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

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2ème Partie

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- I -

RAPPORT SUR LES TRAVAUX GRAVIMETRIQUES EFFECTUES EN U.R.S.S. EN 1965-1969
Présenté à la Commission Gravimétrique Internationale, Sept. 1970, Paris.

(Traduction)

De 1966 à 1969 en U.R.S.S. les travaux en gravimétrie, coordonnés par le Comité Géophysique Soviétique ont été faits dans les domaines suivants :

I - Déterminations fondamentales de la pesanteur.

II - Détermination de la pesanteur en mer.

III - Etude des variations de la pesanteur.

IV - Mise au point des méthodes et des appareils de détermination du gradient vertical de la pesanteur.

V - Variations périodiques de la pesanteur.

I - TRAVAUX FONDAMENTAUX

1. Des recherches théoriques ont été faites en vue de la détermination de la constante gravitationnelle, et des appareils basés sur la méthode d'observation des oscillations de pendules ont été étudiés. A l'heure actuelle on prépare un système d'appareil (balances à torsion) pour faire cette détermination (1.1, 1.2, 1.3, 1.4).

2. On a examiné certaines questions théoriques générales relatives à la détermination absolue de la pesanteur par la méthode de la chute libre d'un corps. On a étudié l'influence sur les résultats des mesures :

1°) de l'accélération de la pesanteur avec la hauteur ;

2°) de la résistance du milieu, proportionnelle au 1er et au 2ème degré de la vitesse du corps qui tombe :

a - Méthode non symétrique de 3 stations.
b - Méthode symétrique de 2 stations.
c - Méthode symétrique d'une station.

On a commencé la préparation des déterminations absolues d'après la 3ème méthode (1.6).

3. On a fait une liaison entre le point de référence fondamental d'U.R.S.S. :"Liodovo"avec Potsdam - g = 981.565,34 ± 0,06. Ce point peut être utilisé par tous les observateurs qui sont Membres de l'A.I.G. La liaison Liodovo - Potsdam a été faite avec 9 gravimètres GAG.1 et GAG.2 par l'Institut de l'Académie des Sciences de l'U.R.S.S. (1.5, 1.6).

4. Avec les gravimètres GAG.2, on a établi des lignes d'étalonnage pouvant servir à tous les autres gravimètres de l'U.R.S.S. Les polygones qui ont des différences de 100 mgal ont été mesurés avec une précision de 0,01 mgal. Les différents segments de chaque ligne sont mesurés avec une précision de ± 0,007 mgal.

5. Des améliorations ont été apportées aux gravimètres GAG qui sont très pratiques car ils n'ont pas besoin d'étalonnage. Maintenant ces gravimètres GAG sont construits en série.

6. Des améliorations ont aussi été apportées aux pendules "OVM" et on a fait des travaux sur le terrain avec ces pendules. En 1965, la précision était de ± 0,13 mgal, maintenant, en 1969/70, elle est devenue ± 0,06 mgal (1.10). Cette précision a été confirmée par la comparaison avec les gravimètres GAG.2, sur intervalle de 2500 - 3000 mgal, la comparaison entre les résultats des pendules et des gravimètres a donné un écart de l'ordre de ± 0,05 à 0,07 mgal, ce qui donne une erreur relative de $3{,}4.10^{-5}$. En liaison avec ces travaux, on a fait des recherches sur les oscillations des pendules et on a établi que l'erreur sur la période d'oscillation est de ± 1.10^{-8} sec. sur une durée de 15 minutes et la précision sur l'amplitude est de ± 0"6. On a aussi mesuré électroniquement les périodes d'oscillation ; par ce moyen, on a obtenu une précision de ± $0{,}6.10^{-8}$ sec. pour une durée de 10 minutes (1.07).

7. L'étalonnage a été amélioré grâce à la méthode d'inclinaison. On a construit un appareil d'étalonnage portatif, permettant par la méthode d'inclinaison de faire l'étalonnage du gravimètre jusqu'à 3,5 gals avec une erreur relative de 1.10^{-4} et permettant de corriger pratiquement les échelles des gravimètres avec la précision demandée, pour une amplitude de 200 mgal, de 0,01 mgal et pour une amplitude de 4,0 gal de l'ordre de ± 0,02 à ± 0,03 mgal (1.08, 1.09). Les échelles de quelques gravimètres ont été très soigneusement étudiées à l'aide de cet appareil, en particulier celles de gravimètres de la firme Sharp. Ces recherches ont montré que les coefficients d'étalonnage donnés par la firme comportent une erreur qui atteint 1.10^{-3} à 3.10^{-3}. Les erreurs non linéaires de l'échelle pour les gravimètres qui ont une zone de travail peu étendue, ne dépassent pas 0,02 mgal ; et pour ceux qui ont une zone étendue : 0,5 à 1,0 mgal. Les coefficients d'échelle de ces gravimètres dépendent de la température ($\longrightarrow 4.10^{-4}$ pour 1°C), varient avec le temps (jusqu'à 4.10^{-4} par an) et dépendent de la pression atmosphérique (1.11, 1.12) .

II - MESURES DE PESANTEUR EN MER

1. L'Académie des Sciences de l'U.R.S.S. depuis 1967 a commencé des travaux systématiques pour déterminer la pesanteur sur des bâteaux VITIAZ, Academicien KURTCHATOV, MENDELEEV. Les données de ces travaux sont communiquées au B.G.I. de Paris. Les mesures sont faites avec des gravimètres marins "AMG-OMPO" qui sont construits à l'Institut de Physique de la Terre de l'U.R.S.S. Une description détaillée de la construction et des recherches expérimentales en laboratoire et sur mer sont exposées dans la publication (2.1). Grâce à l'existence de deux systèmes sensibles qui travaillent en phase, l'appareil est libéré de l'effet de cross-coupling. Le système est automatique. Les résultats des mesures sont donnés automatiquement sur liste avec les calculs faits. La durée nécessaire pour déterminer un point est de 12mm et l'erreur moyenne quadratique, avec des accélérations perturbatrices peut atteindre 75 gals $\pm$ 2 mgal. L'erreur minimum est $\pm$ 0.5 mgal. Quand on travaille en mer, en règle générale, on fait des déterminations de pesanteur à bord du bâteau dans les ports avec des appareils pendulaires. La précision des observations avec les pendules dans les ports est de $\pm$ 2mgal.

On a fait une série de recherches théoriques et expérimentales en vue d'améliorer d'autres gravimètres et d'évaluer leur précision (2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8).

2. On a poursuivi les travaux expérimentaux avec les pendules à la surface de l'eau ; mais à l'heure actuelle, la précision n'a pu être améliorée ; en présence d'accélérations horizontales perturbatrices ne dépassant pas 50 à 70 gal, elle reste de l'ordre de $\pm$ 7 mgal.

3. Des travaux ont aussi été effectués dans l'Antarctide.

III - VARIATIONS SECULAIRES DE LA PESANTEUR

1. Pour la période indiquée, on a considéré le dernier cycle d'observation des variations séculaires de la pesanteur en prenant la valeur de Potsdam comme point stable. Le premier cycle de mesures a été fait de 1954 - 1956 et le deuxième cycle de 1967 - 1969. Les mesures se trouvent le long de 2 profils : à peu près sur la latitude (55° 56°N) de Potsdam jusqu'à Petropawlow au Kamchatka, et le long du parallèle 45°N de Tbilisi jusqu'au point GARM qui se trouve sur les pentes occidentales du Pamir.

Les résultats de ce travail fondamental sont exposés d'une manière plus détaillée dans les documents donnés par le Comité Géophysique Soviétique au congrès de la Commission Gravimétrique Internationale, Paris, 1970.

Sur la base des recherches faites, il est possible d'assurer que les variations séculaires relatives, si elles existent le long des profils désignés, ne doivent pas dépasser 0,01 mgal par an.

2. Dans (3.1, 3.2, 3.3) sont communiqués les résultats des déterminations répétées de la pesanteur sur la Volga moyenne et en Ukraine. Les différences obtenues sont interprétées par les auteurs comme des variations seculaires de la pesanteur liées à des phénomènes se passant à l'intérieur de la terre et déterminés par de grandes formations géologiques.

IV - MESURES DE GRADIENT VERTICAL

Pour mesurer le gradient vertical ΔV_{zz} on a fait des maquettes astatiques et non astatiques de gravimètres avec des balances à fil horizontal.

Les essais ont été faits en laboratoire et sur le terrain. Au cours de ces essais on a mesuré les anomalies du gradient vertical au-dessus d'un gisement de minerai de fer et dans d'autres conditions où les masses donnaient des anomalies. L'erreur moyenne quadratique de la valeur de l'anomalie obtenue dans ces conditions est $\pm$ 10 eötvös.

On a fait des recherches théoriques et expérimentales de la détermination de ΔV_{zz} sur le fond de la mer et sur un corps en mouvement. Les anomalies du gradient vertical atteignent 30 - 100 ë. On a évalué l'influence des microséismes sur le gradiomètres (4.1, 4.2, 4.3, 4.4, 4.5).

V - ETUDE DES MAREES TERRESTRES EN U.R.S.S. DE 1967 - 1970

Au cours de ces 3 dernières années, on a étudié, plus intensément qu'avant, les marées terrestres.

Les observations ont été faites avec les gravimètres GS.11 et GS.12 en 8 points : Talgar, Krasnaia, Pakhra, Obninsk, Novosibirsk, région du Baïkal, Simpheropol, Yalta, Bakhtchisaraï. Le nombre total de points où des mesures de marées terrestres ont été faites sur le territoire de l'U.R.S.S. a atteint 17. Le point fondamental est la station de TALGAR, près de Alma Ata où les observations sont faites avec deux gravimètres depuis la fin de 1961 , par l'Institut de Physique de la terre, Académie des Sciences de l'U.R.S.S. Cette station est particulièrement intéressante car elle est éloignée de la mer de plus de 2.000 km.

Les calculs de ces mesures ont été faits par différentes méthodes, celles de Pertsev, Matveiev, Lecolazet et Venedictov, ainsi que par des méthodes spectrales. Les résultats obtenus par ces différentes méthodes sont concordants.

Pertsev a trouvé une nouvelle méthode pour enregistrer l'influence des zones lointaines des marées océaniques sur les marées terrestres ; les termes correctifs pour les déviations de marées observées et pour les changements de la pesanteur sont apparus effectifs même pour l'Asie Centrale. Les termes correctifs ont été faits pour de nombreux points pour 4 ondes principales M2, S2, K1 et O1. La différence entre les valeurs du facteur gravimétrique δ pour des points situés dans les parties européennes et asiatiques de l'U.R.S.S., après l'introduction du terme correctif dû aux marées océaniques, pour l'onde M2 a pratiquement disparu, mais pour les ondes S2, K1 et O1, il est conservé.

A Talgar, en tenant compte de l'influence des marées océaniques sur 8 séries indépendantes d'observations (3.042 journées de 24h) on a obtenu en moyenne, venant des 4 ondes principales $\delta = 1{,}158 \pm 0{,}5$ %, c'est-à-dire, que l'amplitude moyenne de l'onde est déterminée avec une précision de $\pm$ 0,2 MKGL. En moyenne pour 4 points de l'Asie Occidentale (Talgar, Novosibirsk, Tachkent et Frounze) on a obtenu $\delta = 1{,}153 \pm 0{,}45$ %. Il est rationnel d'utiliser ces valeurs lors de la construction de modèles de la structure de la Terre. A l'Institut de Physique du Globe on a trouvé des méthodes de mesure du retard instrumental des gravimètres. Le retard des gravimètres Askania peut atteindre 4° et plus. En tenant compte de ce retard, la différence des phases de la marée de pesanteur observée et de la marée théorique pour des ondes de 12h pour une terre homogène, est suffisante pour expliquer le ralentissement séculaire de la rotation de la terre, mais ne concorde pas avec une petite avance observée pour les ondes de 24h.

