximating shapes are directed towards the
points 58° and 150. E.G. of the Equator. The form of these two approxima-
ting functions is the following :

$$\Sigma_1 = - 1,90 - 0,58 \, P_{20} - 7,23 \, P_{30} + 1,28 \, P_{40} + 2,44 \, P_{50}$$

$$\Sigma_2 = + 9,68 \, \overline{P}_{20} + 6,82 \, \overline{P}_{30} - 3,94 \, \overline{P}_{40} - 0,80 \, \overline{P}_{50}$$

where P_{io} are the zonal spherical functions related to the point 58° E.G.
of the Equator, as polar point, and $\overline{P}_{io}$ are the zonal spherical functions
related to the point 150. E.G. of the Equator, as polar point. The
positions of the symmetry-points and the form of the functions refer, of
course, to the geoid mentioned only, but a certain more general validity
may be attributed to them on account of the similarity of geoid shapes
obtained in different ways.

The fact, that the equatorial geoid section can be well approxi-
mated by the sum of two symmetrical shapes, leads to the assumption that
the geoid anomalies existing in the areas of the Eastern Pacific Ocean,
South America, the Atlantic Ocean and Africa originate probably from the
opposite side-superposition of the anomalies in the main directions only,
not having any independent mass or energy-inhomogeneity basis at all.

Our ideas developed in connection with the geoid anomalies are
highly simplified by this assumption, directing our attention, in con-
nection with the cause of phenomenon, to the Equator and thus to the
dynamic phenomena of the Earth. It seems therefore desirable to step out
from the meagre possibilities of the equatorial cross-section and to
investigate the phenomenon also from the point of view of the entire
anomaly system of the geoid.

A possibility for this is given by the rotational symmetry of the zonal spherical functions employed for the approximating computations. By computing the spherical distance of the round-number coordinate intersection points from the approximation directions, it is easy, by utilizing the rotational symmetry, to determine and sum the individual anomaly-components on map-like distributed point of the Earth's surface. By eliminating the polar flattening occurring in the course of summation, and by taking the known "pear"-shape of the Earth into consideration, a theoretical geoid shape is obtained (Fig. hereafter).

The geoid shape computed in this way may be taken as to position character and size of the anomalies, not only for similar but also for identical with geoid shape measured. The difference between certain geoid shapes computed with different methods is greater than the difference between the measured and computed shapes as presented here.

It is an important fact, that we used, for the construction of the computed geoid, shape, merely the equatorial data system of the measured shapes ; therefore the identity of these two shapes can not simply be regarded as a result of approximation, but it can be considered as a proof of the complicated geoid shape being merely the sum of two rotation symmetrical anomaly systems, and no other essential agent plays a role in the formation of the geoid pattern. Apart from the main inhomogeneities of Australia and India, the remaining geoid-anomalies have no independent material or energetic background.

Certain further conclusions may be drawn too, from the coefficients of the approximating functions. The zonal spherical function series approximating from the direction of Australia is converging sufficiently evenly. The coefficients of the subsequent even and odd terms are regularly decreasing. On the other hand, the even terms of the function approximating from India are small as compared to the odd ones, i.e. this form has no ellipticity.

The statements made up to now refer only to the formal properties of the approximating functions and may be regarded as mathematical facts. With a hypothetical character, however, also certain physical conclusion may be drawn from them :

1°) From the ellipticity drawn out towards Australia, it can be concluded for a lasting, though eventually changing with time, very deep positive material excentricity in this direction.

2°) From the direction of India neither a positive, nor a negative static material excentricity can be assumed, in lack of ellipticity. The phenomenon may be caused rather by and energy-inhomogeneity, an effect or a process. The approximating form from the direction of India is flat over a large area, indicating the vortex effect of a convection current flowing in a great depth.
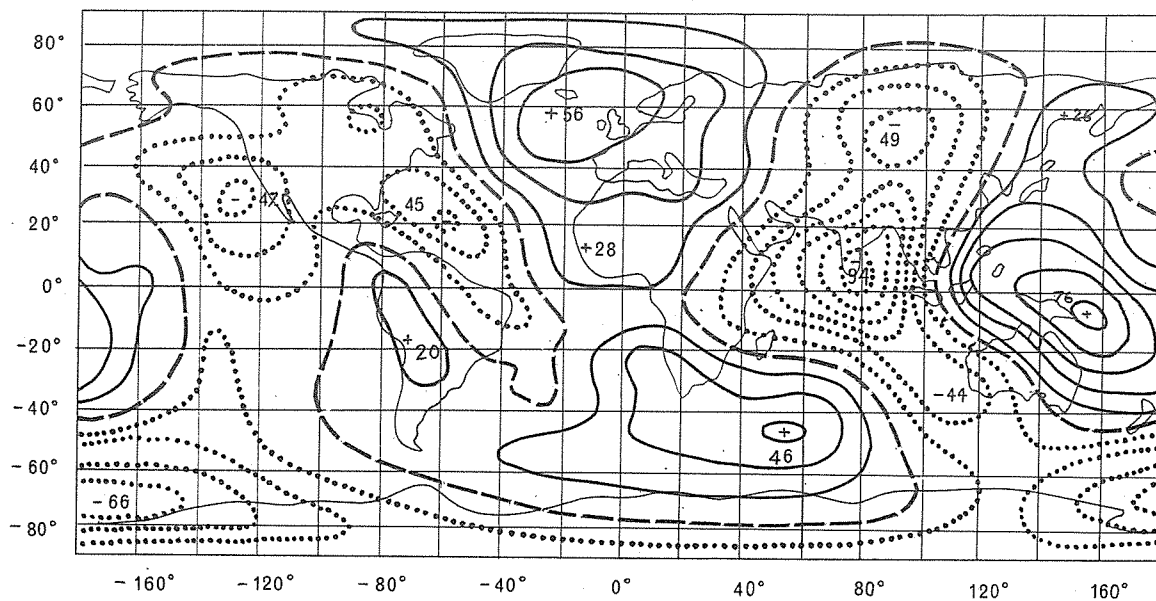
The "Smithsonian Standard Earth 1966" geoid.
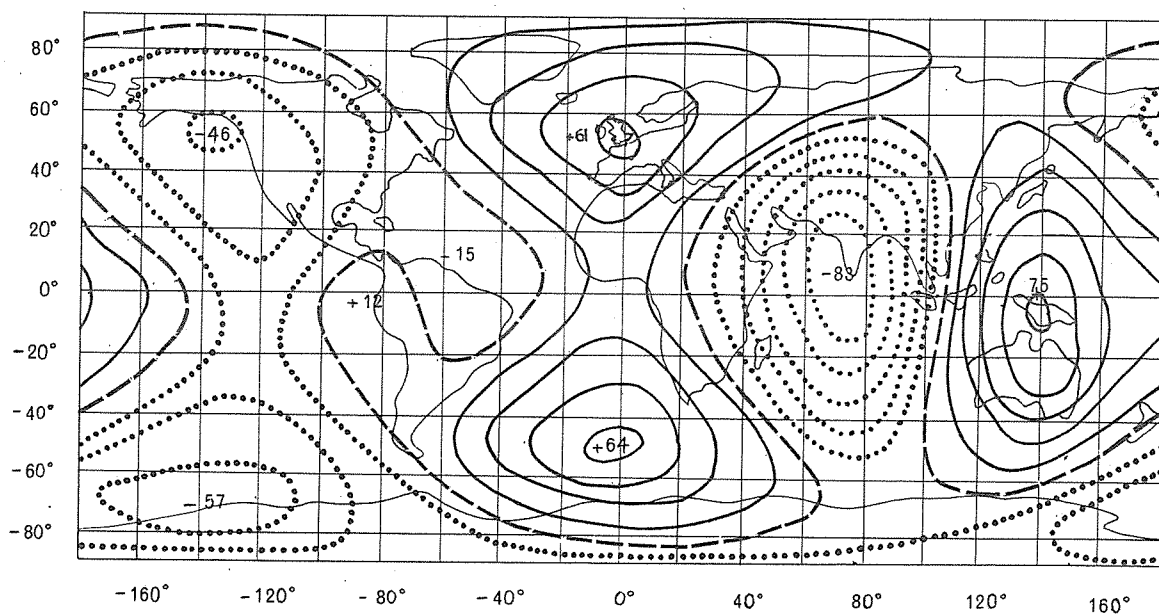
Geoid as calculated from two rotation -
symmetrical anomaly - systems.

(Contour interval : 15 M)

It is visible then, that the coefficients of the mathematical formulas and the shapes calculable from them support the hypothesis that, according to the excentricity of the magnetic field, a deep-lying, positive inhomogeneity of material character exists in the direction of Australia ; nearly perpendicular to this, near the symmetry-point of the magnetic secular variation, a similarly essential geoid deformation exists, related, however rather to a process, to energy-effects.

Besides the high degree of their similarity, the theoretical and the measured geoid patterns contain also certain characteristic differences. The axes of the positive and negative anomaly systems of the northern, resp. southern hemisphere are, on the map measured, not perpendicular to the line of the Equator. Consequently when determining the position of the agent more accurately, one will have to step out from the plane of the Equator. In this way, evidently an approximation still better than the present one can be obtained. Estimations led to the guess that by departing with the agents from the equatorial plane it will be possible to give an explanation also for a considerable part of the known polar asymmetry of the Earth.

- D -

ON THE DEPENDENCY OF A SHARP GRAVIMETER SCALE FACTOR ON THE ALTITUDE OF OBSERVATION POINTS

by Y.D. BOULANGER, K.Y. KOZYAKOVA, R.B. RUKAVISHNIKOV)

(Institute of the Earth's Physics Academy of Sciences, USSR)

Under cooperation between geodetic surveys and the Academies of Sciences of Bulgaria, Hungary, Poland, Romania, Czechoslovakia and the USSR the dependency of a Sharp gravimeter scale factor on the altitude of observation points was investigated in 1971 in Bulgaria. Scale factors were determined by tilting, using the apparatus and methods developed in the Institute of Physics of the Earth of the Academy of Sciences, USSR (1), (2), (3). Scale factors were determined in Varna (H = 10 m), Sofia (H = 570m) and Morena (H = 1780 m). Observations for checking purposes were made in the following consequence : Sofia 1 - Morena 1 - Varna 1 - Varna 2 - Varna 3 - Morena 2 - Sofia 2.

As the scale factor is rather sensitive to temperature (4), (5), (6), certain measures were taken to maintain temperature in the course of observation at the point and also to maintain, as far as possible, the same temperature at all the points. In case of considerable temperature variations, proper corrections were made.

For gravimeters NN°° 174, 181, 228 and 240 large and small dials were investigated. For gravimeter N°177 only the small dial was studied. Scale factors for both dials were measured for at least 6 times. The average of all the measurements was taken as the result.

Basing on experimental data, the dial equation of a geodetic gravimeter may be written as :

$$g_{rc} = g_{ro} + K_1 N + K_2 N^2 + \varphi (N) \tag{1}$$

where g_{ro} — constant

K_1 — linear scale factor

K_2 — second order scale factor

N — gravimeter reading in dial divisions

$\varphi(N)$ — function describing individual scale properties, i.e. scale correction function.

In the case of calibration by tilting the reference gravity is :

$$g_{rc} = g(1 - \cos\beta) \qquad (2)$$

where   g - gravity at the calibration point

β - angle of tilting for the sensitive system of the gravimeter to the horizontal plane.

Coefficients K_1 and K_2 calculated and averaged for each point are listed in Table 1, (p.I-17).

There is a high degree of correlation between K_1 and K_2. Therefore, a change in each of them does not reflect a real variation in the sensitivity of the gravimeter scale factor. Thus, to represent an adequately variation of sensitivity of the meter, a set of Δg values was calculated by substituting various pairs of K_1 and K_2, and those Δg were compared :

$$\Delta g = K_1 (N-N_o) + K_2 (N^2-N_o^2) + \varphi(N) - \varphi(N^o) \qquad (3)$$

The comparison of the calibration results obtained at the points with different altitudes was as follows. Readings N_o and N within the required range of the dial were taken for each gravimeter. Then, according to (3), values of Δg were calculated with coefficients for each observation point, proper scale corrections being made. Values of Δg for all the points were reduced to 20°C. Those reduced Δg are plotted against altitudes in Figs 1 and 2, (p.I-19-20).

Points	Gravimeter N° 174		Gravimeter N°181		Gravimeter N° 228		Gravimeter N° 240	
	K_1	$K_2 \times 10^5$	K_1	$K_2 \times 10^5$	K_1	$K_2 \times 10^5$	K_1	$K_2 \times 10^5$
Varna 1	5.12700	9.2382	6.49371	9.6222	4.36466	2.6570	6.18893	0.4108
Varna 2	5.12942	8.9159	6.49671	9.7061	4.36652	2.8532	6.18316	1.9029
Varna 3	-	-	6.49043	10.5091	4.36391	2.9117	-	-
Sofia 1	5.12728	10.0083	6.49690	9.9528	4.36476	3.2042	6.18831	0.7209
Sofia 2	5.12501	10.4362	6.49437	10.2368	4.36306	2.6872	6.18308	2.0974
Morena 1	5.12060	11.0406	6.49361	9.5598	4.36468	2.4820	6.18299	1.4036
Morena 2	5.11967	11.0121	6.48852	11.2330	4.36469	2.5594	6.17678	2.9035

TABLE 1

GRAVIMETER N° 174

H meters

GRAVIMETER N° 181

H meters

Fig. 1

GRAVIMETER N° 228
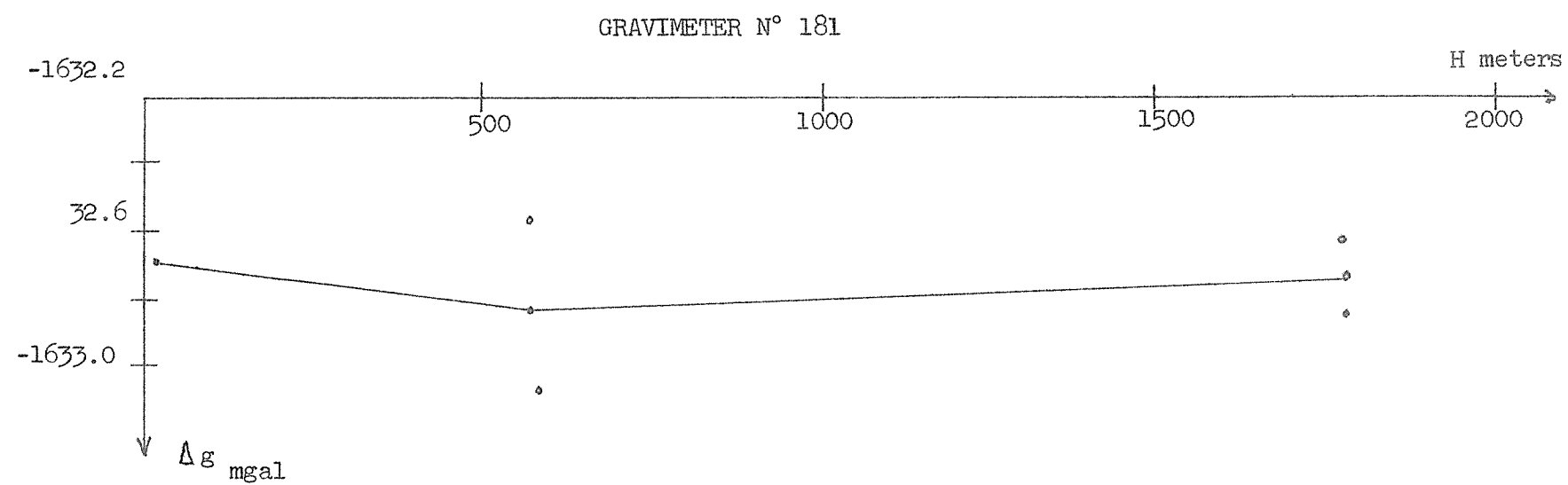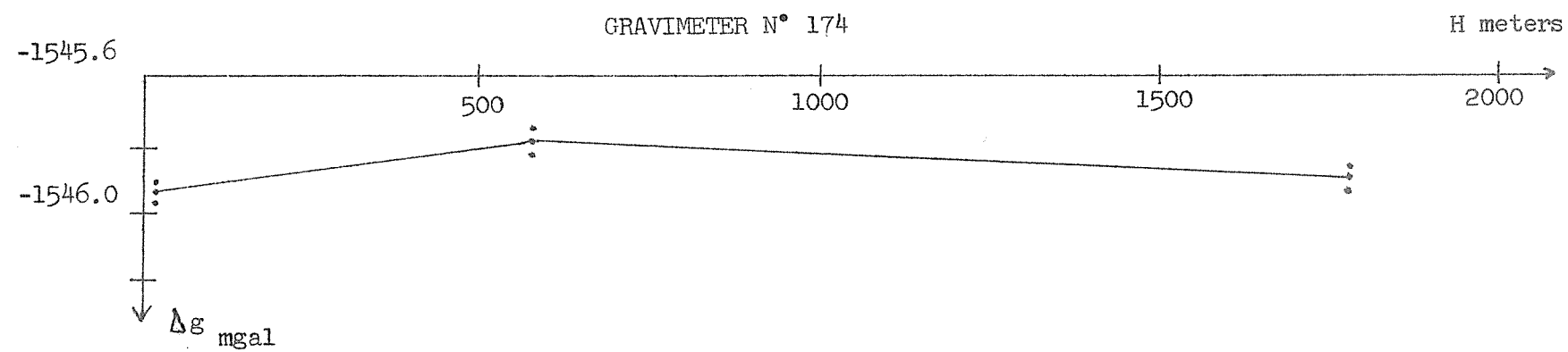

GRAVIMETER N° 240

Fig. 2

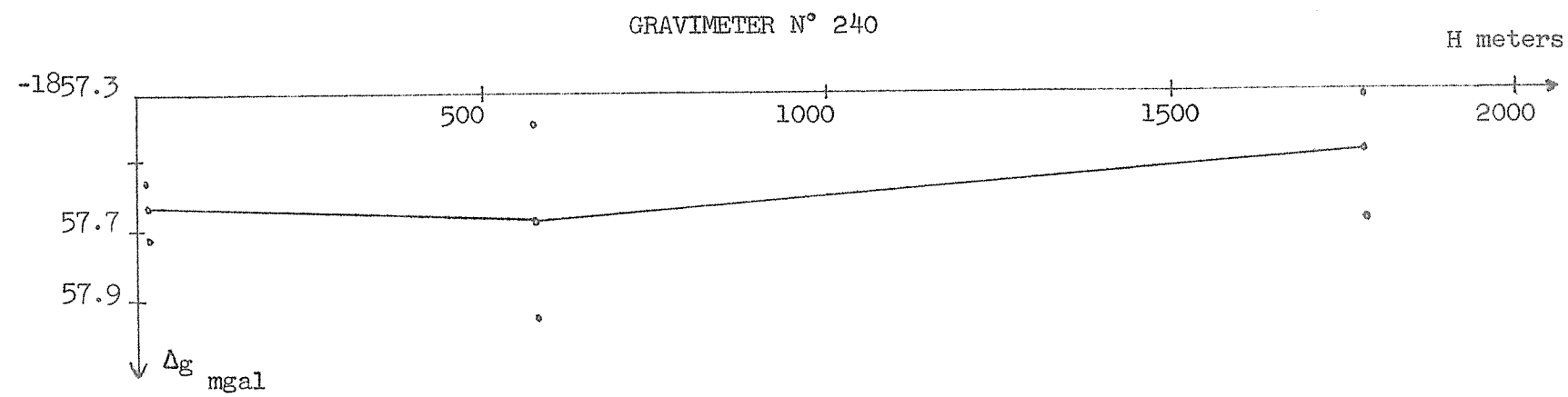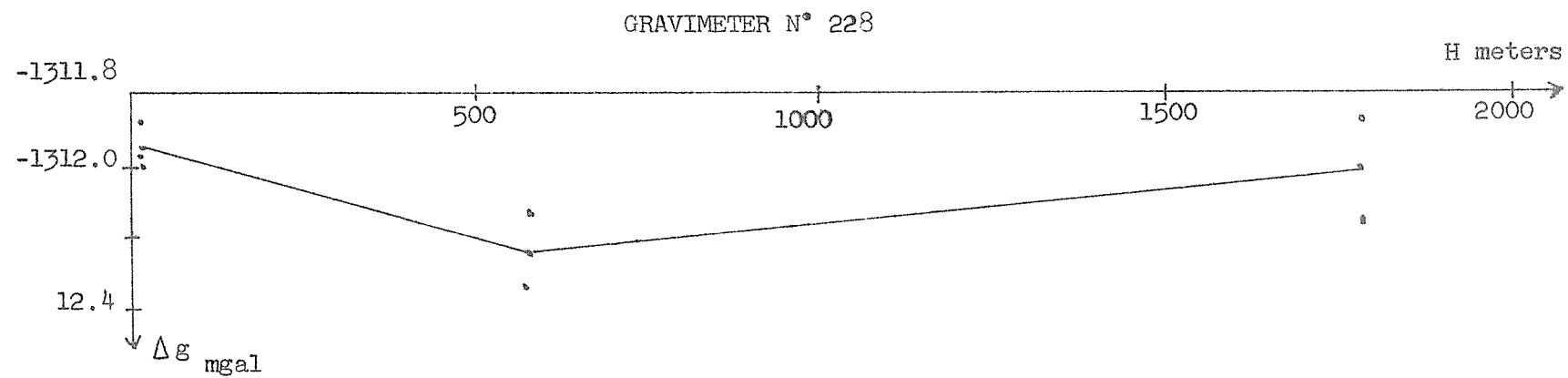Values of Δg obtained for all observation points and ratios of $\delta(\Delta g)$ variation to elevation ΔH are summarized in Table 2, (p.I-21). Column 2 gives ratios for Δg between the points Varna and Morena ($\Delta H = 1.77$ km), and column 3 - those for Varna and Sofia ($\Delta H = 0.56$ km). In column 4 a weighted average of the two values is given. The weight P was taken as ΔH^2. The last column gives relative changes of the meter sensitivity per 1 km of altitude. It may be easily seen that all the changes are well within measurement accuracy. The effect of atmospheric pressure variation with altitude is from - 3.6 to 7.4×10^{-5}km^{-1}, and the average for 4 gravimeters was found to be $\pm 1.1 \times 10^{-5}$km^{-1}, the standard error for the latter being $\pm 2.7 \times 10^{-5}$km^{-1}. Similar results were obtained also for the small dials. In this case the investigation routine was simplified. In (1) $K_2 N^2$ was omitted. The results of K_1 determination are given in Table 3 and, as in the first case, they indicate the absence of the effect under investigation.

The studies carried out have shown that Sharp gravimeters are rather sensitive to temperature when measurements are made with UEGP calibration bench. The bulk of the scatter observed in Δg may be attributed to improper consideration of temperature effects. Therefore, evidently, the accuracy of calibration may be considerably increased by putting the UEGP into a thermostat.

TABLE 2

Point	Δg	$\left[\dfrac{\delta(\Delta g)}{\Delta H}\right]_{V-M}$	$\left[\dfrac{\delta(\Delta g)}{\Delta H}\right]_{V-S}$	$\left[\dfrac{\delta(\Delta g)}{\Delta H}\right]_P$	$\dfrac{\delta(\Delta g)}{\Delta H \Delta g}$
	(1)	(2)	(3)	(4)	(5)
	mgal	mgal/km	mgal/km	mgal/km	$10^{-5} \times km^{-1}$
		Gravimeter N° 174			
Varna	-1545.94				
Sofia	-1545.79	+0.023	+0.268	+0.045	-3.0
Morena	-1545.90				
		Gravimeter N° 181			
Varna 2	-1632.68				
Sofia	-1632.82	-0.039	-0.250	-0.058	+3.5
Morena	-1632.75				
		Gravimeter N° 228			
Varna	-1311.95				
Sofia	-1312.26	-0.051	-0.554	-0.096	+7.4
Morena	-1312.04				
		Gravimeter N° 240			
Varna	-1857.64				
Sofia	-1857.68	+0.079	-0.071	+0.065	-3.6
Morena	-1857.50				

Point	Gravimeter N° 174		Gravimeter N° 177		Gravimeter N° 181		Gravimeter N° 228		Gravimeter N° 240	
	K_1	$\dfrac{M(K)}{K_1}$	K_1	$\dfrac{M(K)}{K_1}$	K_1	$\dfrac{M(K)}{K_1}$	K_1	$\dfrac{M(K)}{K_1}$	K_1	$\dfrac{M(K)}{K_1}$
		$\times 10^4$		$\times 10^4$		$\times 10^4$		$\times 10^4$		$\times 10^4$
Varna	0.10630	± 1.9	0.09569	± 1.8	0.10249	± 2.0	0.10288	± 5.0	0.10018	± 1.8
Sofia	0.10628	2.5	0.09568	2.0	0.10250	1.0	0.10289	4.0	0.10018	3.4
Morena	0.10631	2.0	0.09569	1.7	0.10253	3.4	0.10288	2.7	0.10020	1.2

TABLE 3

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   The Bulletin for the inventions and openings by the Council of Ministers of the USSR, n° 21, Moscow, 1967.

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   Works of the Institute of the Earth's Physics of the Academy of Sciences of the USSR, n° 31, (198), Moscow, 1964.

3. ROMANIUK V.A. & R.B. RUKAVISHNIKOV. - "The calibration of gravimeters with the horizontal turned string by tilting".
   Nauka, Moscow, 1966.

4. KOZYAKOVA K.Ya & al. - "Some results of the calibration of sharp gravimeters by tilting".
   Studia Geodetica & Geophysica, n° 1, 1972.

5. OLEJNIK S., L. TRÄGER - "Calibration of the CG-2 gravimeter sharp N° 174 by tilting".
   Prague, 1970.

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   Institute of the Earth's Physics of the Academy of Sciences of the USSR, Moscow VINITI, 985-69, copies limited.

- E -

THE THREE CATEGORIES OF BOUGUER OR ISOSTATIC ANOMALIES
by J. LAGRULA

A previous paper (1) concerned the "representativity" of the various gravimetric anomalies. A remark made by J. Goguel determined me to complete the adopted classification.

The free-air anomaly represents the attractions of all the masses which differenciate the actual Earth from the ellipsoïdal model : it is generally too much

The first Bouguer anomaly b_1 takes into account the correction of spherical plateau ; b_1 represents on one hand, the differences between the actual Earth and a superficially regularized Earth, on the other hand, an indirect effect.

The second Bouguer anomaly is $b_2 = b_1 + c$, where c is a topographic correction evaluated by means of the conventional densities 2,67 (continental masses) and 1,027 (oceanic masses) ; b_2 is very frequently utilized and represents :

1°) weak "residual masses",
2°) masses of compensation,
3°) subcrustal structures,
4°) the indirect effect.

The third Bouguer anomaly b_3 is supposed free from the action of the "residual masses" owing to the geological correction c' obtained by means of the actual densities, instead of the conventional ones, for the continental and eventually for the oceanic masses.

Among the isostatic anomalies, I did not consider, in my previous paper, those which correspond to b_1, because the determination of the masses of compensation is generally deduced from the superficial masses (topography). But J. Goguel uses sometimes i_1 anomalies when the topography is not well known. Consequently we will have three categories of isostatic anomalies, i_1, i_2, i_3, corresponding to b_1, b_2, b_3.

For each category there are some varieties corresponding to the type of compensation (deepness, regionality, intermediate layer, oceanic crust, etc...). But the essential features are that of i_1, i_2, i_3.

The anomaly i_1 is deduced from b_1 by means of the compensation of the plateau and topo-isostatic corrections for the zones 18-1 ; i_1 represents on one hand the differences between the actual Earth and a superficially regularized "compensate" Earth, on the other hand an indirect effect. As the attractions of the plateau and its compensation are nearly equivalent, one may consider that i_1 is deduced from the free-air anomaly by means of the topo-isostatic corrections of the 18-1 Hayford zones.

The anomaly i_2 is deduced from b_2 and is still influenced by the "residual masses" whose attraction is generally stronger than the opposite attraction of their compensation. In analogy with b_2, i_2 is the most available isostatic anomaly.

If the topographic and structural data allow a good determination of c', we obtain the anomaly i_3, free from all crustal influences ; i_3 represents only on one hand a residual indirect effect, on the other hand the deep structures ("mascons", etc...) and is consequently the most interesting for the determination of the essential features of the gravity field. The term "essential" concern the structures perhaps too small for being detected by disturbed satellites, but important at a geological or geophysical scale (nearly 10^4 or 10^5 km^2).

In any case it is recommended to state what kinds of anomalies b or c are available and to avoid mixing their heterogeneous categories 1, 2, 3.

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[1] Sur les corrections topographiques, géologiques et isostatiques. C.R. Acad. Sci., t.272, p.816, 1971.

LISTE DES PUBLICATIONS

reçues au

BUREAU GRAVIMETRIQUE INTERNATIONAL

(Février à Août 1971

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CONCERNANT LES QUESTIONS DE PESANTEUR

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* 293 - MAKRIS J., P. THIELE & J. ZIMMERMANN - "Crustal investigation from gravity measurements at the scarp of the Ethiopian Plateau".
Zeits. Geophys. Physica-Verlag, Band 36, S.299-311, Würzburg, 1970.

Models of the crust have been constructed from gravity traverses across the escarpment of the Ethiopian Plateau and the northern part of the East African Rift near Addis Ababa. The densities used for the computations are closely related to seismic results obtained at the western part of the Rift, the Red Sea and the Gulf of Aden. They are :
2.65 g/cm³ for the upper part of the crust,
2.85 - 2.95 g/cm³ for the "intermediate" layer,
3.00 - 3.10 g/cm³ for the mantle material.
The main results are :
The crustal thickness decreases to the north from 38 km under Addis Ababa to 15 km under Asmara at the edge of the Plateau ;
the gravity anomaly obtained in the Rift can be explained by mantle material rising under the Rift ;
the major tectonic fracture between the Ethiopian Plateau and the Depression of Afar seems to be located just in front of the escarpment on the side of the Depression ;
the "intermediate" layer rises at the edge of the Plateau towards the Depression to a depth of about 10 km.

294 - MAKRIS J., H. MENZEL, J. ZIMMERMANN, K. BONJER, K. FUCHS & J. WOHLENBERG. - "Crustal and upper mantle structure of the Ethiopian Rift derived from seismic and gravity data".
Zeits. Geophys. Physica-Verlag, Band 36, S.387-391, Würzburg, 1970.