Molodenski a élaboré une théorie des marées pour une terre élastique et en rotation avec un noyau liquide.

Les mesures des variations des marées ont été effectuées principalement par des inclinomètres photoélectriques de Ostrovsky (plus de 100). En U.R.S.S. les observations ont été faites en 55 points. Les travaux ont été faits par l'Institut de Physique du Globe, Académie des Sciences de l'U.R.S.S., l'Observatoire Gravimétrique de Poltava de l'Académie des Sciences de la République Soviétique d'Ukraine et aussi par l'Académie des Sciences de l'Ouzbekistan, Tadjikistan de Turkménie, d'Estonie, de Crimée, par le département sibérien de l'Académie des Sciences de l'U.R.S.S.et par les filiales ouraliennes et de la presqu'île de Kola de l'Académie des Sciences de l'U.R.S.S.

Outre les observations habituelles dans les galeries et les fouilles, Ostrovski a élaboré une méthode d'observations dans les fouilles à profondeur de 10 m qui a donné de bons résultats. La moyenne simple (sans poids et pour l'instant encore sans enregistrement de l'influence des océans) donne pour le facteur γ, obtenu avec l'onde M2 les valeurs suivantes (Ostrovski et Matveiev) :

	(N - S)	(E - W)
28 points de l'U.R.S.S.	0,653 ± 0,015	0,683 ± 0,007
4 fouilles de l'Ukraine	0,670 ± 0,020	0,699 ± 0,006
6 galeries autour Moscou	0,669 ± 0,020	0,70 ± 0,007

On continue les recherches des mesures des variations des marées en liaison avec les fractures locales et tectoniques.

Parallèlement des inclinomètres sont utilisés pour étudier les variations lentes des déviations. L'enregistrement de l'influence des océans n'explique pas les désaccords entre γ (N-S) et γ (E-W), diminuant cette différence seulement d'un tiers. Pour l'instant on a calculé cette différence seulement pour 5 points.

Les observations avec des "déformographes" sont faites en 8 points : Talgar, Obninsk, Serpoukhov, Tbilissi, Kondara, Garm, Nourek, Toktogoul.

Les irrégularités périodiques de la rotation de la terre déterminées par des marées de longue période, de deux semaines et de un mois ont été explorées par l'analyse des déterminations multi-annuelles des termes correctifs des horloges. Pilnik, à partir de l'analyse d'observations sur 15 ans, faites par le Service de l'Heure en U.R.S.S., a obtenu des valeurs du nombre de Love K :

- pour une onde de deux semaines Mf : K = 0,318 ± 0,008
- pour une onde d'un mois Mm : K = 0,284 ± 0,013

Goubanov, d'après des observations de 7 et 13 ans dans 5 observatoires (Poulkovo, Creenwich, Zikovië, Tokio, Mont-Strombo), à partir d'ondes de deux semaines, a obtenu :

Mf : K = 0,311 ± 0,41.

Il est montré que la détermination du nombre de Love K, lors des irrégularités périodiques de la rotation de la terre d'après les formules de Jeyffreys et Woollard, s'applique aussi dans le cas d'une terre se rétrécissant. (Pariski et Pertsev).

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(5)

(5) Recueil : Sur le changement en expérience des observations avec inclinomètres et Symposium sur l'examen critique de leur sens physique.
Ed. Acad. Sci. U.R.S.S., Moscou, 1969.

5.47 - BALAVADZE B.K. & K.Z. KARTVELICHVILI. - "Observations après des phénomènes périodiques dans l'écorce terrestre à Tbilisi".
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(4) voir page I-16.

- II -

EQUAL-AREA BLOCKS

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Abstract :

Two systems of strictly equal-area blocks are proposed. The first, and more difficult, includes only no-spherical "triangles". The second includes polar "triangles" and "tesseral-areas".

The problem of the equal-area blocks has been discussed by M. R.H. RAPP (1), who proposed blocks with equal amplitude of latitude, evaluated the number n of blocks in the zone between the latitudes φ_i and φ_{i+1} from the relations :

$$\Delta\lambda = \frac{\theta \sin\theta}{\sin\varphi_{i+1} - \sin\varphi_i}, \quad n = 360^\circ / \Delta\lambda^\circ,$$

(where λ is the longitude), and rounded n to the nearest integer value : consequently the areas of the blocks are not strictly equal to the area $\theta \sin\theta$ of the "basic block".

Let us divide the surface of the (spherical) Earth into 8 blocks by means of the equator and two perpendicular meridian planes. Thus we would have 8 perfectly shaped blocks : 8 equilateral spherical triangles, with the same amplitude $\frac{\pi}{2}$ for latitude and longitude.

Now we have two ways.

A - If such an equilateral triangle were plane instead of spherical, we could divide it into 4 equilateral triangles, the 4 into 16, the 16 into 64, etc...

On a spherical representation of the Earth, let the term "triangle" represent the figure included between three circles (a spherical triangle is a special "triangle" included between three great circles).

It is possible to join the middles B', C' of the borders A C, A B of a "triangle" A B C by means of an infinity of circles. With one of them the area A B' C' is the quarter of the area A B C. Thus we can divide A B C in 4 "triangles" of strictly equal areas, from which we could determine the blocks on a map, and so on. For very small blocks we could trace rectilinear triangles.

But the computations of the areas would be difficult.

B - Utilizing conventional maps with their longitudes and latitudes, we can adopt blocks of equal amplitude for longitude, and make our subdivision conform to the analytical structure of the spherical area : let us consider one of our 8 initial triangular blocks, the one with $0 < \varphi < \frac{\pi}{2}$, $0 < \lambda < \frac{\pi}{2}$: we divide it by the arcs $\lambda = \frac{\pi}{4}$ and $\varphi =$ arc sin $\frac{1}{2}$ into 4 blocks (2 polar "triangles" and 2 "tesseral areas").

Applying that process to the 8 initial blocks, we obtain 32 blocks (16 polar "triangles", 16 "tesseral areas").

With the arcs $\lambda = \frac{\pi}{8}$, $\frac{3\pi}{8}$, ..., $\varphi = \pm$ arc sin $\frac{1}{4}$, $\pm$ arc sin $\frac{3}{4}$, we have 128 blocks (32 polar "triangles", 96 "tesseral areas").

Following the subdivision we come to this table :

"tesseral areas"	polar "triangles"	total
0	8	8
16	16	32
96	32	128
448	64	512
1920	128	2048
7936	256	8192
32256	512	32768
130048	1024	131072
522240	2048	524288
2093056	4096	2097152
.....	....	.....

The last numbers correspond to a $\Delta\lambda$ of about 10'33".

For example in the case of 512 blocks we have in the initial block : $0 < \varphi < \pi/8$, $0 < \lambda < \pi/2$:

λ = 0, 11°15', 22°30', 33°45', 45°, 56°15', 67°30', 78°45', 90° ,

φ = 0, 7°11', 14°29', 22°01', 30°, 38°41', 48°35', 61°03', 90°.

In the other 7 initial blocks we have the same values of λ, + 90°, 180°, 270°, and the same values of φ, positives or negatives.

Discussion

1°) The first condition of M. RAPP's proposal is respected : the borders of the blocks are easily defined and located.

2°) The blocks have strictly the same area, which differ without inconvenience from the area of a "basic block". The blocks have different shapes, as with the process of M. RAPP.

3°) A consistent system for computing the blocks coordinates for various size blocks is available (and easy).

4°) The mean anomaly in a large block is the mean of the mean anomalies of smaller size blocks that fall solely within the larger block.

Remarks

1°) We have divided the 8 initial blocks into 8 x 4, 8 x 4 x 4, and so on. We could adopt other rates of subdivision.

2°) The same method B could be applied to an ellipsoid (instead of a sphere), with elliptic meridian arcs. But that complication appear not usefull because the mean anomalies are not very accurate.

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(1) Equal-area blocks. R.H. RAPP, August 1970.
Department of Geodetic Science, the Ohio State University, Columbus.

- III -

GRAVITY BASE VALUES IN TAHITI

by R.T. HAWORTH

Connections by J.M. WOODSIDE & M.D. HUGHES - Hawaii to Tahiti.

Connections were carried out with the LaCoste and Romberg Geodetic Gravimeter n°93 belonging to the University of Hawaii. Woodside connected from the University of Hawaii, HIG 108 Bench Mark via Hawaii Station Q at Honolulu International Airport to the University of Hawaii station at the Papeete International Airport, Faa, Tahiti. Due to considerable reconstruction since this last station was established, the tie was not made directly to the University of Hawaii station, but to an intermediate station at the airport (hereafter referred to as the JMW station) which was later tied to the University of Hawaii station. Hughes reversed the connection a few days later.

The following raw data were obtained.

Station	Date	Time	Reading	Observer
University of Hawaii HIG 108 Bench Mark	11 May 70	1127 1132	3602.22 3602.22	Woodside Marsh
Oahu, Hawaii Q (Honolulu International Airport)	11 May 70	1307	3567.14	Woodside
Papeete Airport, Faa, Tahiti (JMW Station)	11 May 70	2003	3259.68	Woodside
Papeete Airport, Faa, Tahiti University of Hawaii Station)	16 May 70	1140 1145	3259.35 3259.335 (disturbed by construction)	Hughes Hughes
Oahu, Hawaii Q (Honolulu International Airport)	16 May 70	2150 2200	3567.06 3567.08	Hughes Marsh
University of Hawaii HIG 108 Bench Mark	16 May 70	2229 2232 2235	3602.13 3602.14 3602.145	Marsh Marsh Hughes

Connections by J.M. WOODSIDE & R.T. HAWORTH - Around Tahiti

Connections were made by Woodside with the LaCoste and Romberg Geodetic Gravimeter n°93 belonging to the University of Hawaii, and by Haworth with the LaCoste and Romberg Geodetic Gravimeter n°112 belonging to Bedford Institute. Observations were made at the berth of C.S.S. HUDSON on the waterfront by the tourist bureau, at the Pilier Astronomique (B.G.I., Station 375.79.33) and at Papeete International Airport, Faa, Tahiti. At the latter, three stations were referenced, one of which was the station established in August 1964 by the Hawaii Institute of Geophysics. The other two were the incorrect interpretations by Woodside and Haworth of the position of the University of Hawaii Station since rebuilding of the airport referred to respectively as the JMW station and the RTH station.

The deviation values appended to the Haworth readings represent the RMS deviation from the mean taken from approximately 5 readings at each station.

The following raw data were obtained.

Station	Date	Time	Reading	Observer
HUDSON berth, Papeete	14 May 70	1020	2259.85±0.03	Haworth (#112)
Pilier Astronomique, Papeete	14 May 70	1035	2260.07±0.01	Haworth (#112)
Papeete Airport (RTH Station)	14 May 70	1120	2257.23±0.005	Haworth (#112)
HUDSON berth, Papeete	14 May 70	1145	2259.87±0.02	Haworth (#112)
HUDSON berth, Papeete	15 May 70	0815	3263.19	Woodside (#93)
Pilier Astronomique Papeete	15 May 70	0835	3263.51	Woodside (#93)
Papeete (JMW Station)	15 May 70	0850	3259.53	Woodside (#93)
Papeete Airport (RTH Station)	15 May 70	0906	3259.28	Woodside (#93)
Papeete Airport (U. of H. Station)	15 May 70	0950	3259.29	Woodside (#93)
HUDSON berth, Papeete	15 May 70	1010	3263.20	Woodside (#93)

Reduction of observations

No tidal corrections have been made to the observations. Tahiti is at a nodal point in the tidal range of the Pacific with a maximum spring tide of approximately one foot. The extent of the correction has therefore been considered negligible in obtaining the accuracy of base needed for the HUDSON marine gravity survey.

HAWAII - TAHITI (referred to arbitrary zero of gravimeter)

	(Woodside)	(Hughes)
University of Hawaii (HIG 108 Bench Mark)	2602.75 mgals	2602.69 mgals
Oahu, Hawaii Q (Honolulu International Airport)	2577.35 "	2577.30 "
Papeete Airport (University of Hawaii Station)	2354.65 "	2354.59 "
Connections		
HIG 108 - Oahu Q	25.40 "	25.39 "
Oahu Q - Papeete Airport	222.70 "	222.71 "

Around TAHITI (referred to arbitrary zero of gravimeter)

	(Woodside)	(Haworth)
HUDSON berth, Papeete	2357.37 mgals	2388,49 mgals
Pilier Astronomique, Papeete	2357.60 "	2388.72 "
Papeete Airport (JMW Station)	2354.72 "	
Papeete Airport (RTH Station)	2354.54 "	2385.72 "
Papeete Airport (U.of H.Station)	2354.54 "	
HUDSON berth, Papeete	2357.37 "	2388.51 "
Connections (allowing for drift in Haworth readings)		
HUDSON - Pilier Astronomique	- 0.23 mgals	- 0.23 mgals
Pilier Astronomique - Papeete Airp. (University of Hawaii Station)	3.06 "	3.02 "
Papeete Airport (U.of H.Station) HUDSON	- 2.83 "	- 2.79 "

The gravity value at Oahu Q as deduced by Dominion Observatory in connection with the First Order World Gravity Network is 978932.77 mgals. All station values are referred to this base :

	B.I. Connection	Difference from Oahu Q
Oahu, Hawaii Station Q, Honolulu International Airport	978932.77	
HIG 108 Bench Mark, University of Hawaii	978958.17	+ 25.40 mgals
Papeete Airport University of Hawaii (1964) Station	978710.07	- 222.70 mgals
Papeete Airport, JMW Station	978710.25	- 222.52 mgals
Papeete Airport, RTH Station	978710.07	- 222.70 mgals
Pilier Astronomique, Papeete (BGI 375.79.33)	978713.11	- 219.66 mgals
HUDSON berth, Papeete	978712.88	- 219.89 mgals

Since the sea gravimeter used on HUDSON 69-050 was at a level 5 feet above the station established alongside HUDSON, the reference gravity value used for the cruise was 978712.4 mgals.

Machesky at H.I.G. gives a value at Oahu of 978933.5 mgals and at Papeete Airport of 978710.7 mgals with reference to Oahu Q (personal communication : letter of 16.2.70, file AOL 5310-4-1). This represents a difference of 222.8 mgals with an estimated accuracy of 0.3 mgals after two ties with Worden gravimeters. This is in good agreement with the B.I. measured difference of 222.70 mgals.

The value at the Pilier Astronomique, Papeete quoted by B.G.I. is 978716.2 mgals referred to a value at Nadi Airport of 978549.8 mgals. This latter value has since been modified and is quoted in Woollard and Rose (1) as 978547.1 mgals. This is the revised value quoted by B.G.I. The revised value at Pilier Astronomique would therefore be 978713.5. It is also noted that the Woollard and Rose value for Oahu J is 978933.7 (compared with Dominion Observatory quoted FOWGN value of 978933.0), and for Oahu B is 978953.0 (compared with Dominion Observatory value of 978952.22). Thus Woollard and Rose values seem to be 0.7 mgals higher than Dominion Observatory values. Our comparison at Pilier Astronomique gives a "Woollard and Rose" value 0.4 mgals higher than the "Dominion Observatory" value. There may thus be an uncertainty somewhere of approximately 0.3 mgals. We may however rely on the B.I. connection between the Tahiti bases and Oahu Station Q.

(1) WOOLLARD & ROSE - "International gravity measurements", Published by the Society of Exploration Geophysicists, 1963.

- IV -

CARTES d'ALTITUDES MOYENNES

A maintes reprises, des géodésiens ou géophysiciens se sont informés auprès du Bureau Gravimétrique International, des cartes d'altitudes moyennes alors existantes, car un grand nombre de ces cartes ont été primitivement établies pour le calcul de réductions gravimétriques et ont été envoyées à la cartothèque du B.G.I.

Pour faciliter les recherches des géodésiens et éviter que de nouveaux calculs soient inutilement recommencés, on dresse ci-après la liste de toutes les cartes d'altitudes moyennes connues au B.G.I.

Cette liste a pu être complétée et mise à jour grâce aux informations complémentaires qu'ont bien voulu nous faire parvenir les services compétents.

Remarques générales :

1) Les valeurs reportées sur ces cartes (à l'exception des carreaux mixtes) sont des altitudes et profondeurs brutes résultant de la lecture de cartes géographiques, et ne tenant pas compte de la densité superficielle des terrains.

2) Toutes les valeurs reportées sont en mètres.

3) Dans les carreaux mixtes (continents et mers), sont indiqués :

a - ou 3 nombres - altitude moyenne de la portion continentale
- fraction de la surface occupée par le continent
- altitude moyenne de la portion océanique.
(3), (3') et (3").

b - ou 1 nombre : altitude ou profondeur moyenne du carreau <u>entier</u> calculée en tenant compte du pourcentage des 2 fractions et de leur densité relative.
Les nombres positifs représentent toujours la cote moyenne du terrain au-dessus du niveau de la mer, et les nombres négatifs une profondeur moyenne réelle (et non pas une profondeur fictive ramenée à la densité continentale).
(8), (9), (16) et (17).

c - ou 2 nombres : altitude et profondeur moyennes (évaluées comme en b), de fractions égales de carreau subdivisé dans le sens du relief.
(2), (7), (11) et (11').

d - ou 1 nombre positif correspondant à l'altitude moyenne de la fraction continentale répartie sur tout le carreau.
1 nombre négatif correspondant à la profondeur moyenne océanique répartie sur tout le carreau.
(12).

4) Pour chaque carte, les dimensions des carreaux ont été reportées dans le tableau ci-après et les plus utilisées ont été soulignées.

Pays	Echelle	Longitude	Latitude	Dimension des carreaux	Ref.
Monde	Tableau	177°30.W-182°30E	84°N-88°48	5° x 4°48'	(83)
Monde	Tableau	180°W-180°EG.	90°N-90°S	5° x 5°	(84)
Europe Centrale	1/2.000.000	2°20'-24°20'EG	46°-58°N	6' x 10'	(1)
Europe méridionale et Afrique du Nord	1/5.000.000	25gW-20gE méridien 0 = Paris	20g-50gN	1g x 1g	(2)
Italie, régions et mers environnantes	1/1.000.000	7°EG-21°20'EG	34°-49°N	6' x 10' 10' x 15' 5' x 7'5 20'g x 20'g	(3)
Italie, régions et mers environnantes	1/2.000.000	11°E-11°W méridien 0 = Rome	32°-51°N	10' x 15' 12' x 20' 20'g x 20'g	(3')
Italie, régions et mers environnantes	1/4.000.000	18°E-18°W méridien 0 = Rome	28°-56°N	20' x 30' 24' x 40' 40'g x 40'g	(3")
Allemagne de l'Ouest	1/2.000.000	6°-14°EG	47°30'-55°N	6' x 10'	(4)
Allemagne de l'Ouest	1/4.000.000	2°-18°EG	46°-56°N	12' x 20'	(4')
Autriche	1/500.000	Frontières		6' x 10'	(5)
Autriche	1/1.000.000	Frontières		3' x 5'	(5')
Espagne	1/500.000	3°20'-9°20'WG	36°-43°30'N	3'20" x 5'	(6)

(a) Voir remarques générales page précédente.

Pays	Echelle	Longitude	Latitude	Dimension des carreaux	Ref.
France (6 feuilles)	1/600.000	2gW-9gW 7gE-1gW 2gW-9gW 7gE-1gW 1gW-8gW (8gE-7gE Corse) 7gE-1gW méridien 0 = Paris	54g-58gN 54g-58gN 50g-54gN 50g-54gN 47g-50gN 46g-48gN) 47g-50gN	2'g x 5'g 4'g x 5'g 20'g x 20'g	(7)
France et régions limitrophes	1/2.000.000	11gE-12gW méridien 0 = Paris	43g-60gN	20'g x 20'g 1g x 1g	(8)
Norvège (4 feuilles)	1/1.000.000	5°-12°30' 4°30'-13° 9°-17°EG 12°E-31°EG	50°-60°N 60°-64°N 64°-68°N 68°-72°N	5' x 10'	(9)
Pays-Bas	1/1.000.000	3°30'-7°30'EG	50°30'-53°30'N	3' x 5'	(10)
Portugal, mers et pays environnants	1/1.000.000	4°10'-11°30'WG	35°30'-44°N	10' x 10' 5' x 5'	(11)
Portugal, mers et pays environnants	1/2.000.000	4°10'-11°30'WG	35°30'-44°N	10' x 10' 5' x 5'	(11')
Suède et mer Baltique	1/1.000.000	10°-24°EG environ	55°-69°N	5' x 10'	(12)
Suède	1/1.000.000	12°-19°EG	56°-69°N	1/8° x 1/4°	(18)
Suisse	1/2.000.000	3°5-12°5EG	44°5-49°N	8 x 8 km 64 x 64 km 128 x 128 km	(13)

Pays	Echelle	Longitude	Latitude	Dimension des carreaux	Ref.
Afrique du Nord	1/2.000.000	14gE-16gW méridien 0 = Paris	30gN-44gN	10'g x 20'g 20'g x 20'g / 1g x 1g	(14)
Afrique Occidentale	1/5.000.000	12°E-16°WG	4°-24°N	30' x 30'	(15)
Côte d'Ivoire Haute Volta Mali méridional	1/5.700.000	0° 8°WG	5°-14°N	1/4° x 1/4°	(19)
Afrique Occidentale	1/5.000.000°	16°EG-0.18°WG	6°-27°N	1/4° x 1/4°	(20)
Tchad 2 feuilles	1/1.000.000	13°-22°EG 15°-24°EG	7°-16°N 16°-23°N	5' x 5'	(21)
Tchad	1/5.000.000	10°-24°EG	7°-23°N	1/4° x 1/4°	(22)
Madagascar (3 feuilles)	1/1.000.000	43°-52°EG 42°-52°EG 44°-51°EG	16°-11°30'S 21°-16°S 27°-21°S	5' x 5' / 30' x 30' / 1° x 1°	(16)
Madagascar	1/2.000.000	40°-54°EG	28°-10°S	10' x 10' / 1° x 1°	(17)
Alaska		170°-130°WG	55°-70°N	1° x 1°	(85)
U.S.A.	Liste	124°-80°WG	30°-49°N	1° x 1°	(86)
Australie	1/22.000.000	114°-150°EG	12°5-36°S	1° x 1°	(87)
Japon	1/200.000	138°-139°E	34°40-36°N	1' x 1'5 2' x 3'	(23)
Japon	1/200.000	138°-141°EG	34°00-37°20N	1' x 1'5 2' x 3'	69-82

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(1) - "Karte der mittleren Höhen von Zentraleuropea". A. SCHLEUSENER. Veröff. d. DGK, Reihe B, Heft 60, Frankfurt/M, 1959.
La partie principale est basée sur les cartes topographiques d'Allemagne au 1/200.000 "Topographische Ubersichtskarte des Deutschen Reiches".
Pour les autres pays concernés, on a utilisé des cartes d'échelle variable (1/25.000 à 1/2.000.000) suivant les régions, mais généralement de 1/200.000.

(2) - "Altitudes moyennes". Bureau Gravimétrique International, Paris, 1959.
Cette carte est tirée de la carte d'altitudes moyennes au 1/2.000.000 et complétée au moyen des cartes suivantes :
- cartes d'Afrique 1/500.000
- cartes d'Europe (I.G.N.) 1/1.000.000
- cartes Sahara 1/2.000.000
- cartes du Service Hydrographique (différentes échelles).