295 - SOVIET GEOPHYSICAL COMMITTEE - Catalog of gravity measurements in Atlantic Ocean, 1969, Cruise : Academician Kurchatov".
Acad. Sci. U.S.S.R., 247 p, Moscow, 1970.

* Les numéros font suite à ceux indiqués dans le Bull. Inf. n°26, Juin 1971.

296 - TOMODA Y., J. SEGAWA & A. TOKUHIRO. - "Free-air gravity anomalies at sea around Japan measured by the Tokyo surface ship gravity meter (1961-1969), from : Proc. Japan Acad., v.46, n°9, p.1006-1010, 1970.

297 - JACOBY W.R. - "Instability in the upper mantle and global plate movements".
J. Geophys. Res., v.75, n°29, 1970.
Contr. Earth Physics Branch n°314, 10 p, Ottawa.

It is shown that the upper mantle is probably unstable. The instability expresses itself in diapirism under the ridges and sinking of the lithosphere under the island arcs. Both processes exert a force on the plate that can move it against the viscous drag from the flow of the asthenosphere. Order of magnitude estimates of the forces and of the required energy demonstrate that the process is plausible and that the drift rate can be determined from the resistance the plate encounters at its edges, particularly below the island arcs where it plunges into the mesosphere. The proposed mechanism can be tested by studying, e.g., the deep structure of the ridges, the stress field in the plates, and the gravity field over ridges and trenches.

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VII.2 - Geophysics

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p.80-102.
2. KOIZUMI K. - "Gravity measurements on land".
p.103-105.
3. IGARASHI T. - "On line real time processing program of the gravity data".
p.106-118.
4. IGARASHI T. - "Batch processing program for computing the corrected depth, Bouguer correction and the Eötvös correction".
p.119-132.

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299 - OCEAN RESEARCH INSTITUTE - Geophysical data of KH-68-4 of the Hakuho Maru.
Univ. Tokyo, 113 p, 1970.

Lists of :
- Coordinates
- Echo sounder depth in m.
- Corrected water depth in m.
- Bouguer correction in mgal.
- Total magnetic force in γ at every 5 min.

300 - SEGAWA J. - "Gravity measurements at sea by use of the T.S.S.G.
Part 1 : Data processing method of the T.S.S.G.".
J. Physics Earth, v.18, n°1, p.19-49, 1970.

Gravity was measured at sea by use of the T.S.S.G. surface ship
gravity meter. The mechanism of the T.S.S.G. and the method of data
processings have already been dealt with in papers by TOMODA et al.,
(1962, 1968), but since then improvement has been made in both respects.
In this paper methods of data processings are described with special
emphasis on the 2nd order correction for finite sampling intervals and
also on the effect of elasticity on the dynamic gravity meters. Effects
of horizontal accelerations are also discussed in relation to the
T.S.S.G., which have mattered with Vening-Meinesz submarine gravity
meters, La Coste-Romberg gyrostabilized shipboard gravity meters or
Graf-Askania surface ship gravity meters.

301 - SEGAWA J. - "Gravity measurements at sea by use of the T.S.S.G.
Part 2 : Results of the measurements".
J. Physics Earth, v.18, n°3&4, p.204-284, 1970.

Among numerous cruises on which gravity was measured by use of the
T.S.S.G. the cruises of the Umitaka-maru of the Tokyo University of
Fisheries made in July and August 1966 and from November 1967 to
February 1968, the cruises of the Hakuho-maru of the Ocean Research
Institute, University of Tokyo made in August 1967, in July and August
1968 and from April to June 1969, and the cruise of the Meiyo of the
Hydrographic Office, Maritime Safety Agency of Japan are selected to
illustrate actual situations of gravity measurements during each of
the cruises. Gravity measurements by use of the Vening Meinesz gravity
meter made in 1934 and 1935 by Matsuyama et al. are also taken up and
compared with the measurements by use of the T.S.S.G.
Gravity values obtained by these measurements have been compiled
into gravity tables, and maps or profiles of certain tectonically inti-
mate areas have been drawn. The areas selected from tectonical viewpoint
are : Japan trench and its vicinity, Suiko sea-mount at the emperor
ridge, Brisbane Hill at the coral sea, Shatzky rise (north-west Pacific
rise), Bismark plateau, Mariana trench and Solomon trench.

302 - PRAUS O., J.M. DeLAURIER & L.K. LAW. - "The extension of the Alert geomagnetic anomaly through Northern Ellesmere Island, Canada". Canadian J. Earth Sci., v.8, n°1, p.50-64, 1971.

Earlier studies have shown that the anomaly in geomagnetic variations in the vicinity of Alert at the north end of Ellesmere Island is compatible with a narrow band of induced electric currents flowing in a northeast-southwest direction in the earth's crust or upper mantle. The present analysis of magnetic recordings obtained at 11 sites in Ellesmere Island during 1967 indicates that the Alert anomaly extends to the southwest as far as Eureka, a distance of 475 km. The anomaly has its greatest effect at Alert, and its "strength" diminishes by a factor of 2 or 3, 225 km to the southwest. Its half-width up to this point is about 50 km. The anomalous zone curves to the west near Greely Fjord 300 km southwest of Alert and appears to broaden near Eureka. The path of the anomaly closely follows the structural trends of the near vertical, tightly-folded strata of the Franklinian geosyncline underlying the whole Lake Hazen Plateau region of northern Ellesmere Island. Evidence for the extension of the anomaly through Ellesmere Island includes the near reversal of Wiese vectors on opposite sides of the zone, the confinement of the horizontal magnetic variation and its polarization transverse to the direction of strike, and the large contrast between apparent resistivities observed inside and outside the zone.

304 - BOTT M.H.P. & A.B. WATTS. - "Deep sedimentary basins proved in the Shetland - Hebridean continental shelf and margin". Nature, v.225, n°5229, p.265-268, 1970.

A regional geophysical survey of the continental shelf and margin west of the Orkney and Shetland Isles was completed during cruises of RRV John Murray in 1967 and 1968. These surveys yielded about 9,000 km of continuous surface ship gravimeter and magnetometer track across the shelf and margin, including ten seismic reflexion (sparker) traverses. This report gives a preliminary interpretation of the resulting Bouguer anomaly map.

305 - INSTITUT GEOPHYSIQUE de l'ACADEMIE TCHECOSLOVAQUE des SCIENCES Trav. Geophys.,v.XIII, n°215-239, 627 p, Praha, 1966.

a) JAKUBCOVA I. - "Nomograms for more accurate calculation of gravity terrain correction". p.71-84.

b) VYSKOCIL V. & I. JAKUBCOVA. - "Studium der Korrelation zwischen den Schwereanomalien und Seehöhen auf dem Gebiete der CSSR". S.87-98.

Es wird die Abhängigkeit der Bouguerschen und isostatischen Anomalien von der Seehöhe des Terrains für das Gebiet der CSSR untersucht, das durch ein regelmässiges Meridiane - und Parallelennetz in Felder von Ausmassen $\Delta \lambda = 15'$, $\Delta \varphi = 10'$ und von Fläche 324 km^2 bis 348 km^2 geteilt wurde. Die mittleren Seehöhen für diese Felder wurden aus der im Geodätischen und topographischen Institut zu Prag i.J.1960 verfertigten Karte der Mittelhöhen übernommen.

Das Studium der Korrelation zwischen den Schwereanomalien und Seehöhen des Terrains auf dem Gebiete der CSSR hat die ausdrucksvolle negative Korrelation (r = -0,58) im Falle der Bouguerschen Anomalien und die Nullkorelation für die isostatischen Anomalien (das Airy-Heiskanensche System) mit der Kompensationstiefe von T = (24 $\pm$ 4) km erwiesen. Die gewonnenen Ergebnisse dienen als Beweis der Existenz von isostatischer Kompensation der topographischen Massen auf dem Gebiete der CSSR.

306 - OBSERVATOIRE ROYAL de BELGIQUE - Sixième Symposium International sur les Marées Terrestres, Strasbourg, 15 - 20 Septembre 1969. Comm. Ser. A, n°9, Ser. Geophys. n°96, 235 p, 1970.

MELCHIOR P. - Marées Terrestres.

309 - Bull. Inf. n°58, p.2782-2836, Bruxelles, Septembre 1970.

310 - Bull. Inf. n°59, p.2838-2920, Bruxelles, Octobre 1970.

311 - Bull. Inf. n°60, p.2922-2999, Bruxelles, Février 1971.

312 - KOVALEVSKY J. & H.M. DUFOUR. - "Formulation pratique du champ de gravité terrestre par des fonctions régionalisées". Bureau des Longitudes - Inst. Geog. Nat., Paris. Contrat DRME/ADOP n°622/67, 72 p, 1970.

La connaissance du champ du potentiel de la gravité terrestre a deux origines essentielles :
- L'étude de la trajectoire des satellites.
- Les mesures au niveau de la surface topographique : intensité g de la pesanteur, déviations de la verticale, gradients, etc...

Une liaison entre les deux sources d'information peut être tentée par l'usage du développement du potentiel de gravité en harmoniques sphériques, l'origine étant au centre de gravité G des masses. Un tel développement convient bien aux études d'orbites de satellites, on peut même dire qu'il semble le seul adapté aux études analytiques. Par contre, il se prête très mal à une "régionalisation" poussée.

Par ailleurs, les représentations traditionnalles de la gravimétrie font appel à des intégrales de fonctions prises sur la surface topographique ou sur le géoïde. Elles se prêtent assez bien à la régionalisation mais conduisent à des calculs très spéciaux, aux formules connues de façon littérale, mais se prêtant mal aux calculs pratiques, ainsi qu'à l'extrapolation au champ dans tout l'espace.

L'étude présentée ici a pour but de tenter une synthèse entre les deux sources d'information.

Après une analyse numérique "pour voir", utilisant la représentation par "masses enterrées", on a examiné leproblème sous une forme théorique générale.

313 - INSTITUT GEOPHYSIQUE de l'ACADEMIE TCHECOSLOVAQUE
Studia Geophys. & Geod., v.15, n°1, 104 p, Praha, 1971.

a) NADENIK Z - "Les formes différentielles extérieures dans la Géodésie I : Courbure de Gauss".
p.1-16.

b) BURŠA M. - "Comparison of satellite and terrestrial gravity data".
p.7-33.
The integral mean values of gravity on the surface W = W, obtained from satellite observations with the use of harmonic coefficients and from terrestrial gravity measurements are compared. The squares and products of the harmonic coefficients were neglected, with the exception of $|J_2^{(o)}|^2$, which was taken into account. The Potsdam correction and the geocentric constant are being discussed. The paper ties up with former papers * and the symbols used are the same. The given problem was already treated ; in the present paper the values of gravity are compared directly.

c) ŠIMON Z. & B. SOKOLÍK - "Eine Eichmethode für die Askania Erdgezeiten-registrieranlage mit dem Galvanometer".
p.92-94.
The scale-value switch makes it possible to calibrate even the older Askania tidal equipment with a galvanometer at a reduced scale-value. If resistors R_2 and R_3 are selected as shown in Eqs (4) and (5), the ratio of reduction of the scale-value 1/n does not depend on the

* Voir Bull. Inf. n°26, p.II-2 et 26.

internal resistance of the photo-cell in the gravimeter. The resistance of the recording galvanometer R_4 must be determined with an accuracy of $\pm$ 1 % in order to obtain an accuracy of $\pm$ 0.5 %. Together with the reduction in scale value also the damping is considerably decreased, which enables the time, required for calibration, to be cut down considerably.

314 - LAUER S. - "Über die stochastischen Eigenschaften Lakaler Schwere-anomalien und ihre Prädiktion".
Dissert., 156 S, Bonn, 1971.

     1 - Die Prädiktion trendüberlagerter Zufallsprozesse und ihre Zerlegung in zwei unabhängige Teile.
     2 - Die Heraustrennung der deterministischen Anteile aus dem Gesamtvorgang.
     3 - Methoden zur empirischen Bestimmung der Kovarianzfunktion für zweidimensionale stochastische Prozesse bei nicht äquidistantem Datenmaterial.
     4 - Prüfung der Trendabspaltung aus den stochastischen Eigen-schaften der verbleibenden Reste.
     5 - Numerische Untersuchungen an Hand der Schwereanomalien im Kottenforst bei Bonn.

315 - WORLD DATA CENTER B.1 - Six-monthly catalogue of data on seismology and gravity received during the period January 1 - June 30, 1969.
38 p, Moscow, 1969.

316 - WORLD DATA CENTER B.1 - Catalogue of publications received by WDC B.1 between January and June 1969 : Seismology, Gravimetry & Geodesy.
32 p, Moscow, 1969.

317 - WORLD DATA CENTER B.1 - Catalogue of publications received by WDC B.1 between January and June 1969 : General and periodicals.
31 p, Moscow, 1969.

318 - WORLD DATA CENTER B.1 - Catalogue of publications received by WDC B.1 between January and June 1970 : General and periodicals.
33 p, Moscow, 1970.

319 - WORLD DATA CENTER B.1 - Six-monthly catalogue of data on seismology and gravity received during the period January 1 - June 30, 1970.
34 p, Moscow, 1970.

CENTRE NATIONAL de la RECHERCHE SCIENTIFIQUE - Bulletin Signalétique 120.

. Astronomie et Astrophysique, Rayons cosmiques, Météorites, Physique du Globe.

320 - v.XXXI, n°7-8, p.10082-11748, Paris, 1970.

321 - v.XXXI, n°12, p.17962-20325, Paris, 1970.

. Astronomie, Physique spatiale, Géophysique.

322 - v.XXXII, n°1, p.1-676, Paris, 1971.

323 - v.XXXII, n°3, p.1713-2687, Paris, 1971.

324 - v.XXXII, n°4, p.2688-3993, Paris, 1971.

325 - MENDES-VICTOR L.A. - "L'interprétation des mesures gravimétriques et magnétiques aux Iles du Cap Vert et la théorie de l'expansion des fonds océaniques".
Fac. Sci., Univ. Strasbourg, thèse n°A.O.5180, 235 p, 1970.

Dans le premier chapitre nous tenterons de donner un aperçu de l'expansion des fonds océaniques, en cherchant, à priori, des arguments pour inclure l'archipel du Cap Vert dans l'histoire de l'Océan Atlantique telle qu'on la voit actuellement.

Le deuxième chapitre sera consacré aux observations gravimétriques. Y seront présentés les différents traitements numériques qui permettent d'obtenir des résultats interprétables. Nous y donnerons seulement une interprétation qualitative, réservant l'interprétation quantitative pour le quatrième chapitre.

Dans le troisième chapitre, nous ferons l'analyse des mesures géomagnétiques dont nous disposons. Nous présenterons une méthode de traitement des magnétogrammes à partir de l'analyse spectrale généralisée. Les résultats des analyses y seront discutés dans l'hypothèse d'une stratification de la conductivité.

Les résultats des interprétations quantitatives des anomalies du champ gravifique seront présentés au cours du quatrième chapitre ; nous essayerons d'y établir un schéma global de la structure des îles du Cap Vert, compte tenu des idées retenues au troisième chapitre et de l'hypothèse de l'expansion des fonds océaniques.

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      - Série 52, t.1, 48 p, 1970.
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342...Géophysique
      - t.11, 237 p, 1969.
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371 - NATIONAL SPACE SCIENCE DATA CENTER - Data catalog : Satellite
      experiments. (Supplement n°2 to NSSDC 69-01).
      NSSDC 70-12, 79 p, Greenbelt, 1970.

372 - NATIONAL SPACE SCIENCE DATA CENTER - Handbook of correlative data.
      NSSDC 71-05, 198 p, Greenbelt, 1971.

373 - <u>BULLETIN GEODESIQUE, I.A.G., n°99, Mars 1971.</u>

a) REMMER O. - "A test of significance for the Helmert-Kubik problem of weight-determination".
p.29-36.

As it has been shown by Kubik it is possible to get an estimate, $\hat{Q}$, of the reciprocal of the weight-matrix in an adjustment problem. If we want to see whether this new estimate $\hat{Q}$ differs significantly from our a priori value Q_o it is necessary to know the distribution function of the elements $\hat{q}i$, the $\hat{q}i$'s being the elements of $\hat{Q}$. This distribution is found in the present article and it is shown that it is not identical with any of the distributions well known from statistical textbooks. Furthermore a way of computing this new distribution is presented. Finally the connection with the chi-square distribution is explored and it is proved that the chi-square-distribution may be used as an approximation for a large number of over-determinations.

b) LAMBECK K. - "The relation of some geodetic datums to a global geocentric reference system".
p.37-54.

In this paper the relationships between three geodetic datums and the new Smithsonian Astrophysical Observatory's Standard Earth (determined by Gaposchkin and Lambeck) have been established through comparisons of coordinates of stations tied to both the global geocentric system and the respective datum. The datums considered are the North American Datum of 1927 (NAD), the European Datum of 1950 (EUR), and the Provisional South American Datum of 1956 (SAD). For the NAD 12 stations were used, for EUR 7 stations, and for SAD 3 stations. For several other datums one or two stations are available for determining at least the translation of the datum, but it has been found that these elements are not representative of the entire datum. These datums are not discussed further here.

c) KIVIOJA L.A. - "Computation of geodetic direct and indirect problems by computers accumulating increments from geodetic line elements"
p.55-64.

By choosing sufficiently small elements of the length of the geodetic line, or of the latitude or longitude difference, the other two can be computed at each element and the results can be accumulated to solve the problem with more than twenty significant number accuracy if desired. Ten to twelve number accuracy was computed in the examples of this paper. The geodetic line elements are kept in correct azimuth by Clairault's equation for the geodetic line. The computers can do millions of necessary computations very economically in a few seconds.

All other published methods solving the direct or indirect problem can be reliably checked against results obtained by this method. The run of geodetic lines around the back side of the Ellipsoïd is outlined.

d) MATHER R.S. - "The harmonic representation of the disturbing potential". p.65-88.

　　　The alternative harmonic representations of the disturbing potential, correct to the order of the flattening, are examined and an example is given where the incorrect use of a spherical harmonic expansion can give rise to fallacious results. The correct usage of the spherical harmonic expansion for the disturbing potential is given in the solution of the general surface integral to define the indirect effect in the case of the non-regularised geoïd.

e) INTERNATIONAL ASSOCIATION of GEODESY - East European Sub-commission for Satellite Geodesy. p.89-102.

f) CORON S. - Compte-rendu de la Commission Gravimétrique Internationale 7 - 11 Septembre 1970. p.103-110.

g) LEVALLOIS J.J. - "Quelques conséquences géophysiques des nouvelles méthodes de haute précision de mesures absolues de g". p.111-112.

h) RAPP R.H. - "Equal-area blocks". p.113-125.

　　　A choice in the subdivision of the Earth into approximately equal area blocks is considered. Criteria are discussed for judging the value of various types of block divisions. The three divisions considered in this paper are :
1 - A generalized division valid for any size block ;
2 - and 3 - A division of a 30° block and the Zhongolovich 10° blocks so that the sub-blocks may be conveniently meaned to form blocks in sizes up to 30° and 10° respectively.

i) BARANOV V. - "Sur quelques problèmes de la géométrie de l'ellipsoïde, problème de Neumann extérieur". p.127-134.

j) GROTEN E. - "Measurements of vertical gravity gradient".
p.135-136.

374 - Geophysics, v.35, n°6, December 1970.

a) WOOD L.C. & S.N. HOCKENS. - "Least squares smoothing operators".
p.1005-1019.

Smoothing data to extract desired trends has been standard sienti-
fic and engineering practice for many years. Use of polynomials in a
least squares sense to accomplish this end has also been conventional
procedure, and it is well known that smoothing acts as a low-pass filter.
However, detailed analysis of filtering behavior is lacking in the li-
terature and should be useful to geological and geophysical data pro-
cessors. This paper has two objectives : to review least squares poly-
nomial smoothing and to discuss some z-transform properties of the
convolution operator that implements the smoothing...
Several figures illustrate how an interpreter can use this
knowledge to help in choosing the number of points and orders of
polynomials required to smooth data of various kinds : gravity, ma-
gnetics, electrical, well log, stratigraphic. The least squares weights
also apply to array design."

b) GIRDLER R.W. - "Recent geophysical exploration of the East African
Rift System".
p.1146.

The East African Rift System includes the Dead Sea-Aqaba rift, the
Red Sea and Gulf of Aden, and the Gregory rift through East Africa with
its branch, the Western rift. To a first order, these rifts mark the
boundaries of three plates, Arabia, Nubia, and Somalia.
Geophysical studies over the last ten years indicate that various
parts of the rift system show various stages in the break up of a con-
tinental plate. In East Africa, the amount of separation increases from
south to north. In Tanzania, there is rifting with little volcanism ;
the amount of volcanism increases northwards through Kenya and Ethiopia.
In the Red Sea there is a considerable region of plate separation and in
the Gulf of Aden, the separation has been the most spectacular with the
formation of a large region of oceanic crust between the Arabian and
Somali plates.
Since 1965, efforts have been concentrated on under standing the
nature of rifting and associated volcanism in East Africa. The work has
consisted mainly of teleseismic studies and field parties making gravity
and magnetic observations. A much more detailed picture of the gravity
field over the rift system has been obtained. It is found that there is
a wide negative Bouguer anomaly of several 100 kms wavelength and super-
imposed on this, a small positive Bouguer anomaly of a few tens of

kilometers wavelength. The latter (much smaller than the Red Sea and
Gulf of Aden anomalies) is observed along the center of the rift in
Kenya and is closely related to the volcanism. These anomalies are
interpreted in terms of plate attenuation.....

c) FOURNIER K.P. & S.F. KRUPICKA. - "Technique for improved convergence
   of two-dimensional iterative interpretation of gravity anomaly profiles".
   Abstract from : The 40th annual int. SEG meeting, New Orleans, Nov. 70.
   p.1150.

   Since the publication of Talwani (1959), a number of papers have
appeared discussing computer schemes for iterative interpretation of
two-dimensional gravity anomalies by profile analysis. In some cases
no example is published with the reference, and in others, only wide
geologic basins are examined. However, the problems associated with more
narrow anomalies tend to be more difficult to solve by the relatively
simple scheme suggested by Bott (1960) and employed by others.
   An empirical scheme for improving on Bott's straightforward flat plat
plate iterative formula develops after a number of iterations have pro-
ceeded. Bott's formula is modified, and the process repeated until
satisfactory convergence is obtained. Alternatively, the empirical modi-
fications in Bott's formula could be obtained if geologic control was
available on one gravity profile in the area of interest. If this is not
available, however, the results of the empirical least squares computation
can be applied to other profiles across the anomaly of interest and thus
save substantial computer time in that fewer iterations are required.
   Two examples show the Bouguer data first corrected for terrain and
then for regional effects. The residuals are exhibited and the geologic
anomaly appears in the results of the iteration after several steps.
Subsequent computations on other profiles across this anomaly are also
exhibited. The method applies equally well to cases of a fixed formation
top or bottom, in which the structure bottom or top, respectively, is
solved for.

d) HAMMER S. - "Vertical attenuation of anomalies in airborne gravimetry".
   Abstract from : The 40th annual int. SEG meeting, New Orleans, Nov. 70.
   p.1160.

   Analysis of components of the gravity anomaly field from elementary
one, two, and three dimensional masses demonstrates that all components
of the same derivative order attenuate with flight elevation at the same
rate for a given type of anomaly. Different types of anomalies attenuate
with significantly different rates. The "signal strength" of an anomaly
component is conveniently defined as the difference between values at ad-
jacent maximum and minimum points along a profile. For a given type of
anomaly the signal strengths of all comparable components are roughly
equal, within about half an order of magnitude. Relative attenuations of
anticipated signal and terrain noise permit evaluation of favorable and
unfavorable prospect areas for airborne gravity exploration...

f) EVAN T.J. & E. USDIN - "Applications of the gravity generated sub-surface".
Abstract from the 40th Annu 1 Int. SEG Meeting, New Orleans, 1970. p.1160.

...

By modification of the regional gravity field, the local ano-malies can be associated with an arbitrarily selected geological horizon. The analysis may be looked upon as a transformation of the gravity map to a synthetic structural map, whose local features are compatible with the shape and magnitude of the observed gravity.

The process has the advantage of detecting those anomalies which are too sharp to be associated with relief at the depth of interest. These relatively sharp anomalies are not allowed to dis-tort the deeper structural picture.

Examples of applications of the method are presented for near-surface gravity anomalies, moderately deep features of the size of oil field structures, and very deep regional gravity anomalies.

g) LaFHR T.R., M.J. HALL & A.T. HERRING - "Optimal processing of surface-ship gravity data".
Abstract from : The 40th annual int. SEG meeting, New Orleans, 1970, p.1170.

Positioning errors and sea conditions are the largest sources of error in the final gravity anomalies mapped from processed sur-face-ship gravity meter data.

...

Optimal processing can be achieved by a fully integrated soft-ware system which has the flexibility of choosing the best parameters for correcting and adjusting the basic data. Such a system is des-cribed which can select an optimum Eötvös correction algorithm, edit and adjust positions, calibrate the cross-coupling correction, adopt an optimal filter, and correct for line-oriented systematic and random errors.

Results of test calculations indicate that a typical 5000 mile survey can be processed to a computer made Bouguer map in approxima-tely ten working days, or about twenty-five percent of the time required to acquire the field data. Moreover, a rigorous treatment of the errors significantly enhances anomaly identification and yields important diagnostic information for the evaluation of data accuracy.

h) LAWRENCE P.L., G.W. EHLERT, J.A. LESTER & A.W. MUSGRAVE - "Method of processing data representing area gravity".
Abstract from the 40th annual Int. SEG Meeting, New Orelans, 1970, p.1180.

The method of processing data representing physical properties of the Earth which comprises : automatically generating from data profiles along lines crossing said area a plurality of smoothed data profiles each of which is smoothed by different smoothing intervals, and combining these data profiles smoothed by different smoothing intervals.

375 - ELSTNER C. - "Zur Einwirkung der Stativelastizität auf Amplituden und Phasen von Schwerependeln".
Deutsche Akad. Wissensch. Veröff., Zentralinst Physik der Erde, n°3, 25 S, Berlin, 1969.

On examine les perturbations des amplitudes et phases de deux pendules gravimétriques oscillants sur un support élastique en fonction du temps. On expose les valeurs et les périodes des perturbations en fonction des conditions initiales et du rapport (ξ) entre le paramètre du couplage élastique et la différence des durées d'oscillation des deux pendules. On trouve que la perturbation des amplitudes et des différences de phase a un maximum pour la valeur $/\xi/ = 1$ et que l'influence des conditions initiales augmente si le rapport $/\xi/$ croît.
Les résultats des mesures pendulaires absolues et relatives confirment la théorie.

376 - ELSTNER C. - "Zur Störung der Bewegung von Invarpendeln durch inhomogene magnetische Felder".
Wissensch. Z. Tech. Univ., 19Jg, H.1, S.117-120, Dresden, 1970.
Mitt. Zentralinst. Physik der Erde, n°28, Potsdam.

Es wird die Einwirkung eines magnetostatischen Feldes, das durch eine lineare Ortsfunktion beschrieben wird, auf die Schwingungszeiten von Schwerependeln aus Invar untersucht. Die berechneten Störungen der Schwingungszeiten hängen im wesentlichen von den örtlichen Änderungen der magnetischen Feldkomponenten in der Pendelschwingungsebene ab. Bei Pendelsystemen kann ausserdem die unterschiedliche Magnetisierung der Pendel Einfluss haben.
Die durch die Ortsabhängigkeit des Magnetfeldes bewirkte Störung der Pendelbewegung kann bei relativen Schweremessungen Fehler bis zu einigen 10^{-1} mGal hervorrufen.

377 - CHOJNICKY T. & J. BYL. - "Zur Frage der Bestimmung von Gangkorrelationen bei Gezeiteninstrumenten".
Vermessungstechnik, 18 Jg, H.10, S.379-382, 1970.

378 - Vermessungstechnik, 12/70, 18 Jg.
Geod. Kart. Zeits. Deutschen Demokratischen Republik, Wissens. Praxis.

Communications présentées au Symposium de Géodésie et Physique de la Terre, Potsdam, 6 - 8 Mai 1970.

a) Symposium "Geodäsie und Physik der Erde", Potsdam 6 bis 8 Mai 1970.
   Worwort, S.433-434.

b) ARNOLD K. ... - "Zur Bestimmung der Schwereanomalien und Geoidundulation
   aus aufeinanderfolgenden Satellitendurchgängen in den Jahren 1967, 1968
   und 1969".
   S.444-445.

c) MORITZ H. - "Eine neue Reihenlösung des Problems von Molodenski".
   S.445-446.

d) PICK M. - "Verallgemeinerung des Systems der Normalhöhen".
   S.446-448.

e) ARNOLD K. - "Das gravimetrische Zusatzglied in Abhängigkeit von der
   Geländereduktion einschliesslich der Glieder 2. Ordnung".
   S.448-449.

f) HRISTOV W.K. - "Uber die Dimensionen der Erde".
   S.450-451.

g) SCHULER R. ... - "Absolute Schweremessungen mit Reversionspendeln in
   Potsdam".
   S.451-453.

h) MUNDT W. - "Bougueranomalien und Krustenaufbau".
   S.456-457.

i) WIRTH H. - "Komplexe Analyse der geomagnetischen und gravimetrischen
   Potentialfelder und ihre Bezichungen zur regionalen Tektonik in der DDR".
   S.457-459.

j) WALZER U. - "Konvektionsströmungen im Erdmantel, die kugelfunktion-
   sentwicklung der Topographie und seismische Diskontinuitäten".
   S.460-462.

k) THURM H. - "Ableitung von Gradienten rezenter vertikaler Erdkrustenbe-
   wegungen, eine Methode zur Feststellung aktiver geologischer Strukturen".
   S.462-464.

   ...

l) VYSKOCIL V. - "Einige Bemerkungen zur Isostasie".
   S.470-471.

a) SAGITOV M.U. - "Gravitationskonstante, Masse und mittlere Dichte der Erde".
   S.59-63.

b) LEDERSTEGER K. - "Normalsphäroid und Kernradius".
   S.63-65.

c) GRAFAREND E. - "Statistische Modelle zur Pradiktion von Lotabweichungen".
   S.66-68.

d) WACHTER S. - "Der Einfluss von persönlichen Fehlern auf die Ergebnisse der Breitenbestimmung nach Horrebow-Talcott".
   S.69-70.