(3), (3') et (3") - "Carta quadrettata delle altitudine medie dell'Italia e delle regioni limitrofe e delle profondità medie dei mari circostanti". S. BALLARIN, Commissione Geodetica Italiana, Pise, 1959.
La partie italienne est tirée des cartes topographiques au 1/25.000 de l'Institut Géographique Militaire Italien.
Les régions voisines sont complétées au moyen des cartes de A. SCHLEUSENER et de P. LEJAY.
Sur les cartes (3') et (3") les carreaux ont été groupés par 4 et par 16.

(4) - "Mittlere Höhen von Westdeutschland für Gradabteilung 6' x 10' (etwa 130qkm)". Institut für Angewandte Geodäsie, Frankfurt/M.
Les évaluations ont été faites à partir de la carte de A. SCHLEUSENER (cf.1) complétées par des cartes topographiques au 1/25.000. et des cartes hydrographiques.

(4')- "Mittlere Höhen von Westdeutschland für Gradabteilung 12' x 20' (etwa 500qkm)". K. GERKE, H. WATERMAN, D.G.K., Reihe B, n°46-III, Frankfurt/M, 1960.
Les évaluations ont été faites de la même manière que pour la carte (4).

(5) - Bund. für Eich und Vermessungswesen, Wien.
Les évaluations ont été faites à partir de la nouvelle carte d'Autriche en 213 feuilles, échelle 1/50.000.

(5') - Bund. für Eich und Vermessungswesen, Wien.
Echelle 1/1.000.000 et dimensions 3' x 5', 1965.

(6) - "Instituto Geografico y Cadastral". Madrid.
Les évaluations ont été faites à partir de la carte d'Espagne au 1/50.000, de cartes françaises et portugaises.

(7) - "Carte d'altitudes moyennes". R.P. LEJAY,
Comité National Français de Géodésie et Géophysique, 1947-48.
Les évaluations ont été faites à partir de la carte de France au 1/200.000 de l'Institut Géographique National (équidistance des courbes 20 m et 40 m) et ont été complétées avec des cartes espagnoles (1/50.000), des cartes européennes (1/1.000.000) et des cartes du Service Hydrographique de la Marine.

(8) - "Cartes d'altitudes moyennes - France et pays limitrophes".
R.P. LEJAY, Comité National Français de Géodésie et Géophysique, 1948.
Cette carte a été établie à partir de la carte précédente, complétée au moyen de la carte au 1/1.000.000 (Inst. Geog. Nat., Paris), et de nombreux documents du Service Hydrographique de la Marine.

(9) - "Norway mean height". Geographical Survey of Norway, Oslo.
Feuille 2105 (Jotunheimen) ; feuille 2151 (Skagerak) ;
Feuille 2090 (Kiruna) ;
Feuille 2052 : en préparation.
Les évaluations ont été effectuées à partir de la carte topographique au 1/100.000 de Norvège, dont les courbes de niveau sont équidistantes de 30 m.

(10) - "Maps of mean elevations, free-air and Bouguer anomalies for a grid of 3' lat. by 5' long.". Geodetic Institute of the technicological University of Delft, 1963.
Les évaluations ont été effectuées à partir des cartes topographiques au 1/25.000.

(11) et (11') - "Rapport National sur les travaux Géodésiques présenté à la XIIIème Assemblée Générale de l'U.G.G.I., Helsinki, 1960". Instituto Geografico e Cadastral, Lisboa.

Les évaluations ont été faites à partir de la Carte militaire du Portugal 1/25.000, de cartes hydrographiques du Ministère de la Marine, de la carte d'Espagne au 1/500.000 de l'Instituto Geografico y Catastral de Madrid.

(12) - Rikets allmanna kartverk, Stockholm : Meddelande n°30, 1963.

Les évaluations ont été faites à partir de cartes au 1/50.000 et 1/100.000 (équidistance des courbes : 33 m) et de cartes hydrographiques au 1/20.000 et 1/500.000.

(13) - "Travaux astronomiques et géodésiques en Suisse". v. XVII, Th. NIETHAMMER, Comm. Geod. Suisse.

"Beitrage zur Untersuchung der isostatischen Kompensation der Schweiz Gebirgsmassen". M. LEHNER, Verhandl. Naturf. Gesellsch. Basel, Band 41.

Ces valeurs moyennes (transformées en courbes de niveau équidistantes de 200 m dans l'hypothèse de 128 x 128 km) ont été évaluées à partir de :

cartes	1/200.000	(équidistance 100 m)	pour la Suisse
"	1/500.000	(" 100 à 400 m)	" l'Italie
"	1/200.000	(" 20 à 40 m)	" la France
"	1/200.000	(" 20 m)	" l'Allemagne

(14) - "Cartes des altitudes moyennes de l'Afrique du Nord". S. CORON, Bureau Gravimétrique International, 1950.

Cette carte fait suite à la carte établie pour la France (voir n°8) ; les évaluations ont été faites sur les cartes au 1/500.000 de l'Afrique du Nord (Inst. Géog. Nat., Paris), sur les cartes du Serv. Hydrog. de la Marine (échelle variable) et sur les cartes au 1/1.000.000 internationales.

(15) - "Carte d'altitudes moyennes". O.R.S.T.O.M., Paris, (dernier dessin : 1962).

Cette carte est tirée de cartes d'altitudes moyennes régionales au 1/1.000.000 (non publiées).

Les évaluations ont été faites à l'aide de cartes géographiques (1/200.000) et de cartes d'itinéraires gravimétriques dans les zones sahariennes.

(16) - "Madagascar". S. CORON, B.G.I., Paris, 1955.
Les évaluations ont été faites à l'aide des cartes du Service Géographique de Madagascar (1/100.000 et 1/500.000 provisoire) et de cartes du Service Hydrographique de la Marine.

(17) - "Madagascar". S. CORON, B.G.I., Paris, 1956.
Cette carte est tirée de la carte précédente et complétée à l'aide de cartes au 1/1.000.000.

(18) - "Mean topographical heights". Medd. Geod. Inst. Uppsala, n°3.
Cette carte a été établi à partir de cartes hypsométriques au 1/50.000, 1/100.000, 1/200.000 et 1/500.000.

(19) - "Mesures gravimétriques et magnétiques en Côte d'Ivoire". J. RECHENMANN. Mission Géophysique 1958-59-62. O.R.S.T.O.M. n°5, Mai 1965.

(20) - Afrique Occidentale. O.R.S.T.O.M., 1967.
Cette carte comprend la carte n°19.

(21) - Tchad. O.R.S.T.O.M., 1968.

(22) - Tchad.
Cette carte a été établie à partir de la carte précédente.

(23) - Japon. Geophysical Survey Institute.

(69..82) - Japon, Geophysical Survey Institute.

(83) - "Mean elevations". Geodetic Institute, Delft, Technological University Netherlands.
Each elevation is the mean value of 25 points values, equally distributed within the compartment 1956.
Accuracy depends on map accuracy which is not the same in all parts of the world.

(84) - "Spherical harmonic analysis of the Earth's topography". W.H.K. LEE, Institute of Geophysics and Planetary Physics. University of California, Los Angeles.
Topographic values of the 5° x 5° grid elements are given in meters relative to the sea level. They are the mean elevation on land, the mean depth at sea, and the areal average of the mean elevation and depth for grid elements containing land and sea.

(85) - "Gravity measurements in Alaska". E. TIEL, W.E. BONINI, N. OSTENSO & G.P. WOOLLARD. Woods Hole Oceanographic Institution, December 1958.

Carte partielle d'altitudes moyennes 1° x 1°.
Le nombre d'observations est indiqué dans chaque 1° x 1°.

(86) - "The prediction of gravity in the U.S., utilizing geologic and geophysical parameters". W.E. STRANGE & G.P. WOOLLARD., 1964.

Les altitudes sont indiquées en "feet".

(87) - "The free-air geoid in South Australia and its relation to the equipotential surfaces of the Earth's gravitational field". R.M. MATHER, 1968. University of New South Wales, Kensington, N.S.W., Australia.

LISTE DES PUBLICATIONS

reçues au

BUREAU GRAVIMETRIQUE INTERNATIONAL

(Octobre 1970 à Janvier 1971)

CONCERNANT LES QUESTIONS DE PESANTEUR

LISTE DES PUBLICATIONS

* 188 - Studia Geophys. & Geod., v.14, n°1, Prague, 1970.
Papers presented at the SYMPOSIUM ON PHYSICAL GEODESY, September 22 - 28, 1969, Prague.

a) BURSA M. - "Best-fitting tri - axial Earth ellipsoid parameters derived from satellite observations".
p.1-9.

De l'ensemble des coefficients harmoniques du développement du géopotentiel calculé à partir des variations des éléments orbitaux des satellites, on a calculé les paramètres de l'ellipsoïde terrestre triaxial, représentant la surface du géoïde. La solution fut effectuée par méthode analytique sous la condition du minimum de l'intégrale du carré de l'écart du rayon vecteur du géoïde et de l'ellipsoïde, de même que par calcul numérique à partir des valeurs discrètes 10° x 10°.

b) BURSA M. - "Geopotential and gravity on external surfaces as derived from satellite observations".
p.10-24.

On déduit les expressions donnant le géopotentiel et la pesanteur sur un ellipsoïde triaxial extérieur, de même que la pesanteur sur la surface de niveau extérieure et les valeurs moyennes intégrales de ces grandeurs. On discute la convergence des séries et l'usage des formules déduites à la détermination des paramètres de la forme du corps terrestre.

c) BURSA M. - "Global geoid sections determined by satellite orbit dynamics".
p.274-285.

This paper ties up with (5,6) the fundamental notations of which have been adopted. The sets of Stokes'constants (harmonic coefficients) $J^{(k)}$, $S^{(k)}$ were adopted from (4), and the scale factor for lengths, $R_o = {}^nGM/W_o$, from (5). The equations for global meridional and parallel sections of the geoid surface $W = W_o$ are formulated. The geoid sections are represented by best fitting ellipses, as regards the meridians always for the arcs between the equator and the pole.

* Les numéros font suite à ceux indiqués dans le Bull. Inf. n°25, Mars 1971.

191 - Studia Geophys. & Geod., v.14, n°2, Prague, 1970.
Papers presented at the SYMPOSIUM ON PHYSICAL GEODESY, September 22 - 28, 1969, Prague.

Some papers already mentioned in previous Bull. d'Inf. have not been reported.

a) KRARUP T. - "The method of least squares collocation". p.107-109.
(Abstract from : Medd. n°44, Copenhagen, 1969.)

b) DUFOUR H.M. - "Représentation du potentiel terrestre par des développements harmoniques excentrés". p.109-110. (Résumé).

c) BRAGARD L. - "On a regional method of determining the figure of the Earth by successive parts by means of the external gravity field". p.114-120.

d) VELKOBORSKY P. - "On the second approximations of the deflections of the vertical and the quasigeoid height". p.135-138.

The theoretical possibility of the exact solution of the Molodenskii BVP was investigated. This problem was transformed to the third BVP of the potential theory using the Bruns equation. However, it would not be possible to reach the exact results by this well-known procedure, if it were used only once. That is why the terms of the second order were neglected when deriving the Bruns equation, as well as when deriving the boundary condition of the third BVP. In addition this condition was transferred from an unknown Earth's surface S to the known hypsometric surface Σ (the telluroid) without any correction. Therefore, the whole procedure was repeated and the boundary condition, valid for the surface defined by the first approximation, was constructed. This new surface is nearer to the Earth's surface than the telluroid. The corresponding equations for the successive approximations were derived.

The aim of this paper is to find suitable formulae for the terms depending on the difference between surfaces S and Σ .

e) PICK M. - "Generalization of the system of normal heights". p.156-159.