389 - WOOLLARD G.P. & J. MONGES CALDERA. - "Mexico, an area undergoing, secular change in gravity".
   Union Geofisica Mexicana, Auspiciada por el Instituto de Geofisica de la Universidad Nacional Autonoma de Mexico, v.10, n°1, p.9-15, Mexico, 1970.

ACADEMIE DES SCIENCES U.R.S.S. - Références bibliographiques, (texte russe), Moscou, 1971.

390...Géophysique
   - n°1, 280 p.
   - n°2, 275 p.
   - n°3, 278 p.
   - n°4, 283 c.
   - n°5, 234 p.
   - n°6, 252 p.

396...Géodésie, Série 52.
   - n°3, 40 p.
   - n°4, 44 p.
   - n°5, 46 p.
   - n°6, 44 p.

400 - Bureau de Recherches Géologiques et Minières - Série cartes gravimétriques de la France : Feuille 18, BOURGES, échelle : 1/320.000°, d = 2,3, 1970.

401 - KUIPER G.P. - "Selenodetic measuring program".
AFCRL-70-0413, Lunar & Planetary Lab., Univ. Arizona, Final Rep.,
12 p, 1970.

The automatic offset guider was installed and tested in the
telescope. Modifications of the electronic control system to eliminate
observed instabilities are in progress.

The service system of the laser building has been completed, with
the installation of electrical and heat exchange circuits.

Photography of the full moon was continued with excellent results.

An automatic film and print processor was installed and is in
operation

An automatic 5" x 7" lunar camera, designed for rapid-sequence
high-speed exposures, was constructed, installed and is presently
being used.

402 - WOLF H. - "Optimal spacing of stations for the gravimetric determination
of the horizontal gradient of gravity".
Acta Geodaet., Geophys. & Montanist., Acad. Sci. Hung.,
t.5, n°3/4, p.273-278, 1970. (Texte allemand).

The determination of gravimetric horizontal gradient from the
difference in the force of gravity between two points is greatly
influenced by measurement errors if the distance s of the points
considered is too small. On the other hand, for very great distances
a systematic error occurs owing to the deviation of difference quotient
from the differential quotient. An optimal distance s^* is determined,
depending on the curvature g_{ss} of the g-field and the errors m_0 in the
measurement of the force of gravity. This optimal spacing ensures the
least error in the horizontal gradient to be determined.

403 - MORITZ H. - "Molodensky's series and analytical continuation".
AFCRL-70-0698, Ohio State Univ., Rep. n°145, Sci. Rep. n°10,
35 p, 1970.

It is shown that the Molodensky series solution and the solution
of OSU Report 126, based on analytical continuation, are asymptotic
series satisfying the basic equations in terms of which the problems
are formulated. For the investigation of the second solution, analy-
tical continuation to a level surface completely outside the topo-
graphic masses is used. The result provides a logical completion of
the proof of equivalence of these two series solutions.

It is also shown that the results of the method of Report 126 are
the same regardless of the level surface to which analytical conti-
nuation is made. This completes the justification of the formal use
of analytical continuation into the interior of the topographic masses.

404 - MORITZ H. - "Combination of satellite harmonics and gravimetry".
AFCRL-70-699, Ohio State Univ., Rep. n°146, Sci. Rep. n°11,
25 p, 1970.

A relation between the Kaula-Rapp solution and the solution in OSU
Report n°130 is established by deriving the latter solution from a dif-
ferent least-squares principle, whereby this solution is also conside-
rably simplified for practical computation. The Kaula-Rapp solution
turns out to be a limiting case of this solution for small error cova-
riances, and the solution of Report n°130 is represented in the form
of a correction to the Kaula-Rapp solution.

405 - NEEDHAM P.E. - "The formation and evaluation of detailed geopotential
models based on point masses".
AFCRL-70-0718, Ohio State Univ., Rep. n°149, Sci. Rep. n°12,
253 p, 1970.

Detailed models of the geopotential defined in a geocentric coor-
dinate system must currently be based on a combination of satellite
derived data and terrestrial gravity observations. This investigation
concerns the use of such data to develop a geopotential model consisting
of a spherical harmonic series supplemented by point masses of defined
magnitude and position. An undulating reference equipotential surface
described by a 14th degree and order set of spherical harmonic potential
coefficients is established and conventional terrestrial gravity anomalies
are redefined to refer to this surface. These anomalies are used to
determine mass magnitudes for point mass arrays positioned to approxi-
mate Green's equivalent layers. The technique is demonstrated by deve-
loping a geopotential model for the central third of the United States
that is approximately equivalent to a model expressed in spherical
harmonic coefficients to 180th degree and order. A much more detailed
model is also developed for a more limited area. Extensive comparisons
are made between geopotential functions computed from these models and
comparison standards derived through classical geodetic procedures. The
results of this study show that a complex and accurate model of the
geopotential can be developed using the described techniques. The
method would be most useful in situations requiring repetitive compu-
tations of geopotential functions in limited areas.

406 - RAPP R.H. - "The direct combination of satellite and gravimetric data
for mean anomaly determination".
AFCRL-71-0068, Ohio State Univ., Rep. n°131, Sci. Rep. n°13, 56 p, 1971.

The computation of the external gravitational field of the Earth from satellite analysis and its subsequent combination with terrestrial gravity data has been usually done with spherical harmonic potential coefficients representing the Earth's gravitational potential. This paper examines the theory of the problem when the gravity field of the Earth is represented by discrete blocks on the surface of the Earth. Gravity anomalies in these blocks now become the unknown parameters being sought. The determination of such anomalies is discussed as well as the procedure for directly combining terrestrial gravity information with this new type of satellite analysis. Results from a simulation study are given along with recommendations for the improvement of the tested method. Although no real data is used in the study, procedures are outlined in the case real data is to be used.

407 - POPELAR J. - "Gravity measurements in the Sudbury area with map n°138". Gravity map Ser., Earth Physics Branch, 8 p, Ottawa, 1971.

A total of 2,302 gravity stations established in the Sudbury area (N.T.S. map sheet 41 I) in the period 1945-1969, was used to compile the Bouguer gravity anomaly map (scale 1:250,000) with 2 mgal contour interval. Most of the area is characterized by a relatively positive regional gravity anomaly which in its western part includes the Sudbury structure ; it may reflect the distribution of gabbroanorthositic rocks within the crust. Regional gravity lows appear to be related to large bodies of granite, such as the Cartier granite and the Killarney granite, or to granitegneisses of the Grenville Province. Many local gravity anomalies correlate well with the geology but the Sudbury structure itself cannot be related to a simple gravity anomaly.

408 - EARTH PHYSICS BRANCH, Gravity Division. - Index of publications 1948-1970.
Dept. Energy, Mines & Resources, 16 p, Ottawa, 1971.

409 - VALLIANT H.D. - "The canadian pendulum apparatus, design and operation". Pub. Earth Physics Branch, v.41, n°4, p.47-66, Ottawa, 1971.

A bi-pendulum apparatus which uses bronze quarter-metre pendulums has recently been developed by the Earth Physics Branch for relative gravity measurements. Variable factors such as temperature, pressure, humidity, amplitude, and time, are precisely controlled to minimize the corrections required to reduce the periods to identical conditions.

Rigorous testing of the equipment under laboratory and simulated field conditions disclosed that systematic errors in measuring gravity differences would not exceed 0.06 mgal and random errors would not exceed 0.20 mgal r.m.s.

Tests under complete field conditions along the North American Calibration Line resulted in a mean difference between gravimeter and pendulum values of 0.04 mgal and an r.m.s. difference of 0.06 mgal. It was expected that the random error would decrease, as a result of the effects of desiccating the pendulum storage box. Agreement with absolute measurements is within the error bounds estimated for these two instruments.

410 - INSTITUT ROYAL METEOROLOGIQUE de BELGIQUE - Marées Terrestres.
Annuaire 1969, 84 p, Bruxelles, 1971.

CENTRE NATIONAL pour l'EXPLOITATION des OCEANS

411 - Bull. Inf. n°28, 23 p, Avril 1971.

412 - Bull. Inf. n°29, 16 p, Mai 1971.

413 - MORELLI C. - "Physiography, gravity and magnetism of the Tyrrhenian "-
Boll. Geof. teor. & appl., v. XII, n°48, p.275-310, 1970.

An accurate positioning system (Loran C) and good bathymetric resolution (PGR) installed on the CNR's oceanographic vessel "Bannock" has allowed a precise physiographic synthesis of the Tyrrhenian sea, here presented. It comprises a small flat abyssal plain ($\sim$ -3500 m), interrupted by a few elongated sea-mounts with N-S direction, some of them with the top at only a few tens or hundreds of m below the sea surface. The gravity survey reveals that their mean density is generally low (1.6-1.8, exceptionally 2.0), the magnetic one that only the half of them is volcanic.

A system of elongated ridges, normally volcanic, form a barrier for the sediments of continental origin, and determines the form and the extension of the continental slope and shelf, originating in some cases in them thick sedimentary basins.

The continuation into the sea of the neogenic peri-Tyrrhenian volcanism, as revealed by the magnetic anomalies, permits us to correlate its origin with recent tectonism (Plio-Quaternary).

The tectonic style is of subsidence along sub-vertical faults, and confirms the existence in the past of a sialic Crust, previously uplifted by the Mantle, with subsequent radial discharge of the sedimentary covers and also of the basement against the apenninian and sicilian margin"

troughs then existing ; later on absorbed by the same Mantle, with cor-
responding uplifts at the Tyrrhenian borders.

The insular arc structure, the high heat-flow in the south-eastern
part, the gravity and magnetic anomalies, the very thin crustal and the
mantle structure (more hot and less rigid), attribute to the Tyrrhenian
sea the characteristics of a typical marginal sea, beneath which the
absorption yet in action of the lithosphere is being demonstrated by
the intermediate and deep earthquakes.

Plate 1 - Bathymetry and morphology.
Plate 2 - Relief contour.
Plate 3 - Free Air gravity anomaly.
Plate 4 - Bouguer gravity anomaly (d = 2,67).
Plate 5 - Residual gravity anomalies.
Plate 6 - Total magnetic field
Plate 7 - Magnetic anomalies.

414 - PAUL M.K. -"Computation of the vertical gradient of gravity for two
dimensional bodies".
from : Pure & Applied Geophys., v.85, n°II, p.20-37, 1971.
Gravity Division, Dom. Obs., Contr. n°325, Ottawa.

A method of computation of the vertical gradients of gravity, at
different elevations, from the residual gravity profile due to a loca-
lised two dimensional causative body is presented. The vertical gradient
at an elevation above a station has been expressed as a weighted sum-
mation of the gravity values at equally spaced stations along a profile.
These weights (coefficients) depend only upon the positions of the indi-
vidual stations, relative to the station of computation, and upon the
ratio of the elevation at which the vertical gradient value is sought
to the separation of the stations. Functional forms of these coefficients
have been derived analytically and they have been computed for different
relative positions of the individual stations and for different values
for the ratio of elevation to separation.

An analytical expression has been derived for the remainder term
which is necessary when the above summation is performed over a finite
length of the profile only. As this expression involves the parameters,
(i) total mass per unit length and (ii) the positions of the centre of
gravity of the causative body, a method has been developed separately
for their accurate determination from the anomaly profile of finite
length.

The efficacy of the method has been assessed by applying it to an
arbitrary theoretical model.

415 - BARLIK M. - Remarques sur l'anomalie "isométrique" de Bjerhammar.
Komitet Geod. Polskiej, Akad. Nauk, Geod. i Kart., t.XX, Z.2,
p.77-82, 1971.

　　　　L'auteur analyse la proposition émise par le géodésien suédois
A. Bjerhammar concernant la détermination de la densité des couches
en dessous de la surface terrestre par la solution d'un système
d'équations intégrales.
　　　　La première partie de l'article explique nombre de termes usés en
littérature géodésique. Le restant est sacrifié à la critique de la
solution gravimétrique du problème aux limites, préconisée par
Bjerhammar, dont les manquements sont mis en évidence par l'auteur.

416 - INSTITUT GEOPHYSIQUE de l'ACADEMIE TCHECOSLOVAQUE
Studia Geophys. & Geod., v.15, n°2, Praha, 1971.

a) HOLOTA P. & NADENIK Z. - "Les formes différentielles extérieures dans
la géodésie II : courbure moyenne".
p.106-112.

b) BURŠA M. - "Single-layer density as function of Stokes' constants".
p.113-123.

　　　$_{(k)}$A relation between Stokes' constants (harmonic coefficients) $J_n^{(k)}$,
$S_n^{(k)}$ has been derived in the development for the external geopotential
　　　and the coefficients in the development for the single-layer density
distributed over the surface of the external ellipsoid, the external
equipotential surface, as well as the smoothed physical surface of the
actual Earth. Terms of the 2nd order, $\left(J_2^{(0)}\right)^2$, were taken into account,
terms of the 3nd and lower orders were neglected.

c) BURŠA M. - "Parameters of the normal gravity field deduced from
satellite observations".
p.124-131.

　　　　The parameters of the normal gravity field were deduced from the
harmonic coefficients up to n = 6 and compared with the parameters
used hitherto. The symbols used are the same as in the papers with which
this paper connects up. (Bull. Géod. n°97, Studia Geophys. & Geod.
n°13-14).

　　　...

d) PICK M. & J. PICHA - "The mean density of the Earth".
p.141-146

La densité moyenne de la Terre et la densité moyenne de la couche superficielle, jusqu'à 1450 m, furent déterminées à partir des observations du gradient vertical de la pesanteur, dans la mine "Anna" à Pribram. Les calculs furent effectués selon les formules déduites dans l'hypothèse où la Terre est un ellipsoïde de révolution. Les résultats furent comparés aux valeurs déduites pour l'ellipsoïde astronomique et aux valeurs des densités obtenues des prises de roches dans la mine et on a constaté un bon accord.

...

e) ZATOPEK A. - "European seismological commission, sub-commission for the Carpathian and Balkan region". Progress report 1968 - 1970. Presented at the General Assembly of the Europ. Seism. Comm. in Luxemburg on September 23, 1970.
   p.194-198.

f) KARNIK V. - "Seismicity of Europe". Progress report VII. Presented at the General Assembly of the Europ. Seism. Comm. in Luxemburg on September 23, 1970.
   p.199-203.

420 • INSTITUT GEOPHYSIQUE de l'ACADEMIE TCHECOSLOVAQUE des SCIENCES. Trav. Geophys., t.XVI, n°288-301, Prague, 1968.

a) The interpolation error of quasigeoidal heights on the territory of Czechoslovakia".
   p.9-27.

We are connecting up with paper (3) where the Molodensky method was used to determine the components of the astrogeodetic deflections of the vertical, ξ and η , at 800 points on the territory of Czechoslovakia (3. Fig.1). Since the problem of the influence of errors in the astronomical coordinates φ and λ was not solved in (3), we divided the territory under investigation into 16 (n° 14-29) other interpolation regions σ (Fig. 1), so that each deflection of the vertical was computed at least twice independently, as far as possible from different sets of astrogeodetic values. We also determined a detailed quasigeoid chart, and the interpolation error of the quasigeoid heights as a function of the distance of the discrete points. The astrogeodetic and gravimetric data used are the same as those described in (3). Apart from the gravi- map 1:200 000° of the country with a density of 1 point per 5 km^2 we used detailed gravity measurements around 37 astrostations (50 % of the total number), carried out by the gravimetric department of the Surveying Institute, usually following Pellinen's scheme (2). The symbols are the same as in (3).

b) POLA I. - "Point sources of gravity anomalies".
   p.51-79.