...

f) VYSKOCIL V. - "On the covariance and structure functions of the anomalous gravity field".
p.174-177.

The theory of statistically homogeneous and isotropic random fields is applied to an anomalous gravity field $\Delta g\ (P) = \Delta g\ (x, y)$. Apart from the currently used covariance function, also the structure function (Strukturfunktion defined in general, is introduced as a statistical characteristic of the field $\Delta g\ (P)$.

g) KUBACKOVA L. - "Optimum filtration of anomalous gravity fields".
p.177-178.

The purpose of this paper is to inform about the results of an investigation devoted to one of the methods of separating anomalous gravity fields. Mathematically the method considered is based on Wiener's considerations of optimum filtering of a signal subject to noise.

The use of Wiener filters for functions of a single argument, time, is known from radiocommunications. In geophysics, namely in gravimetry papers devoted to the application of the said filters have only begun to appear in the last decade. As an example the papers (1-4) and especially the paper (5) should be mentioned. These papers are devoted to optimum filtration of functions of a single argument, the physical dimension of which is length, the way of introducing the geophysical data (along the whole profile), in contrast to radiocommunications, not requiring the filter to be realized physically.

h) VYSKOCIL V. - "Statistical characteristics of linear transformation of gravity anomalies".
p.179-180. (Abstract from Studia Geophys. & Geod., v.13, p.252, 1969).

i) PICK M. - "Determination of the deflections of the vertical for a mathematical model with slopes over 45°".
p.180-181.

j) MIHAILESCU M. - "L'automatisation du calcul de la déviation de la verticale".
p.183-186.

Pour automatiser le calcul de la déviation de la verticale gravimétrique, nous proposons maintenant une méthode afin d'éliminer

le calcul des valeurs moyennes Δg, sur les secteurs circulaires des palettes. Pour celui-ci toute la région prise en considération pour le calcul de la déviation de la verticale, se divise en des surfaces standard (de préférence des cartes topographiques à l'échelle 1/25.000). Sur ces surfaces on peut calculer des valeurs moyennes de l'anomalie à "l'air libre".

k) PICK M., I. JAKUBCOVA & M. KOZISLOVA. - "Comparison of different systems of deflections of the vertical in the Czechoslovakian test area".
p.186-190.

The High Tatras test area lies in mountains, the maximum heights of which are over 2.600 m and the maximum differences in heights of which amount to about 2.000 m. In this area the figure of the quasi-geoid and the deflections of the vertical have been determined from gravity data for every point of a 2 x 2 km. squaregrid, covering a territory of about 40 x 50 km.

...

The accuracy of the deflections of the vertical, derived from gravity data, was estimated using the procedure, published earlier, it is about 0.8".

...

The gravimetric deflections of the vertical were compared with the deflections, determined from the astro-gravimetric levelling, from trigonometric data, from astronomical measurements and from topographical deflections of the vertical. For transforming the gravimetric deflection of the vertical from the regularly distributed 2 x 2 km square-grid into a general position, a special method of interpolation was used.

l) MARUSSI A.... - "Discussion on the 1967 reference ellipsoïd".
p.191-196.

...

m) LEDERSTEGER K. - "The range of validity of the equipotential ellipsoïd and its significant mass configurations".
p.201-203.

n) KASPAR J. - "On the method of determining the external gravity field on a limited territory".
p.226-241.

The paper discusses the possibilities of using transformation methods for solving problems related to the determination of the

figure of the Earth, of gravity and of equipotential surfaces external to the Earth. The author draws on the papers of Marussi and Hotine and he generalizes the ideas concerning the application of methods of representation, mentioned earlier.

The fundamental idea is the correspondence of two spaces, the "model" space, which approximates the Earth and its external gravity field in the usual way, and the real Earth space, which corresponds to its real shape and to the external gravity field.

With a view to the representation the model space is the original and the real Earth space is the image. It is assumed of the gravity field of the model space (the original) that it is known and, therefore, that the constants and invariants defining it are giveen, whereas the gravity field of the real Earth, i.e., the image space is to be found, so that its constants and invariants have to be determined from the measured quantities. For the approximation of the invariants one can use the corresponding quantities of the model field. In transforming the space it is also necessary to determine the constants and the invariants of the transformation equations.

The procedure for deriving the fundamental equations using methods of natural geometry will now be indicated.

o) BROVAR V.V. - "Determining the gravity potential by means of a force component in a constant direction".
p.242-250.

p) BROVAR V.V. & PHAM-HOANG LAN - "Computation of averaged gravity field characteristics".
p.250-254.

Strictly speaking, the observed gravity always represents some function of the region. The region, on which the observed gravity depends, is in most cases such that the gravity may be considered as constant in the said region, considering the accepted accuracy of observation. It is then possible to consider the gravity as observed in a point. As regards gravimetric surveys on ships and in aircraft, the region of observation is extended and the observed gravity represents a weighted mean of gravity along the route of the survey. In determing the orbital acceleration of artificial satellites, the characteristics of the gravity field, averaged over a section of the orbit, are also determined. The functions of the region represent the real phenomena more accurately than the functions of a point, and their computation should be of interest. The simplest approximation of the function of the region is the function of a point, averaged with a constant weight over the region. The averaging is the simplest if the region in

which it is to be carried out is considered to be section of a straight line $\overline{AB}$, 2L in length, the directional cosines of which are α, β and γ.

...

q) POPPE H. & M. TALWANI. - "Geoidal heights and gravimetric deflections". p.270. (Abstract).

r) TALWANI M. - "Regional gravity maps of oceanic areas". p.271. (Abstract).

200 - SEARLE R.C. - "A catalogue of gravity data from Kenya, to January 1969".
Dept. Geophys. & Planetary Physics, 88 p, Univ. Newcastle, 1970.

3.200 gravity observations in Kenya have been catalogued. These represent all the data available at January 1969 with the exception of a number of small-scale surveys. All the known surveys are described whether or not data from them have been included in the catalogue.

For each survey the investigator, area and purpose of the survey are given. The catalogue lists station coordinates, observed gravity, free-air and Bouguer anomalies. Terrain corrections are given where known. All gravity values have been reduced to the Overseas Geological Survey primary gravity net (see below). Bouguer anomalies were computed for a specific gravity of 2.67.

A Bouguer anomaly map of Kenya on a scale 1/2.000.000 has been prepared, incorporating all the available observations.

The values of the base stations are given in table 1 and have been taken from the paper, by Masson Smith and Andrews. They are based on :

$$g_{\text{Johannesburg}} = 9785495.0 \text{ g.u.}$$

The estimated error for any O.G.S. base station relative to Potsdam is $\pm$ 5.0 g.u.

201 - KURITA T. - "Crustal and upper mantle structure in Japan from amplitude and phase spectra of long-period P-waves. Part 2 : Kanto plain".
Sp. Contr. Geophys. Inst., n°9, p.137-166, Kyoto, Dec. 1969.

Crustal and upper mantle structure in the Kanto plain has been investigated by the same method as described in Part 1 of this paper. Taking the amplitude ratio of the vertical component to the horizontal one of long-period P-waves registered at Tsukua and the

phase difference between them, we obtain two observational curves related only to the structure beneath the Kanto plain. The curves for waves incident from almost due south are conspicuously different from those of the other directions, suggesting a difference in structure. Comparing seven sets of these curves corresponding to seven regions classified by the incident direction with the theoretical curves calculated by varying layer parameters of probable models derived so far from other studies we have obtained several models for each region. The most probable model has been selected on the assumption that the structure does not vary greatly with azimuth. This model has a crustal thickness of about 29 km and a thick 7.4 km/sec. intermediate layer as much as 20 km or more. A comparison of travel-time residuals at Tsukuba with those at Matsushiro has revealed that at Tsukuba P-wave arrivals from the south to southwest direction are as much as 1 second earlier than those from the south to southeast direction. This has been reduced to a higher velocity in the upper mantle under the southwest part of the Kanto plain, compared with the velocity under the southeast part.

202 - Comité National Français de Géodésie et Géophysique.
Comptes-rendus, Année 1969.
148 p, Paris, 1970.

203 - Association Internationale de Géodésie. - Bulletin Géodésique.
n°98, Paris, 1970.

...

a) DUFOUR H.M. - "Générations et applications des tableaux de variances des systèmes de moindres carrés".
p.309-340.

Nous avons voulu :
- D'une part, montrer comment on peut générer des tableaux de variance de systèmes géodésiques, par l'application de méthodes de bases déjà décrites ; l'originalité du présent article tient surtout à la systématisation de ces méthodes, dans leur application à des systèmes de grandes dimensions, et dans un essai de passage du discontinu au continu.
- D'autre part, indiquer le parti qu'on peut tirer de ces tableaux de variance :
  . Utilisation numérique comme tableaux inverseurs rigoureux ou approchés.
  . Utilisation plus qualitative pour étudier les corrélations de diverses grandeurs entre elles.

...

b) Symposium on Geodesy & Physics of the Earth.
On the occasion of the centenary of the foundation of the Potsdam Geodetic Institute in Potsdam. (from May 6th to 8th, 1970).
p.379-383.

c) BAUCH A. - I.A.G., I.A.P.S.O. International Symposium on Coastal Geodesy. (July 20 - July 24, 1970, Munich).
p.387-398.

d) JEFFREYS H. - "The Earth, its origin, history and physical constitution".
Revue des livres par P. MELCHIOR, p. 397 (Compte-rendu).

205 - Osser. Geof. Sper., Bollettino di Geofisica te appl.
v. XII, n°45-46, Trieste, Mars - Juin 1970.

a) NAUDY H. - "Automatic contouring of the total field and the vertical gradient".
p.123-136.

From the digital records of aeromagnetic data obtained from high sensitivity equipment, it is possible to draw automatically the total field and many transformed maps using total field measurements.

Among these maps, one is of special interest to geophysicists : the computed vertical gradient. The present paper shows the different steps involved in its computation. Many examples of the automatic contouring of the total field and vertical gradients attest to the considerable interest of this computation.

Obviously, such sophisticated data depend upon the quality of the measurements.

b) OTALA M. - "A new experimental gradiometer for aeromagnetic surveying".
p.137-147.

Gradient measurements are emerging as a new tool in high-resolution geomagnetic surveying. The lack of measuring instruments possessing at the same time the resolution, stability and the registration speed necessary for economical airborne gradient measurements has, however, hindered the use of this principle in truly large-scale surveying.

This paper describes the theory and construction of a new digital measuring apparatus for high-speed airborne vertical magnetic gradient registration.

The instrument uses a superconducting gradient sensor based on a newly discovered pair-tunnelling effect. The measured data are processed electronically and accumulated in a digital magnetic tape station, which is off-line connected to a digital computer for automatic plotting of the gradient map.

e) WILSON C.D.V. - "The use of the Poisson relationship for separating the anomalies due to neighbouring bodies, and for recognizing inhomogeneities and structural deformation".
p.158-183.

If, in a particular area, the gravity and vertical force magnetic fields are known to arise from two neighbouring bodies, of densities p1, p2 and magnetizations J1, J2, with directions m1 m2 respectively, it is shown that the magnetic (and the gravity) field can in principle be uniquely resolved by Poisson's theorem into the contributions arising from each body, provided that at least one of the inequalities m1 $\neq$ m2, p1/J1 $\neq$ p2/J2 is satisfied, and provided that the parameters p, J, m (regarded as contrasts with the other rocks) are known for each body.

Some special cases, where the computation is lightened, are of interest.

1) m1 = m2 but p1/J1 $\neq$ p2/J2. An example is given of a survey in Scotlant, where the fields, due to adjacent granite and gabbro bodies have been separated.

2) m1 = m2 and e.g. p1 = p2 but J1 $\neq$ J2. The two bodies are parts of the same mass, which has a non-uniform strength of magnetization.