   The application of the method presented in this paper enables the masses of the Earth to be substituted by a certain nearly minimum number of mass sources, in such a way that the observed values of gravity, corrected for the centrifugal acceleration, can be substituted with the required accuracy by the vertical gravitational effect of these sources.
   In agreement with the physical nature of the phenomenon all the sources (their intensity) are positive.
   The complete information concerning the observed gravity data has been transformed into the set of sources, i.e., it is not necessary to assume anything of the mass distribution (and thus of the specific densities of the rocks) of the Earth, it is not necessary to introduce any reductions of gravity measurements, or to carry out the interpolation of these data.
   The method is based on the principle of selection of the maximum source, i.e., that the n-th source is the largest possible source, which may be found after source n-1 has been calculated.
   From the point of view of the theory of approximation the values of gravity measured, corrected for the centrifugal acceleration, were substituted by values defined by a sequence of functions which are harmonic in the whole space with the exception of the points where the sources are located and which have a physical significance. Each of these functions has a weight which is proportional to the magnitude and the location of the mass contained in the source.

c) VYSKOČIL V. & J. PANÝR. - "Least-squares prediction of gravity anomalies and its accuracy".
   p.81-90.

   The paper discusses and by means of numerical examples illustrates some of the properties of the method, worked out by Moritz, for interpolating gravity anomalies called "Least Squares Prediction" (LSP).
   It is assumed that the "observed" values of the gravity anomalies g_i at discrete points P_i are determined with a certain accuracy, characterized by the accidental mean square error m_i.

422 - BURŠA M. - "Determination of parameters of a selenocentric reference system and deflections of the vertical at the lunar surface". Presented at the XVth IUGG General Assembly, Moscow, July 30 - August 14, 1971. Research Inst. Geod., Topog. & Cart., 19 p, Prague, 1971.

423 - INSTITUTE of GEODESY & CARTOGRAPHY
Proc., t.XVIII, Z.1(42), 119 p, Warszawa, 1971.

424 - LOZANO CALVO L. - "Red de observaciones con gravimetro en la provincia
de Toledo".
Inst. Geog. & Cat., Sección la, 10 p., Madrid, 1963.

   Liste de 572 stations : latitude, altitude, valeur de g,
anomalie de Bouguer.

425 - INSTITUTO GEOGRAFICO Y CATASTRAL - "Mapa gravimetrico de la Provincia
de Ciudad Real".
Sección la, Geofísica, 66 p, Madrid, 1970.

   Tableaux donnant les informations de 845 stations : coordonnées,
altitude, valeur de g, anomalies de Bouguer et isostatiques.
(20, 30 km).

426 - CHAPMAN S. - "The Earth".
Quart. J. R. Astr. Soc., v.11, n°5, p.382-395, 1970.

427 - COUZY A. - Comptes rendus du COMITE NATIONAL FRANCAIS de GEODESIE
et GEOPHYSIQUE.
Année 1969, 148 p, 1970.

430 - Geofísica Internacional.
Revista de la Union Geofísica Mexicana, Auspiciada por el Instituto
de Geofísica de la Universidad Nacional Autonoma de Mexico,
v.8, n°2-4, Mexico, 1968.

   a) KAULA W.M. - "On the relation of long wave variations in gravity to
   the crust and upper mantle".
   p.33-42.

   b) SLICHTER L.B. & C.L. HAGER - "Earth tides".
   p.43-54.

431 - WOOLLARD G.P. & J. MONGES CALDERA - "Mexico, and area undergoing, secular change in gravity".
Geofisica Internacional. Revista de la Union Geofisica Mexicana, Auspiciada por el Instituto de Geofisica de la Universidad Nacional Autonoma de Mexico. v.10, n°1, p.9-16, Mexico, 1970.

There are places where there have been marked local changes in gravity of the order of 1 mgal or more in association with crustal displacement related to earthquakes of surface subsidence due to underground mining or oil field pumping, but little evidence to support regional continuous change in gravity. Boulanger (personal communication) feels that repeat gravity measurements with multiple gravimeters at key sites between Moscow and Vladivostok indicate one such area in the eastern USSR, but in the writers' experience in conducting gravity measurements since 1939, the only other location where a secular change in gravity appears to be well substantiated is the southern end of the plateau of Mexico.

432 - KNEISSL M. - "Deutsche Beiträge zur Satellitengeodasie vorgelegt bei der 5. Sitzung der Westeuropätischen IAG - Subkommission für künstliche Satelliten vom 13.bis 16.April 1970 in London".
Verof. Bayer. Komm. Int. Erd., Astro.-Geod. Arbeiten,
H. 27 , 125 S, München, 1970.

1 - Theoretical papers
2 - Computation of the satellite triangulation
3 - Experimental investigations, new equipments and methods
4 - Reports of the West German satellite observation stations.

433 - ECKER E. - "Uber die räumliche Konvergenz von kugelfunktionsreihen".
D.G.K., Reihe A : Höhere Geod., H. 68, 35 S, München, 1970.

In this paper the spatial domain of convergence of a special type of spherical harmonics series is studied. For this type the surface harmonic of degree n, Y_n (θ , λ), consists for n $>$ N, N $<$ ∞ of the term Y_n (θ , λ) = (a_{nm} $\cos m \lambda$ + b_{nm} $\sin m \lambda$) P_n^m (cos θ) only, and m is fixed to n linearly by the factor ℓ , according to m = ℓn.

First it is shown that these series converge absolutely outside (we consider series of outer potentials, to consider one case) the "figure of convergence", $r = M \sin^\ell \theta$; this figure is the sphere $r = M$, if $\ell = 0$, i.e. in the case of a zonal series, and e.g. Krarup's torus r (θ) = $M \sin \theta$, if $\ell = 1$, m = n, i.e. in the case of sectorial series.

The divergence almost everywhere inside the figure of convergence has been proved for these cases. For $\ell = 1$ Krarup has shown the divergence and for $\ell = 0$ a proof is possible with help of the property c of the Legendre polynomials, which has been given before.

434 - MORITZ H. - "Least-squares estimation in physical geodesy".
D.G.K., Reihe A : Höhere Geod., H. 69, 34 S, München, 1970.

A powerful and simple least-squares estimation method for the gravitational field, due to T. Krarup, is presented and applied to such different problems in physical geodesy as the geodetic boundary-value problem according to A. Bjerhammar, the application of aerial gravimetry, the geodetic use of gradiometer measurements, and the combination of gravimetry with satellite harmonics and with astro-geodetic data.
The algorithm is formally identical to that of usual least-squares gravity estimation ; it is only necessary to interpret the covariances in a different way. The data may be errorless or affected by observational errors.
This method permits an objective use and combination of all measurements for determining the geoid and other quantities of the terrestrial gravity field.

435 - DIRK H. - "Die Geodimeter 2-A-Messungen des Instituts für Angewandte Geodäsie im westdeutschen Anteil der europäischen Eichlinie Tromsø - Catania".
D.G.K., Reihe B : Angew. Geod., H. 178, 19 S, Frankfurt, 1970.

In 1966, the Institut für Angewandte Geodäsie (IfAG), Division II of the Deutsches Geodätisches Forschungsinstitut (DGFI) was asked, to carry-out electronic distance measurements with the Geodimeter 2 A in the West-German part of the European calibration line for satellite triangulations Tromso - Catania. In addition to the 15 first-order lines measured between 1962 and 1966, which are part of the triangulation chain constituting this traverse, another 10 lines were measured with the Geodimeter 2 A in 1967 and 1968. The combined results of all measurements for these 25 lines are given in this report.

436 - SOLTAU G. - "Möglichkeiten zur kartographischen Darstellung des Schwerefeldes".
D.G.K., Reihe B : Angew. Geod., H. 179, 30 S, Frankfurt, 1970.

This paper describes the methods by which a test-sheet (scale 1:200,000°) of height-reduced gravity values was produced. The production of such a map was suggested by K. Ramsayer.
The gravity values shown on the map are based on all data registered in the Archive of Gravity Values of Division I of the Deutsches Geodätisches Forschungsinstitut, München.
Isogams of reduced gravity were computed and interpolated by means of the electronic data processing equipment of the Deutsches Rechenzentrum, Darmstadt.

The map was drawn on the background of the Topographische Uber-sichtskarte von Deutschland, which is produced at a scale of 1:200,000, each sheet covering an area of 48 x 80 minutes of arc.

437 - GEOGRAPHICAL SURVEY INSTITUTE & HYDROGRAPHIC OFFICE - "Cartographic works in Japan. The period 1967 - 1969".
The Sixth United Nations regional cartographic conference for Asia and the Far East, 24th Oct. - 7th Nov. 1970, Tehran, Iran.
Bull. Geog. Surv. Inst., v.XVI, Part 1, p.1-16, 1970.

438 - INSTITUTO PANAMERICANO de GEOGRAFIA e HISTORIA - Revista Cartografica Año XIX, n°19, 239 p, Buenos Aires, 1970.

At the XI Pan-American Consultative Meeting on Cartography, held in June 1969, Resolution 47 was adopted. By this resolution it was resolved to translate to the official languages of the P.A.I.G.H., and to publish in one publication as a Supplement of the Cartographic Review, a series of articles and monographies, the mayor part of them presented by the U.S. Naval Oceanographic Office.
In view that the Oceanographic Office has already published the English version of the above articles and monographies, it was consi-dered unnecessary to include them once more in the Cartographic Review n° 19.
With this new issue of the Cartographic Review which appears in the year 1970, we implement the idea of publishing a Review every six month by which a greater frequency and continuity in the communication with members of the Commission is attempted. Some of these members, in addition to advocating such procedure for the Commission's periodic publication, offered an ample technical and literary production.

439 - MAKOVIECKI L.Z. A.J. KING & C.R. CRATCHLEY - "A comparison of selected geophysical methods in mineral exploration".
Inst. Geol. Sci., Geophys. Paper n°3, 80 p, London, 1971.

This paper describes work in East Africa sponsored by Overseas Geological Surveys. The fieldwork was carried out between December 1959 and June 1962 ; the airborne surveys were flown by contractors, and the ground surveys were made by the authors, two of whom at the time were with Overseas Geological Surveys and the third with the Geological Survey Division, Tanzania. The paper compares the three airborne techniques employed, in the light of the results obtained over two mineralized areas in East Africa. An abridged account of the results has been published in 1965 in Geological Survey of Canada Paper 65-6 : "Some guides to mineral exploration", edition by F.R.W. Neale.

440 - DIRECTION des MINES et de la GEOLOGIE, DIVISION de la GEOLOGIE,
      Département de Géophysique au Royaume du Maroc.
      Carte gravimétrique du Maroc, au 1/500.000° en 7 feuilles,
      (d = 2,67), 1971.

447 - DAVEY F.J. - "Bouguer anomaly map of the North Celtic Sea and entrance
      to the Bristol Channel".
      Geophys. J. R. Astr. Soc., n°22, p.277-282, 1970.

        Gravity data in the North Celtic Sea and entrance to the Bristol
      Channel are presented in the form of a Bouguer anomaly contour map.
      The major feature shown by the map is the presence of two E.N.E.-
      W.S.W. trending gravity lows, one just off the southern Irish coast
      and the other starting from the entrance to the Bristol Channel. It
      is suggested that these are caused by basins containing low density
      sediments and simple models for these basins, involving a single
      density contrast, have been computed.

448 - ALLAN T.D. - "Magnetic and gravity fields over the Red Sea".
      Phil. Trans. R. Soc., London, A, v.267, p.153-180, 1970.

        Strong magnetic anomalies associated with the axial trough of the
      Red Sea are considered to be related to a second phase of opening. Lack
      of magnetic expression of the first and wider separation is attributed
      to initial thinning and necking of the continental crust and, possibly,
      to a slow rate of spreading. The rise of the mantle during this first
      stage is reflected in the positive Bouguer gravity anomaly which extends
      over the whole Sea.
        A displacement of the magnetic anomaly pattern and a grouping of
      earthquake epicentres at latitude 19 1/2°N delineates a transform fault.
      Further offsets in the anomaly pattern between 19 1/2°N and 23°N may be
      related to other transform faults presently inactive.
        If Sinai is treated as a separate block then the two-stage clockwise
      rotation of Africa to open the Red Sea leads to the southerly displa-
      cements of this block required by the geology. Negative gravity anomalies
      in the Gulf of Aqaba support the idea of a shear. A separate rotation of
      the Horn of Africa is believed to have contributed to the opening of the
      Gulf of Aden.

450 - CENTRE NATIONAL pour l'EXPLOITATION des OCEANS.
      Bull. Inf. n°30, 14 p, Juin 1971.

451 - MEISSL P. - "A study of covariance functions related to the Earth's disturbing potential".
AFCRL-71-0240, Rep. n°151, Sci. Rep. n°14, 86 p, 1971.

The following quantities are considered : geoidal undulations N, gravity anomalies Δg, deflections of the vertical Δv, a fictious surface density $\Delta \varphi$, the vertical gradient of gravity anomalies Δa. These quantities are interrelated by linear operators having the spherical harmonics as eigen-functions. If the covariance of one of these quantities is specified, that of the others can be computed. Thereby rigorous bounds for the ratios of the different variances can be established. These bounds demonstrate that Δg, Δv, $\Delta \varphi$ are quantities of equal smoothness. N is smoother and Δa is less smooth. These smoothness properties are important in various approaches to determine the Earth's potential. Though the Earth's disturbing potential can be represented by any of the above quantities, there are differences in the stability of the resulting solutions. Attention is focused on potentials obtained from a combination of satellite information and gravimetry. In that case the introduced quantities are considered as residuals with respect to a geoid resulting from the adjusted lower degree harmonic coefficients. It is shown that the covariance of any one of the residual quantities tends to have certain theoretical properties. These are a predetermined number of zeros as well as negative correlation at certain predetermined distances. A comparison has been performed between the gravity anomaly residuals with respect to a low order geoid and mean 5° x 5° block anomalies having uncorrelated errors. Compared are the resulting errors in geoidal undulations and deflections of the vertical.

452 - MEISSL P. - "On the linearization of the geodetic boundary value problem".
AFCRL-71-0295, Rep. n°152, Sci. Rep. n°15, 71 p, 1971.

The geodetic boundary value problem consists in determining an unknown closed surface from the boundary values of an external potential and its gradient. A rigorous mathematical formulation of this problem is given leading to a system of non-linear integro-differential equations. The formalism of differentiation in function spaces is applied yielding a linearized version which involves no further neglections and approximations. Tensor calculus is used in linearizing the various differential geometric quantities. The results are specialized to a linearization with respect to the equipotential sphere in which case the formulas of Stokes and Vening Meinesz are simultaneously obtained.

453 - GRAFAREND E. - "Lotabweichungsverteilungen Westdeutschlands und ihre gruppentheoretische Struktur".
Inst. Theor. Geod., n°1, 41 S, Bonn, 1971.