3) m1 = m2 and e.g. J1 = 0 or p1 = 0. The two bodies are geologically separated, e.g. two neighbouring beds in a fold. This is a "mismatch" in which the direction m, as found by Poisson analysis may be in error.

4) p1 = p2, J1 = J2 but m1 $\neq$ m2. This is the case of deformation, where the two bodies are parts of the same mass, the remanent vector having been rotated in part of the mass.

In case 2 to 4 the properties may not be known in advance and synthetic examples are given, showing how Poisson analysis can be applied so as to enable some of these cases to be distinguished and some of the properties estimated.

d) LEVALLOIS J.J. - "Géodésie Générale".
t. 1 - Méthodes générales et techniques fondamentales.
t. 2 - Géodésie classique bidimensionnelle; et
(t. 3 - Le champ de la pesanteur)
Coll. Sc. I.G.N. : t.1, 402 p, Paris, 1970.
t.2, 408 p " "
(t.3, 436p) " "

Centre National pour l'Exploitation des Océans (C.N.E.X.O.)

206 - Bulletin d'Information, n°22, 22 p, Octobre 1970.

207 - " " n°23, 19 p, Novembre 1970.

208 - " " n°24, 26 p, Décembre 1970.

209 - Association Internationale de Géodésie.
Publication spéciale du Bulletin Géodésique : Geodetic Reference System 1967.
116 p, Paris, 1970.

Tables de l'ellipsoïde équipotentiel (système de référence géodésique 1967) donnant pour chaque latitude de 10' en 10' deg. (et 10' en 10' grade) :
- le rayon de courbure méridien, la grande normale,
- la longueur d'arc méridien et la valeur de la pesanteur.

Travaux effectués conformément au Voeu n°2 de l'A.I.G., Lucerne, 1967.

210 - Instituto Geografico y Catastral - "Red de observaciones con gravimetro en la Provincia de Santander".
36 p, Madrid, 1968.

Cartes d'anomalies de Bouguer et isostatiques (Airy 20 km et 30 km).

Liste de 506 mesures de pesanteur effectuées dans la Province de Santander.

211 - BILSKI E. - "Critical analysis of the geodynamical hypotheses".
Prace Nauk., Geod. n°5, 118 p, Politechnika Warszawska, 1969.

A critical analysis of the geodynamical hypotheses was made on the base of the observational data of the last decades of years. This analysis shows that now Staub's hypothesis, A. Wegener's hypothesis of the wanderings of the continents and H. Quiring's hypothesis of the eruptional formation of the Moon can not be taken

into account. On the other hand explanations of the system of the forces deforming the Earth crust given by all other hypothesis having mostly local meaning can be admited on the whole or partly.

In this article there is represented also some attempt of getting an understandable point of view on the problem of the formation and the development of the Earth on the base of Dirac's hypothesis of the gravitational constant decreasing and of author's suggestions of periodical changes of the gravitational constant. This last idea is expressed as the hypothesis of the gravitational pulsation.

Politechnika Warszawska, Prace Nauk.

212 - Geod. n°6, 53 p, Warszawa, 1969.
213 - Geod. n°7, 77 p, Warszawa, 1969.
214 - Geod. n°8, 78 p, Warszawa, 1970.

215 - Proc. Inst. Geod. & Cart., t XVII, Z.1/40, Warszawa, 1970.

a) BOKUN J., D. CHOWANSKA-OTYS, M. JEDRZEJEWSKA & M. MAJEWSKA. "A new method of determining the mean anomalies of gravity on a wide area, and its practical application". p.23-38.

In the Institute of Geodesy and Cartography a new method has been developed how to determine and calculate such mean values of gravimetric anomalies. By means of this method it is possible to take advantage of the most recent results of gravimetric surveys and thus to obtain for elementary surfaces, apart from the mean values of Faye's anomalies, at the same time also the mean values of Bouguer's anomalies for a constant density of the substratum.

The details of this new method are :

1) Determination for surfaces assumed to be elementary ($\Delta\varphi$ = 1'15", $\Delta\lambda$ = 1'52.5") their mean values of gravimetric anomaly, this anomaly presented by definite source material (mostly in the form of a gravimetric survey made for geological exploration purposes, in most cases determined in the form of isolines of Bouguer's anomalies) ; hence there is obtained the mean value of the source anomaly, i.e. in horizontal plane, and for the densities of the substratum assumed in this source material.

2) Introduction into the mean values of the source anomaly which values represent elementary surfaces, of corrections (δg) reducing to a uniform national standard of gravimetric reference, and of reductions which recalculate these values to the values of the Bouguer anomaly with its uniform constant density of the substratum σ. For these recalculations are used the mean altitudes a.s.l. for the elementary surfaces.

3) Calculations of the mean values of Faye's anomalies, these values representing elementary surfaces, on the basis of the results obtained from the above mentioned recalculations, and introduction of reductions in order to pass from Bouguer's anomalies to Faye's anomalies.

4) Using as basis the mean values thus obtained of the anomalies for the elementary areas, one can obtain the mean values of constant density of the Bouguer as well as the Faye anomalies, representing areas which are arbitrarily chosen multiplicities of the elementary area.

The ultimate form of presenting the mean values of gravimetric anomalies covering large areas can be a map ; the scale of the map depends on the extent of the size of the small areas for which these mean values are to be presented. At the rate how additional and more accurate results are obtained in the given area from gravimetric surveys, it will be a rapid and easy matter to exchange for any fragment of the investigated area previous data for new data.

b) JEDRZEJEWSKA M. - "An analysis of the accuracy of determination of mean values of gravity anomalies".
p.39-62.

When the interpretation given in 1) is applied, the accuracy of the mean value for a given area is defined, in accordance with the terminology introduced by Graff Hunter, by what is called the "error of representation" ; this error is expressed by Equation (14). Interpretation 3) leads to the appraisal of the mean value of the anomalies by means of the mean error of the arithmetic mean ; this error, in contrast to the error of representation, rapidly decreases parallel with the number of determinations making up the arithmetic mean, when the errors are distributed accidentally.

In consideration of the admissible interpretation mentioned above, the author has established her own procedure and has made an analysis of the accuracy with which mean values of Faye's and Bouguer's anomalies have been determined in the Institute of Geodesy and Cartography. In Poland this sort of determinations was made for the first time ; in it an original method has been applied for standardizing source data and in this method the mean values of anomalies are defined directly from the available source material and, afterwards, they are suitably reduced and recalculated in accordance with Equations (1) and (2).

The author indicates the errors made in the corrections for the uniform gravimetric level and the errors in reducing to constant densities σ (Errors of Group B) as defined by Equations (10) and (11), in Table 2 and in diagram 1. The errors referring to "source anomalies" presented in source maps (Error Group A) as defined by Equations (5), (7), (8), (9), are presented in Table 1.

Finally the combined influence of the errors of Groups A and B (Equations (3) and (4)) is indicated in Table 3 and by diagram 1.

Using as basis the above material for accuracy analyses one can now obtain accuracies of the determined mean values of anomalies for a variety of averaging areas and for the different interpretations of the mean values.

The author made a series of determinations of the mean values of the mean anomalies for interpretation 3). By making use of twice repeated independent measurements of gravity acceleration it became possible to indicate, partly at least, the influence exerted by systematic errors.

The values of the mean errors for an area of 1'15" x 1'52,5" and their multiplies are illustrated by the values given in Table 6, while their accidental or systematic distribution and the way how in such cases errors are transmitted, i.e. the differences of two independent determinations of mean anomalies, are listed in Tables 7 and 8.

216 - WYRZYKOWSKI T. & T. BARANOWSKA. - "The changes of heights of the precise levelling benchmarks in upper Silesia coal-basin, as determined by means of comparison of observations executed in 1967 with previous measurements".
Proc. Inst. Geod. & Cart., t. XVII, Z.2/41, p.39-64, Warszawa, 1970.

The paper describes the results of examining the movements of precise levelling benchmarks in Upper Silesia coal-basin.

The studies concern the benchmarks, located on so-called principal lines of the levelling net. The changes of heights of the benchmarks (Δ H) are determined on the base of successive measurements of the net, and on the points of connection assumed to be constant. Those points are situated on the peripheral line of the net.

The results obtained from the last comparison (1967-1957/58) as well as from the previous ones are discussed in chapter 4. The values of maximal lowerings of the benchmarks during the period 1967-1957/58 for individual lines and areas are given by the table 4. The table 5 contains the list of benchmarks for which the changes of heights proved greater ($\Delta H \leq -10$ cm, in any one of the considered periods).

The analysis of those materials points at the appearence of most considerable sinkings in the areas being under the influence of mining or situated in their proximity. Comparing the sinkings of a particular point during various periods, one can see that the values of those sinkings have sometimes a definite tendency to increase or to decrease.

217 - Komitet Geodezji Polskiej, Akad. Nauk.
Geod. i Kart., t. XIX, Z.4, p.250-316, Warszawa, 1970.

218 - Osser. Geof. Sper., Bollettino di Geofisica teor. appl.
v. XIII, n°47, Sept. 1970.

a) CAPUTO M., L. PIERI & M. UNGUENDOLI. - "Geometric investigation of the the subsidence in the Po Delta".

A short introduction to the enquiry regarding the movement of the soil and the zero reference elevations is followed by an historical analysis of subsidence in the area, and an enquiry into the reference bench marks and into the connections between the various levelling networks. References is then made to the statistical investigation, carried out by sampling, which shows that the levellation data collected is sufficiently accurate. An examination is then made of subsidence during the periods 1900-1957 and 1958-1968, and, as far as is practicable, the areas of the Delta and of the Lagoon of Venice are associated. The report conduds with an indication of a network that would make it possible effectively to continue the investigations during the next few years. Numerous tables illustrate the results obtained.

b) ECKER E. - "The convergence of a series of zonal harmonics".
p.225-233.

It is shown that series of zonal spherical harmonics $\sum a_n r^{n-1} P_n (\cos\vartheta)$ converge outside and diverge inside a sphere, called "sphere of convergence", the radius of which is given by : $\overline{\lim_{n\to\infty}}^{n} |a_n|$. The inverse result holds for $\sum a_n r^n P_n (\cos\vartheta)$.

c) GIORGETTI F. - "Attivita e pericolo sismico nella regione friuli Venezia Giulia".
p.234-240.

Earthquakes of the Friuli - Venezia Giulia Region have been analized in order to construct seismic activity and earthquakes risk maps.

d) GROTEN E. - "Gravity prediction and crustal structure".
p.241-249.

...

Problems arising in linear regression prediction of gravity using correlation of free air anomalies with elevation are discussed. Local variations of the regression coefficient in the Northern Alps are found to be, at least partly, remarkably big and systematic. Some geological aspects are outlined.

e) GROTEN E. - "Outline of alternative combination solutions in satellite orbit analysis".
p.250-255.

The use of surface gravity and astrogeodetic data (and gravity disturbances, respectively) for strengthening satellite determinations of the gravity field is outlined. Applications of the Poisson integral and of Helmert's coating layer are discussed.

220 - KINOSHITA W.T. - "A gravity survey of the Island of Hawaii".
Pacific Science, v.XIX, n°3, p.339-340, 1965.
Hawaiian Volcano Obs., Contr. n°196.

A Bouguer anomaly contour map, based on a gravity survey made on the island of Hawaii during parts of 1961 and 1962 is presented.

221 - KINOSHITA W.T. & R.T. OKAMURA. - "A gravity survey of the Island of Maui, Hawaii".
Pacific Science, v.XIX, n°3, p.341-342, 1965.
Hawaiian Volcano Obs., Contr. n°195.

A Bouguer anomaly contour map, based on gravity measurements made on the island of Maui during February 1962, is presented. The table of principal facts is reported elsewhere (Hawaii Inst. Geoph., 1965, Table 2).