   As fundament of isotropic tests for vertical deflections density the TAYLOR-KARMAN theorem out of turbulence theory and plasma physics is formulated. The characteristics, longitudinal and lateral correlations, are calculated for 6, each 30° different directions of vertical deflections from 15000 products of Western Germany vertical deflections. The analized vertical deflection field is proved as a statistical isotropic one, in first order approximation. The result agrees with those calculated from gravity anomalies, following (Kaula 1959, 1966) isotropically distributed, by (Shaw, Paul and Henrikson 1969) and the author (1971). The essential identity of mean vertical deflections correlation as the trace of the second rank correlation tensor and the correlation of gravity anomalies in isotropic statistics is proved. Eigenvalues of the correlation tensor for vertical deflections are discussed in correlation elliptic and hyperbolic graphs.

454 - CORON S. & J. LAGRULA - "Sur le gradient vertical sous-marin de la pesanteur".
C.R. Acad. Sci., t.272, Sér. B, p.1449-1452, Paris, 1971.

   Le gradient vertical de g dans les masses océaniques est une fonction légèrement décroissante de la profondeur. On peut le déterminer en bathyscaphe. Ses anomalies, beaucoup plus amorties que sur terre, peuvent être utiles en géodésie.

464 - MANZONI M. - "Paleomagnetic data of Middle and Upper triassic age from the Dolomites (Eastern Alps, Italy)".
Contr. n°306. Tectonophys., v.10, p.411-424, 1970.

   A paleomagnetic survey of Middle and Upper Triassic porphyrites, dykes, and tuffites from the Dolomites (Eastern Alps, Italy) has yielded an average direction (based on 57 samples from 12 collecting localities) with declination 329°E of true north and inclination + 25° after magnetic cleaning and correction for geological dip. The declination deviates from that of "stable" Northern Europe by about 50°, but the inclination agrees well with the expected value. This indicates that the Dolomites area has rotated 50° anticlockwise relative to northern Europe since the Triassic but there is no evidence of relative changes in latitude...

465 - BERRY M.J. & K.G. BARR - "A seismic refraction profile across the
polar continental shelf of the Queen Elizabeth Islands".
from : Canadian J. Earth Sci., v.8, n°3, p.347-360, 1971.
Earth Physics Branch, Contr. n°334, Ottawa.

During the spring of 1967, a seismic refraction experiment was
conducted from the SW tip of Prince Patrick Island in the Queen
Elizabeth Islands of Arctic Canada to a point mid-way down the
continental slope, some 220 km from the coast.
...
The interpretation shows a crustal model with depths to the M
discontinuity of 28 ± 4 km at the coast, thinning to 15 ± 9 km at
the end of the profile. The velocity of the mantle is measured as
8.05 ± 0.17 km/s. Mid-way down the continental slope there are
5.0 ± 1.63 km of sediments overlying material with a velocity of
5.36 ± 0.15 km/s. Material of a similar velocity, 5.72 ± 0.18 km/s,
lies 2.7 ± 1.9 km beneath the surface material at the coast, where
the surface layer has a velocity of 4.76 ± 0.4 km/s. It is concluded
that the data support the hypothesis that the Canada Basin has an
oceanic rather than a continental crust.

466 - HAINES G.V., W. HANNAFORD & R.P. RIDDIHOUGH - "Magnetic anomalies
over British Columbia and the adjacent Pacific Ocean".
from : Canadian J. Earth Sci., v.8, n°3, p.387-391, 1971.
Earth Physics Branch, Contr. n°335, Ottawa.

A contoured residual map of the vertical magnetic field,
observed at approximately 5 km altitude above sea level, provides a
broad view of the major structures of the buried Canadian Shield,
the Cordilleran Region, and the northeast Pacific Ocean.

470 - BERRY M.J., W.R. JACOBY, E.R. NIBLETT & R.A. STACEY - "A review of
geophysical studies in the Canadian Cordillera".
from : Canadian J. Earth Sci., v.8, n°7, p.788-801, 1971.
Earth Physics Branch, Contr. n°340, Ottawa.

Geophysical studies of the crust and upper mantle have been
conducted in the Canadian Cordillera for over two decades, but only
recently have sufficient data been collected to permit a synthesis
and a correlation with the major geological units. The studies have
included gravity, heat flow, and magnetotelluric observations, geo-
magnetic depth sounding, and high level aeromagnetics as well as
both small and large scale refraction and reflection seismic surveys.
It now appears that major crustal units may be recognized geophysi-
cally :
(i) Seismic and gravity data suggest that the Plains and Rocky
Mountains are underlain by two units of the North American craton

with a crustal section 45-50 km thick. The northern unit appears to terminate at the Rocky Mountain Trench while the southern unit may extend to the Omineca Geanticline.

(ii) The combined geological and geophysical data suggest that the Rocky Mountain Trench and possible the Kootenay Arc near the 49th parallel mark the edge of the Precembrian continental margin and that the western Cordillera was formed by a complex succession of plate interactions with repeated reactivation of block boundaries.

(iii) A combination of magnetic and heat flow data suggest that the region between the Rocky Mountain Trench and the Fraser Lineament is part of the Cordilleran Thermal Anomaly Zone recognized by Blackwell in the United States.

(iv) Seismic data in Central British Columbia suggest that the Pinchi Fault system is a boundary between two crustal blocks.

(v) The crustal thickness of the Coast Geanticline appears to increase gradually to the west to approximately 40 km and, at least in southern British Columbia, does not have a root zone below the mountains.

(vi) The crustal section beneath Vancouver Island is abnormally thick and there is some paleomagnetic data which suggest that the Island may not have been formed in its present position contiguous to the Cordillera. The crustal section for the northern part of the Insular Trough is significantly thinner.

(vii) The active spreading of the Juan de Fuca Rise - Explorer Trench is now well documented. The geophysical data suggest active subduction of the Juan de Fuca plate beneath Oregon, Washington, and southern Vancouver Island. However, further north there is no evidence for subduction.

472 - BARR K.G. - "Crustal refraction experiment : Yellowknife 1966".
from : J. Geophys. Res., v.76, n°8, p.1929-1947, 1971.
Earth Physics Branch, Contr. n°338, Ottawa.

A crustal refraction experiment was carried out around Yellowknife, Northwest Territories, in 1966. The records were unusually simple, and nearly all arrivals could be explained by a shallow surface layer (3.5 ± 1.2 km at 5.5 km/sec) overlying a uniform crust (6.1 ± 0.04 km/sec). No significant difference was found between the crustal thicknesses under the Slave and Churchill Precambrian provinces, but they are separated by a narrow belt corresponding to the east arm of Great Slave Lake, under which the crust is about 4 km thicker. The upper mantle velocity west of the Precambrian margin (8.23 ± 0.04 km/sec) was found to be higher than that east of the margin (8.10 ± 0.03 km/sec). This may be related to an orogenic belt parallel to but west of the margin in late Aphebian time.

476 - BUCHBINDER G.G.R. - "A velocity structure of the Earth's core".
Bull. Seis., Soc. America, v.61, n°2, p.429-456, 1971.

Travel times and amplitudes of PKP, P2KP and higher multiple K
phases are determined from a worldwide distribution of short-period
seismograms. The sources are one explosion in Novaya-Zemlya and seven
earthquakes, consisting of one intermediate focus event in the New
Hebrides, and deep-focus events in Fiji, Java, Kermadec Islands, and
Peru. The data are used to determine a new velocity model of the
lowest mantle and the core. In the new velocity model 132, the velo-
city of the bottom of the mantle is 13.44 km/sec ; the core mantle
boundary is placed at 2892 ± 2 km.
...
The top of the inner core boundary is placed at a depth of 5145 km
with an uncertainty of at least 10 km and represents a discontinuity of
0.576 km/sec. Older core models have transition zone discontinuities an
order of magnitude larger than those of model 132 with a discontinuity
at the inner core boundary of about 1 km/sec.

478 - COLLETTE B.J. - "Mediterranean oceanization - a comment".
Verhandelingen Kon. Ned. Geol. Mijnbouwk. Gen., v. XXVI,
p.139-142, 1969.

479 - LePICHON X. & M.G. LANGSETH Jr. - "Heat flow from the Mid-Ocean ridges
and sea-floor spreading".
from : Tectonophys. v.8, p.319-344, 1969.
Lamont-Doherty Geol. Obs., Contr. n°612, Palisades, N.Y.

Observations of heat flow, topographic elevation and topographic
slope are examined in the light of the hypothesis of ridge formation by
ocean-floor spreading. This analysis shows that the shape of the norma-
lized anomaly of high heat flow over the ridge is independent of sprea-
ding rate, however, the amplitude of this anomaly over the fast-spreading
Pacific ridges (3-6 cm/year) is generally 0.5 μcal/cm^{2}sec larger than
that over the Atlantic and Indian Ocean Ridge which are spreading at a
slower rate (1-2 cm/year). More than 60 % of the heat lost over the
ridges in excess of the adjacent basin heat loss takes place in a narrow
zone near the axis, corresponding to the part of the ridge that has been
created in the last 6 million years. There is also a nearly linear rela-
tion between spreading rate and ridge topographic slope. The normalized
slope, however, decreases slightly with increasing spreading rate...

483 - GAIBAR-PUERTAS C. & J. RUIZ LOPEZ - "Las anomalias de la pesantez en la isla de Alboran (Almeria)".
Revista de Geof., n°116, v.XXIX, n°4, p.267-292, Madrid, 1970.

A gravity survey using 53 stations has been carried out as part of the geological study of the Island of Alboran. The values observed were reduced using the usual corrections (Topographic, Bouguer, etc...). The value of gravity at the base station was found to be 979893 ± 0.05 mGal, and the corresponding Bouguer anomaly + 71.84 mGal. The results obtained for the other 52 stations are quite similar to these ; their anomalies oscilate between 71.37 and 72.43 mGal. The relative discrepancies are grouped in areas perfectly defined revealing for the eastern half of the island a density deficiency with respect to the western half, where the anomalies form four stripes oriented W.E. approximately. The geological explanation of this is considered to be that the relative anomalies are produced by the increases in local density related to the existence of geoclases filled up with consolidated material.

484 - FALLER J.E. & J.A. HAMMOND - "A laser-interferometer system for the absolute determination of the acceleration of gravity".
AFCRL-70-0163, Final Report, 135 p, Bedford, 1970.

A new and portable instrument for making an absolute determination of the acceleration of gravity has been built. The design and construction of this apparatus together with the results obtained using it are discussed. The instrument consists of an optical interferometer in which one of the mirrors, a corner cube reflector, freely falls. The resulting fringes are counted to provide a direct measurement of the distance fallen in terms of the wavelength of light. A stabilized He-Ne laser is used for the light source and provides the required coherence and brightness to achieve high quality fringes over the one meter dropping distance. The drop-to-drop scatter is less than 1 part in 10^7, and the consistency of 50 drop data sets each is better than ± 3 parts in 10^8 . Non gravity forces and other experimental factors have been carefully taken into account ; the accuracy of the final results (70 % confidence level) is ± 5 parts in 10^8. Measurements have been made at and results are given for eight different sites. These are the National Bureau of Standards, Washington, D.C. (Gaithersburg site) ; the National Physical Laboratory, Teddington, England ; the Bureau International des Poids et Mesures, Sèvres, France ; Wesleyan Univ., Middletown, Conn. ; Air Force Cambridge Research Labs., Bedford, Mass. ; the Institute of Geophysics, Fairbanks, Alaska.

485 - COLLETTE B.J., R.A. LAGAAY, A.R. RITSEMA & J.A. SCHOUTEN - "Seismic investigations in the North Sea". (Parts 3 to 7).
Geophys. J. R. Astr. Soc., v.19, p.183-199, 1970.

Parts 1 and 2 of this paper explained why a seismic crustal investigation programme was started in the North Sea, and gave a description of the sedimentary structure off Flamborough Head as resulting from five reverse refraction lines. These lines cover the 200 kilometres long crustal refraction line which was shot using a variant of the velocity - depth or common reflection point method. The present paper gives in part 3 the results of this 200-km line. The line appeared to be situated over a zone in which the crust shows a considerable thinning. This violates the presumptions of the velocity-depth method. Part 4 presents the revision of a crustal refraction line at the Doggerbank, also using the velocity -depth method, and shot in 1964. In part 5 the anomalous station term of Eskdalemuir is discussed. It is suggested that a high velocity/low density body is situated under Eskdalemuir, possibly consisting of anorthosites. Part 6 deals shortly with a crustal reflection experiment in 1966 at the site of the 1965 refraction line off Flamborough Head. The negative outcome of this experiment is ascribed to insufficient instrumentation and strong water reverberations occurring in our region. Part 7 concludes the paper with a general discussion on the structure of the Earth's crust under the North Sea, on structural effects in both the seismic refraction and the reflection method, and on the use of crustal seismic experiments in general.

486 - COLLETTE B.J. & J.A. SCHOUTEN - "Bifurcating and wandering ocean ridges: a progress report".
Marine Geophys. Res., v.1, p.46-60, 1970.

First conclusions of a study of the fault pattern in the North Atlantic ocean are briefly outlined. Correlation of fracture zones in deep ocean basins, even over short distances (30 miles) is difficult when using only topographic and seismic profiler data, and requires the additional criterion that the magnetic pattern is shifted along the fracture zones. This implies that each track must be paralleled by at least one more track at close distance to detect breaks in the magnetic pattern...
...

488 - MATHER R.S. & G. FRYER - "Geoidal studies in Australia".
Survey Review, v.20, n°156, p.268-282, 1970.

The co-geoid obtained by the use of free-air anomalies in Stokes' integral and entitled the free-air geoid is computed for Australia from a composite set of data. The near zones were represented by surface gravimetry while the distant regions were represented by a combined solution from satellite data and terrestrial gravity.

The solution so obtained is compared with both an astrogeodetic geoid on the arbitrary Australian Geodetic Datum as well as astro-geodetic deflections of the vertical, and the nature of the comparisons is studied. Estimates are obtained for the corrections necessary to convert the Australian Geodetic Datum to a geocentred system.

489 - MATHER R.S. & J.G. FRYER - "Orientation of the Australian Geodetic datum".
The Australian Surveyor, v.23, n°1, p.1-10, 1970.

The Australian Geodetic Datum is defined in relation to an Earth centred system of co-ordinates. The technique for mapping the geoid on the latter system is outlined, using a composite solution from surface gravity data for the closer areas and a combination of satellite observations and gravimetry for the distant zones. Such a solution is used to relate the Australian Geodetic Datum to the centre of the Earth by the continent wide comparison of astrogeodetic data and the gravimetric solution. This provides a set of corrections for the co-ordinates of the origin which enables all points on the datum, whose relative positions are known to first order geodetic accuracy, to be related to the geocentre with an uncertainty approximately an order smaller than at present.

490 - MATHER R.S. - "The geocentric orientation vector for the Australian geodetic datum".
Geophys. J. R. Astr. Soc., v.22, p.55-81, 1970.