222 - MOORE J.G. & H. KRIVOY. - "A reconnaissance gravity survey of the Island of Molokai, Hawaii".
Pacific Science, v.XIX, n°3, p.343-345, 1965.
Hawaiian Volcano Obs., Contr. n°198.

A Bouguer gravity map was prepared for the island from gravity measurements from 72 stations. The table of principal facts is reported elsewhere (Hawaii Inst. Geoph, 1965, Table 3). As with gravity surveys of the island of Hawaii (Kinoshita et al., 1963), a density of 2.3 g/cc was used for the Bouguer corrections. No systematic tidal, drift, or terrain corrections have been made.

223 - KRIVOY H.L., M. BAKER & E. MOE. - "A reconnaissance gravity survey of the Island of Kauai, Hawaii".
Pacific Science, v. XIX, p.354-358, 1965.
Hawaiian Volcano Obs., Contr. n°197.

A large Bouguer anomaly on Kauai, similar to anomalies found at most of the other major volcanoes of the Hawaiian Islands, lies about 10 miles east of the caldera indicated by geologic mapping. Another gravity high suggests a second center of volcanism just west of the island.

Average Bouguer values on Kauai are higher than on other Hawaiian islands, indicating either that the crust beneath Kauai is 1 - 2 km thinner than it is beneath the eastern part of the Hawaiian Chain, or that the zone of increased density in the dike complex lies closer to the surface at Kauai than do similar cores within other islands of the chain".

224 - KRIVOY H.L. - "A gravity survey of the Island of Niihau, Hawaii".
Pacific Sciences, v.XIX, n°3, p.359-360, 1965.
Hawaiian Volcano Obs., Contr. n°194.

Gravity data collected on Niihau support geologic evidence that the island is an erosional remnant of a dead shield volcano whose center of volcanism was just east of the present Niihau highlands. Bathymetric and gravity evidence offer clues to a genetic link between Niihau and west Kauai ; onshore gravity suggests a continuous Bouguer high connecting the two regions. This link would be in accord with ocean-bottom topography, which shows a prominent ridge rising above sea level at Niihau and at Kaula Rock to the west.

225 - WALCOTT R.I. - "Flexural rigidity, thickness, and viscosity of the lithosphere".
J. Geophys. Res. v.75, n°20, p.3941-3953, 1970.
Earth Physics Branch, Contr. n°311, Ottawa.

The Earth's lithosphere and asthenosphere are modeled as a thin elastic sheet and a fluid substratum, respectively ; the physical principles involved are briefly described. The flexural rigidity of the lithosphere is deduced from observations of the wavelength and amplitude of bending in the vicinity of supercrustal loads. Data from Lake Bonneville given by M.D. Crittenden, Jr., are reinterpreted to give a value for the flexural rigidity of the lithosphere in the Basin and Range province of the western United States of 5×10^{22} Newton meters. Observations of loading in Canada give values for the flexural rigidity of greater than 3×10^{23} N m for the Caribou Mountains in Northern Alberta ; about 4×10^{23} N m

for the topography over the Interior Plains ; about 10^{23} N m for the Boothia uplift in arctic Canada ; and about 10^{23} N m for the bending of the beaches of Pleistocene Lakes Agassiz and Algonquin. The flexure of the lithosphere at Hawaii and the bending of the oceanic lithosphere near island arcs give values of about 2 x 10^{23} N m. For short-term loads (10^3 - 10^4 years) the flexural rigidity of the continental lithosphere is almost two orders of magnitude larger than for long-term loads, indicating nonelastic behavior of the lithosphere with a viscous (about 10^{23} N sec m^{-2}) as well as an elastic response to stress. From the values of the flexural rigidity, the thickness of the continental lithosphere is inferred to be about 110 km and that of the oceanic lithosphere about 75 km or more. The anomalously low flexural rigidity of the lithosphere of the Basin and Range province may be due to a very thin lithosphere, only about 20 km thick, with hot, lower crustal material acting as an asthenosphere.

226 - WALCOTT R.I. - "Flexure of the lithosphere at Hawaii".
Tectonophysics, n°9, p.435-446, 1970.
Earth Physics Branch, Contr. n°308, Ottawa.

The hypothesis that the Hawaiian Deep and Arch (or Rise) are produced by the elastic flexure of the lithosphere under the load of the volcanic rocks of the Hawaiian Ridge is quantitatively examined. Although a similar pattern of flexure is produced by a loaded unbroken lithosphere the calculated amplitudes of displacement are less than half those observed. However, a lithosphere fractured along the line of the ridge will bend to match the morphology of the structure both in wavelength and amplitude and will also explain the displacement of the Moho and the observed gravity field. The flexural rigidity of the lithosphere inferred from the best fit model is about 10^{30} dyne· cm.

227 - NIBLETT E.R. & K. WHITHAM. - "Multi-disciplinary studies of geomagnetic variation anomalies in the Canadian Arctic".
J. Geomagnetism & Geoelectricity, v.22, n°1/2, p.99-111, 1970.
Dom. Obs., Contr. n°289, Ottawa.

Recent work on prominent magnetic variation anomalies in Canada is reviewed. The first of these is on Ellesmere Island in the Arctic Archipelago, and results from magnetic and magnetotelluric data collected in 1967 are presented. Anomalous effects, i.e., an abnormally high level of magnetic activity coupled with a persistent tendency for the horizontal variations vector to be restricted to a single direction appear to be confined to a narrow zone nearly 500 km long stretching between Alert on the north coast and

Eureka on the west. Recent data indicate that the strength of the anomaly is not uniform along its strike, but is somewhat diminished in the central and southern portions. The main features of the anomaly have been explained by postulating the presence of a long narrow conducting body located in the lower part of the crust. The existence of such a conductor would provide a natural channel for currents induced over a much broader area. It may also imply an abrupt upheaval of isotherms underneath Ellesmere Island. Available surface wave dispersion and heat flow information in the Ellesmere Island area will be discussed : the evidence supporting a thermal explanation for the geomagnetic anomaly is unconvincing but still ambiguous.

The Mould Bay anomaly is located in the eastern part of the Arctic Archipelago and is known to extend over large portions of Prince Patrick and Melville Islands. Over this area shorter period fluctuations in the vertical component are very strongly attenuated. The presence of a massive conducting layer deep in the crust is postulated to explain the effect. Seismic, heat flow and gravity data are available in this area, but no clear relation to the geomagnetic anomaly has been found.

229 - SOWERBUTTS W.T.C. - "Crustal structure of the East African Plateau and Rift Valleys from gravity measurements".
Nature, v.223, n°5202, p.50-53, 1969.

This article presents an east-west profile across the Rift System at latitude about 3°S and considers three structural models that would account for the observed gravity anomalies.

The profile extends from the Congo Basin to the Indian Ocean, crossing the Western Rift south of Lake Kivu, the East African Plateau south of Lake Victoria and the Eastern Rift between Moshi and Lake Eyasi. The Western Rift south of Lake Kivu is a graben about 50 km wide, largely obscured by sediment fill and recent volcanics. The Eastern Rift in central Kenya is a well-defined graben about 50 km wide bounded by two sets of opposing normal faults which tend to split up and diverge on passing southwards into Tanzania, so that at latitude 3°S the Eastern Rift is a zone of block faulting and tilting about 250 km wide.

230 - SOBCZAK L.W. & G.J. TAYLOR. - "Results of a differential omega test in the Mackenzie River Delta".
Geophys., v.XXXI, n°3, p.514-520, 1970.
Earth Physics Branch, Contr. n°309, Ottawa.

231 - WALCOTT R.I. - "An isostatic origin for basement uplifts".
Canadian J. Earth Sciences, n°7, p.931-937, 1970.
Contr. Earth Physics Branch n°307, Ottawa.

The tectonics involved in the structural development of uplifts in the stable platforms are suggested to be a natural consequence of loading the platform by sedimentary rocks. Any original compensated topography on the platform will cause differential loading with sediments thicker and the load greater in the valleys than over the hills. If the wavelength of topography is large, differential vertical movements can occur causing an amplification of the original topography and the growth of an arch. If the wavelength lies in a critical region defined by the flexural rigidity of the lithosphere, stress differences within the lithosphere caused by the loading may exceed the elastic limit producing faulting and the development of horsts. The Boothia Uplift, the Early and Middle Paleozoic development of the Peace River Uplift and other structures in Canada are suggested to be examples of such a process.

232 - O.R.S.T.O.M. - Cahiers n°10,
Série Géophysique, 46 p, Mai 1970.

233 - WELSCH W. - "Eine Programm in ALGOL 60 zur Transformation geodätischer geographischer Koordinaten".

234 - EHLERT D. - "Rechenprogramme zur Ausgleichung grosser Dreiecksnetze".
D.G.K., Reihe C : Dissert., H.n°140, 99 S, Frankfurt, 1970.

Seit ungefähr zwei Jahren befasst sich der Verfasser mit der Ausgleichung des westdeutschen Anteiles an der europäischen Hauptnetztriangulationen (RETrig). Der Mangel an Personal und die Gefahr von Rechenfehlern waren für den Entschluss massgebend, auf manuelle Rechenarbeiten vollständig zu verzichten und die wesentlichen Teile des Arbeitsablaufes auf einen Rechenautomaten zu verlegen. Während die Daten mit Hilfe eines mittelgrossen Rechners aufbereitet werden Konnten, liess sich die Ausgleichung selbst nur an einer grossen Anlage durchführen.

Es zeigte sich bald, dass programmtechnisch die Ausgleichung kontinentaler Dreiecksnetze nur unwesentlich schwieriger zu beherrschen war als die ohnehin gegplante Ausgleichung des westdeutschen Anteiles am RETrig. Die Rechenprogramme wurden deshalb sofort so gestaltet, dass sie auch die Bearbeitung sehr grosser Netze gestatten.

Im folgenden werden die Gesichtspunkte und Forderungen, die für die Gestaltung der Programme massgebend ware, dargelegt und der Uberblick über den Ablauf einer Grossausgleichung gegeben.

235 - NEUGEBAUER G. - "Entwurf einer Geomorphologischen Ubersichtskarte des westlichen Mitteleuropa 1 : 1 Million".
D.G.K., Reihe C : Dissert., H.n°148, 117 S, Frankfurt, 1970.

237 - GRAFAREND E. - "Die Genauigkeit eines Punktes im mehrdimensionalen EUKLIDischen Raum".
D.G.K., Reihe C : Dissert., H.n°153, 77 S, München, 1970.

Point accuracy of Euclidean multivariate statistics is analyzed by cybernetics, entropy, information and group invariant theory (Hilbert theorems) and stochastic processing. For vector functions and vector functionals a generalized error propagation theorem is derived within the concept of local and nonlocal field theories. Basis point errors are found from invariant theory equal the number of dimensions, corresponding in two dimensions as trace of the rank two error tensor to the Helmert Point error (1868) and as determinant to the Werkmeister point error (1920), identical with the Wilks generalized variance (1932). By the fundamental Hilbert theorem each rational invariant can be calculated from the basis invariants. Former difficulties in generalizing two dimensional point errors to three dimensional space are solved. Different strategies in minimizing these point errors are exampled.

242 - MATHER R.S. - "The Australian geodetic datum in Earth Space".
Univ. New South Wales, Unisurv., Rep. n°19, 124 p, Kensington, 1970.