The geocentric orientation vector is defined for the Australian Geodetic Datum on the assumption that the geoid has the same potential as the value on Reference Ellipsoid 1967 on adopting Reference System 1967. It is shown that only the free air geoid need be considered to provide the required definition in the Australian region with a precision equivalent to that of the data set currently available. Solutions obtained by two different techniques indicate that the parameters required to define the vector at the Johnston origin of the datum are :

$$\Delta \xi_o = - 4.2 \pm 0.2 \text{ s}$$
$$\Delta \eta_o = - 4.5 \pm 0.2 \text{ s}$$
$$\Delta N_o = 7.2 \pm 0.2 \text{ m}.$$

The error estimate in the last parameter also assumes that no significant errors exist in low degree harmonics of degree n (< 5) and orders zero and one used in the representation of the Earth's gravity field. Such errors cannot be detected over the 2 per cent of the Earth's surface area included in the present study. The consequent errors are unlikely to exceed ± 3m on current estimates of the accuracy of low degree harmonic coefficients.

491 - YOUSSEF M.F. - "Agyptens beitrag zur Erdmessung".
        Geod. Inst., Univ. Fridericiana., 87 S, Karlsruhe, 1970.

        1.- Travaux géodésiques
        2 - Le réseau gravimétrique 1969/70 dans le Delta du Nil.
            Le réseau est basé sur la station Giza avec la valeur :
            979318,30 mGal.
            - Carte des anomalies à l'air libre et de Bouguer.
            - Schémas des stations de référence (Annexe 4).
            - Liste des 77 stations (Annexe 5).

492 - BLOT C. - "Etudes sismologiques de Vulcano".
        O.R.S.T.O.M., Cahiers n°11, p.3-32, 1971.

495 - TORGE W. - "Grossräumige Schweremessungen mit LaCoste-Romberg
        Gravimetern 1964-1970".
        D.G.K., Reihe B : Angew. Geod., H. 183, 20 S, München, 1971.

            Between 1964 and 1970, the "Institut für Theoretische
        Geodäsie" of the Technical University of Hannover participated
        in some gravimetric research projects in Europe and Africa. In
        these projects, long-range gravity measurements have been carried
        out, using two LaCoste-Romberg gravity meters. The observed
        gravity differences form a network extending from Reykjavik to
        Capetown.
            It is shown that the standard deviation of a gravity diffe-
        rence observed in the AB-manner, has the order of a few mGal/100.
        The standard deviations of the adjusted gravity values, referring
        to Hannover, vary between a few mGal/100 and $\pm$ 0,2 mGal. The
        scale factor was obtained from pendulum measurements with an
        accuracy of $\pm$ 5.10^{-5}. Finally it could be shown that the linear
        calibration factor significantly changed with time, the maximum
        variation being 15.10^{-5}.

499 - Bulletin Géodésique de l'A.I.G., n°100, Juin 1971.

    a) GIBBINGS D.L.H., J.B. PATTERSON & G.A. BELL - "The absolute
       determination of the gravitational acceleration at Sydney,
       Australia".
       p.147-158.

            An absolute measurement of the gravitational acceleration
       "g" has been made at the National Standards Laboratory, Chip-
       pendale, N.S.W., Australia.

The determination was made by studying the free motion of a body projected vertically upwards in a vaccum and the time between its initial and final passages through two horizontal planes of known vertical separation was measured.

The measured value of g at a point 12 metres above the floor in room B.37 of the National Standards Laboratory is :

$$9.7967134 \text{ m/s}^2$$

The corresponding value at floor level at the BMR gravity station is :

$$9.796717 \text{ m/s}^2$$

b) SAKUMA A. - "Observations expérimentales de la constance de la pesanteur au B.I.P.M., Sèvres, France".
   p.159-164.

c) BARTA G. - "On the hypothesis of the secular variation of gravity field".
   p.165-174.

d) BOULANGER J.D. & S.N. SCHEGLOV - "On secular changes of gravity".
   p.175-178.

e) SZABO B. & D. ANTHONY - "Results of AFCRL's experimental aerial gravity measurements".
   p.179-202.

   Between December 1965 and March 1968 AFCRL conducted a series of experimental airborne gravity measurements to determine the feasibility of large scale aerial gravity surveys. Several instruments, such as the LaCoste and Romberg, Askania-Graf and a PIGA-25 pendulous gyro accelerometer were used in the experiments. Several filtering methods were developed and applied to smooth the aerial gravity profiles :

   1 - Frequency cutoff filter that eliminates from the measured data those frequencies known to be absent from the true data ;

   2 - Least squares filter, minimizing the differences between the true and smoothed gravity values ; and

   3 - Equal spectrum filter similar to the least squares method with the additional condition that the power spectra of the true and filtered anomalies are the same. Representative sample profiles are discussed and the achieved accuracies in terms of profile and mean anomaly accuracies are presented.

f) LAMBECK K. - "Comparison of surface gravity data with satellite data".
p.203-220.

A new estimate of the Earth's gravity field has recently been obtained by Gaposchkin and Lambeck, and designated as the 1969 Smithsonian Standard Earth II (SE II). This solution is based on some 100,000 camera and laser range observations to numerous satellites collected from a world wide tracking network. The solution included input from deep space probes provided by the Jet Propulsion Laboratory as well as surface gravity data. The total field is represented by spherical harmonic coefficients complete to degree and order 16 plus a number of higher terms. The accuracy of this global solution has been estimated as $\pm$ 3 m in geoid height or about 9 mgal.

Figure 1 gives the free-air gravity field corresponding to this solution referred to an ellipsoid of flattening 1/298.255. Its most significant features, not shown up in earlier solutions, are the new detail found in southern latitudes and that almost all of the areas of tectonic activity are associated with positive gravity anomalies ; both the areas where new crust is being generated, such as the ocean ridges and areas where the crust is being destroyed, such as the trenches. Earth models for explaining this apparent paradox have already been proposed by Kaula.

In the present paper those aspects of the Smithsonian Standard Earth II solution relating to surface gravity data, that is the comparison and combination of the satellite based solution with these data, are discussed and some requirements for future solutions explored.

g) HEITZ S. - "On the astrogeodetic determination of the geoid by least squares estimation".
p.221-224.

A special application of T. Krarup's theory of collocation (least squares estimation) to astrogeodetic determinations of the geoid is treated.

- ACADEMIE DES SCIENCES U.R.S.S. - Références bibliographiques, Géodésie.
501 - Sér. 52, n°10, 45 p, Moscou, 1970.
502 - Sér. 52, n°2, 46 p, Moscou, 1971.
503 - Sér. 52, n°7, 44 p, Moscou, 1971.
504 - Sér. 52, n°8, 46 p, Moscou, 1971.

ACADEMIE DES SCIENCES U.R.S.S. - Références bibliographiques,
Géophysique.

505 - n°7, 242 p, Moscou, 1971.

506 - n°8, 244 p, Moscou, 1971.

507 - Československá Akademie Věd - Upper mantle project programme in
Czechoslovakia 1962 - 1970., Final Report, Praha, 1971.

  a) KOLBENHEYER T. - "On some methods of interpreting gravity anomalies".
  p.13-18.

  b) PICK M. - "On the computation of the gravity terrain correction in
  Czechoslovakia".
  p.19-22.

  c) BURŠA M. - "Satellite gravity studies".
  p.23-39.

     T following were determined from the harmonic coefficients
  Stokes' constants) of the Earth $J_n^{(k)}$ and $S^{(k)}$ in the development
  of the geopotential W, derived from the n variations of the
  orbital elements of satellites, the geocentric constant GM, the
  Earth's angular velocity, the heights above sea level, and the
  co-ordinates of satellite SAO stations in the C7 system.

  d) VYSKOČIL V. - "Correlation analysis of gravity anomalies and
  isostasy".
  p.40-46.

     The paper presents some results of the correlation analysis of
  gravity anomalies obtained in Czechoslovakia during the recent years
  when attention was being devoted in particular to the investigation
  of the correlation between gravity anomalies and heights above sea
  level of the terrain, and to the possibilities of applying the
  theory of homogeneous random fields to processing and interpreta-
  tion of geophysical data, especially the anomalous gravity field.
  The paper also presents some data which have not been published
  previously.

  e) IBRMAJER I. - "Gravity anomalies and the structure of the Earth's
  crust on the territory of Czechoslovakia".
  p.47-50.

f) ŠIMON Z. & L. TRÄGER - "Polygons for studying the secular variations of the acceleration of gravity on the territory of Czechoslovakia". p.51-53.

g) KÁRNÍK V. - "Crustal and upper mantle seismic activity in the European area". (2nd Report). p.54-68.

h) VANĚK J. - "Amplitude curves of seismic body waves and the structure of the upper mantle". p.69-74.

...

i) CIMBÁLNÍK M. & P. VYSKOCIL - "Recent crustal movements in Czechoslovakia". p.116-119.

j) PICK M. - "Determination of the figure of the Earth". p.120-121.

k) PICK M. - "Check of Molodenskii's method on mathematical models and in test-areas". p.122-134.

l) BURŠA M. - "Correlation between deflections of the vertical and the axes of zones of increased macroseismic mobility". p..135-139.

508 - WOOLLARD G.P. - "Part I : A regional analysis of crustal structure in North America".
        - "Part II: A study of the problems associated with the prediction of gravity in Europe".
HIG-69-12, Final Rep. 152 p, Univ. Hawaii, 1969.

This report is contained in two parts. Part I is an analysis of present gravity prediction procedures in the light of geophysical data concerning the crust and upper mantle. The assumptions on which these procedures are based (areas in isostatic equilibrium, relationship between Bouguer values and elevation, secondary control of Bouguer values, effects of near surface changes in geology) and their effects are discussed. (U).

Part II analyses the problems of predicting gravity in Europe. The geophysical factors related to these problems (a continental block bounded by deep water, intense tectonic deformation, acid and basic intrusives, lack of seismic measurements, glacial loading) are reviewed and the results tabulated. (U).

509 - AFSHAR H.K. & H. ZOMORRODIAN - "The measurements and the adjustments of the first order gravity network in Iran".
Inst. Geophys., Pub. n°45, 35 p, Tehran Univ., 1970.

The bases of first order include all points in the principal airports of the country for the measurement of which air-transportation has been provided and points for which road transportation has been used.
All these bases have been duly connected to the National Gravity Base in the International Airport of Tehran (Mehrabad).
The Absolute Gravity Value at Mehrabad Airport has been used as a reference value to calculate the values at other bases throughout the country.
Different observers with different gravimeters have effected repeat observations and the value adopted for this National Base amounts to :

$$979.445,429 \text{ mgal.}$$

510 - ZOMORRODIAN H. - "The measurements and the adjustments of the second order gravity network in Iran, Part I : Azarbayjan".
Inst. Geophys., Pub. n°53, 39 p, Tehran Univ., 1971.

The measurements of the Second Order Gravity Network (S.O.G.N.) of Iran are in reality a continuation of the already completed First Order Gravity Network (F.O.G.N.) which has been previously presented under the Pub. n°48, March 1970 of the Institute of Geophysics, Tehran University.
The present report deals with the necessary details concerning the first part of the (S.O.G.N.) measurements including the adjustments and the sketches to the North-Western part of Iran (Azarbayjan).
The Network consists of 27 new Second Order Gravity Bases (S.O.G.B.) separated by distances of about 30-189 km. depending on the locality and the facilities and the proximity to the available Bench Marks.
The bases have been selected as close as possible to the already existing Bench Marks of the Iranian leveling system.

511 - GUBARENKO L.A. - "Gravimètres à cordes".
Fizika Zemli, U.R.S.S., n°11, p.49-56, Nov. 1970.

L'article donne un aperçu des constructions de gravimètres à cordes développées en URSS et à l'étranger et décrit les tentatives faites pour les utiliser dans la mesure de la pesanteur sur les sous-marins, les navires de surface, les instruments utilisés dans les puits et les gravimètres des fonds marins.

512 - LOUIS P. - "Contribution géophysique à la connaissance
géologique du Bassin du Lac Tchad".
O.R.S.T.O.M., Mémoire n°42, 295 p, 1970.

      1ère Partie : Métrologie - Les mesures géophysiques et leur
                exploitation.
      1 - Généralités sur les anomalies gravimétriques.
      2 - Calcul des anomalies et précision des résultats.
      3 - Considérations sur les caractéristiques et le tracé
          des cartes gravimétriques.
      4 - Les mesures électriques.

      2ème Partie : Interprétation - Commentaires géologiques des
                documents géophysiques.
      5 - Les techniques d'interprétation utilisées.
      6 - Considérations générales sur les cartes gravimétriques.
      7 - Le Tchad méridional.
      8 - Le Tchad central et le Cameroun septentrional.
      9 - Le Tchad septentrional.
      10 - Le Niger oriental.
      11 - Le bâti structural de l'Afrique occidentale et centrale
          et la gravimétrie.

      En Annexe : différents documents, en particulier cartes
    gravimétriques (1/3.000.000°).

513 - QURESHY M.N. - "Gravity anomalies as related to regional tectonics
of Peninsular India".
XXII International Geological Congress, India, 1964.
Proc. Section 4 : Rock deformation & tectonics, p.490-506.

    Gravity anomalies paralleling the major strike directions in
the Pre-Cambrian formations are found to occur in Peninsular India.
    Gravity maxima are associated with the Aravallis, Satpuras,
Assam Plateau, Nilgiris, and Eastern Ghats. Gravity minima occur
over the Dharwar region of Mysore, Vindhyan, Gondwana, and the
Tertiary sedimentary basins. Over the Deccan Traps the relation-
ship between surface geology and gravity is obscure. Probably
the gravity "lows" over the Traps are basalts, concealed sedimen-
tary basins, or downwarping of the crust.
    It appears that the gravity maxima may be indicative of horst-
like structures and the minima of "grabens". The vertical diffe-
rential movements might have occurred along fundamental zones of
weakness (lineaments), which are indicated on gravity anomaly maps.
These lineaments have been examined in relation to the known geo-
logy of the Peninsular India.
    Among the northwest-trending are the Kharwar, Madras-Sibi,
Godavari-Kirana Hills, and Mahanadi lineaments. The east and
northeast trending are the Aravallis, the Narbada-Satpuras, the
Nilgiri-Eastern Ghats, and Assam Plateau lineaments.

514 - QURESHY M.N. - "Relation of gravity to elevation and rejuvenation of blocks in India".
from : J. Geophys. Res., v.76, n°2, p.545-557, 1971.

An analysis of free-air, Bouguer, Pratt-Hayford (D = 113.7 km), and Airy-Heiskanen (T = 30 km) anomalies visa vis elevation in India indicates that on an over-all basis isostatic equilibrium prevails in India. Regression study of Bouguer anomalies versus elevation made by grouping the data according to tectonic and geologic units shows that the Bouguer anomaly decreases rather slowly with the increase in elevation over the Himalayas, Aravallis, Nilgiris, Eastern Ghats and the Assam plateau, all of which are post-Mesozoic rejuvenated blocks of the Archaean shield. Small, and sometimes even positive regression coefficients characterize these blocks ; the isostatic anomalies are found to be near zero or positive. It is concluded that the uplifting of these shield blocks has probably taken place through movement and incorporation of material from the upper mantle into the crust.

515 - MAJEWSKA M. - "The calibration of sharpe gravimeter N°228G by means of tilting method in relation to temperature, atmospheric pressure and time".
Inst. Geod. & Cart., 12 p, Warszawa, 1971.

This report presents the results of the examinations, worked out by application of linear function between the reading value of gravimeter and its constant calibration values as well for the large measuring ranges of scale as for the narrow ones. The analysis of correction values relating to the non-linearity of the reading scale, which is also determined during the process of calibration by means of tilting method, has not been included in this paper.