The Australian Geodetic Datum is defined, together with a review of the relationship existing between a complete gravimetric solution and the Earth's geocentre. Working formulae are derived for practical computation. It is shown that only the Free Air Geoid need be considered to provide a geocentric orientation of the Australian Geodetic Datum with a precision equivalent to that of the data set currently available. A consistent representation of the gravity anomaly field is used in the computation of the 1970 Free Air Geoid for Australia and the geocentric orientation parameters, obtained either by comparisons at the corners of a one degree grid or by detailed investigations at thirty-eight well-spaced astrogeodetic stations, are in substantial agreement. The required parameters at the Johnston Origin of the

Australian Geodetic Datum are :

$$\Delta\xi_0 = -4.2 \pm 0.2 \text{ sec}$$
$$\Delta\eta_0 = -4.5 \pm 0.2 \text{ sec}$$
$$\Delta N_0 = +7.2 \pm 0.2 \text{ metres}$$

The error estimate in the last parameter assumes that no significant errors exist in zonal harmonics of degree n and order one ($n<5$) in the representation of the Earth's gravity field which cannot be detected over the 2 % of the Earth's surface area included in the present study. The consequent error is unlikely to exceed $\pm$ 3 metres on current estimates of the accuracy of low degree harmonic coefficients.

243 - WESSON P.S. - "The position against continental drift". Quarterly J., R. Astr. Soc., v.11, n°4, p.312-340, 1970.

An attempt has been made to correlate some of the data which do not fit into the continental drift hypothesis, and to find alternative hypotheses. These include the classical polar wandering and expanding Earth hypotheses, with a generalization of the former, with suggestions concerning instability of the geomagnetic field.

While the paper is essentially a review, implications from all fields have been considered, especially boundary conditions imposed by planetary formation, and hypotheses which have probably escaped geophysics as a whole (e.g. cosmology). The position against drift is analysed in five main sections dealing with classical drift evidence, global palaeomagnetism and polar wandering, palaeomagnetic correlations, convection currents, and sea-floor spreading...

Drift is found to be inadequate by itself to account for geophysical data, and may well be mechanically impossible.

244 - Geophysics, v.35, n°5, Oct. 1970.

a) WOLD R.J., T.L. WOODZICK & N.A. OSTENSO. - "Structure of the Beaufort sea continental margin". p.849-861.

An airlifted gravity survey was conducted in 1968 in the Beaufort Sea between Barter Island and Banks Island, south into the Mackenzie River Delta area and northward to about 74° latitude. The 1968 gravity data were combined with data from previous airlifted surveys and ice island T-3.

The major feature of the free-air anomaly gravity map of this area is a more or less continuous 100 mgal high paralleling the coast from Barrow, Alaska, to the edge of the survey area north of Banks Island. The gravity high is explained by a thinning of the crust and a ridge in the basement rocks at about the 200 m isobath. This linear anomaly is broken by saddles off the Colville, Mackenzie, and Bernard Rivers, which are interpreted to reflect sedimentary fans built by the discharge of these rivers.

Two-dimensional crustal models constructed from gravity profiles indicate a narrow transition zone from ocean to continental crustal thickness, 55 km to 100 km shoreward of the 2000 m isobath. In a review of continental margin structure, Worzel (1968) found the transition zone to be centered under the 2000 m isobath. The departure from "normal" in the Beaufort Sea area may be explained by a greater accumulation of sediments seaward of the "structural" continental margins. This accumulation implies a faster rate of sedimentation and/or a greater age for the Beaufort Sea continental margins than for those analyzed by Worzel.

b..e) Compte-Rendu p.934,
from : Exploration Geophysics, v. 47, New-York.

b) ABASHIDZE V.G. - "Thermal effects in GAK quartz gravimeters".

The author describes laboratory and field investigations concerning the effects of temperature variations on the displacement of the null point of the GAK gravimeters.

c) NOVOSELITSKII V.M. - "Construction of a density boundary from gravity anomalies".

The author discusses the various aspects of the determination of a model on a computer in the interpretation of gravity surveys. He demonstrates the convergence of the successive approximation approach used by Strakhov to determine the higher derivatives of potential fields. He also discusses the problems created by analytical representations of tabulated data, approximations, and lack of absolutely accurate anomalies.

d) BEREZHNAYA L.T. & M.A. TELEPIN. - "Determination of density from gravimetric data".

The authors describe a computational scheme for deriving density profiles from gravity profiles using the spectral method.

e) BEREZKIN V.M. & A.P. BUKETOV. - "The use of harmonic analysis in determining the density of an intermediate layer".

The authors describe a method of determining the density to use for surface corrections directly from the gravity data by representing both the Bouguer anomalies and the relief of the profile in Fourier series. They mention the importance of using a proper regional assumption (removal) in determining the accuracy of the density determination.

f) CORNELISON B., E.G. MILLIS & F. E. ROMBERG. - "Material flow gravity meter".
C.R. p. 935, Patent abstract.

A gravity measuring system including a vessel with upper and lower storage chambers communicating at an orifice. Fluid granular material is disposed in the upper chamber with the orifice closed. The time interval required for all of the granular material to flow through the orifice is measured and is a measure of the gravity.

245 - Netherlands Geodetic Commission,
Pub. on Geod., v.3, n°3, Delft, 1969.

a) Van BOECKEL J. - "Regional gravity survey of Northern Surinam".
p.10-52.

The aim of this monograph is to present the results of the regional gravity survey in northern Surinam. The contents of this report are divided into two parts. The first part contains a description of the gravity measurements. The second part explores the interpretational aspects of the gravity field in northern Surinam. This chapter first gives a brief account of the Surinam geology. Before passing on to the interpretation of the broader scale phenomena of the gravity field, it then continues with the examination of two small scale anomalies (near Dramhoso and Afobaka). As the gravity field in northern Surinam is dominated by a belt of intensly negative anomalies, the main part of the interpretation in chapter two is specifically devoted to the explanation of this prominent gravity deficit. Finally, the positive deviations of the gravity field in western Surinam are discussed in relation to the basement configuration of the Corantijn Basin.

For this report the author used those parts of his doctorate thesis (1968) which are relevant to the regional gravity survey of northern Surinam as such. For a more comprehensive treatment of the

gravity field of Surinam, in particular as regards its correlation with the geomagnetic investigations in Surinam, the reader is referred to the original thesis, which also discusses the method of interpretation applied here in more detail.

Tables of Free-Air and Bouguer anomalies for 439 stations, and Bouguer anomalies maps.

b) LAGAAY R.A. - "Gravity anomalies in the Netherlands Leeward Islands Area".
p.53-77.

In 1962 a gravimetric and geomagnetic survey was carried out in the Netherlands Leeward Islands Aruba, Bonnaire and Curaçao and in 1964-1965 this survey was extended to the sea surrounding these islands. The following is a summary of the gravity results described more fully in : Geophysical Investigations of the Netherlands Leeward Antilles by R.A. Lagaay, 1969.

Tables 1, 2 and 3 contain for each island :

1. Station number
2. Latitude
3. Longitude
4. Station height in metres
5. Free-air anomaly
6. Bouguer anomaly, including topographic corrections for the zones A - 0_2.
7. Isostatic anomaly (T = 30, R = 0).

The anomalies are given with regard to normal gravity values according to Cassinis' formulae.

Table 4 contains :

1. Indication of profile
2. Latitude
3. Longitude
4. Seadepth in metres
5. Free-air anomaly
6. Bouguer anomaly, including topographic corrections for the zones A-0_2
7. Isostatic anomaly (T = 30, R = 0)
8. Effect of topography, zones A-0_2
9. Local Airy reduction, effect of compensation, zones A-0_2, T = 30
10. Local Airy reduction, effects of topography and compensation, zones 18-1, T = 30.

247 - BABUSKA V. - "Elastic anisotropy of the upper mantle and the Mohorovicic discontinuity".
Ceskosl. Akad. Studia Geophys. & Geod., v.14, n°3, p.296-309, Praha, 1970.

248 - Ceskosl. Akad. Studia Geophys. & Geod., v.14, n°4, Praha, 1970.

a) MORITZ H. - "A generalized least-squares model.
p.353-362.

At the Symposium on Physical Geodesy in Prague, September 1969, I Presented a paper "A general theory of gravity processing". In the meantime I recognized that the underlying mathematical structure is really quite general : it can be applied to other geodetic problems as well. Furthermore, after writing this paper, the outstanding publication by Krarup came to my attention. By following an idea in this publication, it was possible to formulate the above mathematical structure within the context of least-squares adjustment, which resulted in a different and simpler deduction. These considerations will be the subject of the present paper.

An interpolation method is given for the case in which a function consisting of a systematic and a random part is to be estimated from measurements affected by errors. This is a combined problem of parameter estimation, filtering and prediction, which has applications in different fields of geodesy and gravimetry. The solution of the problem is derived from a least-squares principle, it is formally very similar to a general case of least-squares adjustment.

b) BURSA M. - "The differences in structure of the gravity field and the figure of the Earth in the northern and southern hemispheres".
p.363-375.

It was shown (see above n°188c, p.II-2) that the flattening of parallel sections of the geoid ($\varnothing$ = const.) differs in the northern and southern hemispheres. This leads up to the idea of studying further the size and shape of the Earth and the structure of the gravity field separately for the northern and for the southern hemispheres. In this paper attention is devoted especially to the mean values of the radius-vectors, to the best fitting ellipsoid parameters and to the mean values of gravity for the whole hemispheres, on the one hand, and for their $\varnothing$ = const. sections, on the other. The symbols used are the same as in n°188c.

249 - WOODSIDE J. & C. BOWIN. - "Gravity anomalies and inferred crustal structure in the Eastern Mediterranean Sea".
Geol. Soc. America, Bull. v.81, p.1107-1122, 1970.

Gravity data in the eastern Mediterranean area have been compiled from Woods Hole Oceanographic cruises of the R/V Chain in 1964 and 1966, and supplemented by other shipboard and land measurements.

Over most of the area, free-air anomalies are negative and Bouguer anomalies are consistently lower, by 50 to 100 mgal, than in the western Mediterranean. Broad negative free-air anomalies (-80 to -240 mgal) and low positive Bouguer anomalies (0 to 80 mgal) follow an arcuate zone, concave northward, south of Crete from western Greece to the Rhodes abyssal plain. Relatively high anomalies (free-air anomaly as high as -60 mgal and Bouguer anomaly of +100 to +140 mgal) centered over the Anaximander seamounts separate the arcuate low south of Crete from a similar trend south of Cyprus that gradually becomes less distinct toward northern Syria. Cyprus is characterized by free-air anomalies greater than 100 mgal, Bouguer anomalies of from +100 to +250 mgal, and some of the world's largest positive isostatic anomalies (as great as +173 mgal). A crustalstructure model was constructed for a profile south from Turkey, approximately along long. 31°E., toward Egypt. The simulated structure showed a range in depth to the top of the mantle from 23 km beneath the outer margin of the Nile Cone to 34 km beneath the axis of the Mediterranean Ridge. A free-air anomaly gradient of about -1.2 mgal/Km to the north over the southern margin of the Mediterranean Ridge corresponds to a downward slope on the crust-mantle interface of about 7° to the north. The thickening of the crust by almost 50 per cent north of 34°N, is interpreted as largely due to underthrusting of Mediterranean crust beneath Cyprus, the Anaximander Mountains, and Turkey. A concomitant thick accumulation of sediment may have further downwarped the crust beneath the Mediterranean Ridge.

255 - Bulletin of the Geographical Survey Institute, v.XV, Part 1, Tokyo, 1969.

a) HAYASHI T. - "A study on the vertical movements of the Earth's crust by means of the precise leveling".
p.1-69.

b) FUJII Y. - "Relation between maximum vertical displacements of the crust and magnitudes of earthquakes and its application to the problem of earthquake prediction".
p.69-91.

Maximum vertical displacement of the crust is defined as the largest vertical displacement in the anomalously deformed part of the crust accompanied by earthquake neglecting the sign of it, and a relation between these values h and magnitudes of earthquakes M is investigated using the data from 23 earthquakes.

Bureau de Recherches Géologiques et Minières

Cartes gravimétriques de la France, échelle : 1/80.000°, densité : 2,3, Paris, 1971.

n° 69 - Nancy
n° 99 - Langres
n°113 - Gray
n°114 - Montbeliard

260 - WORLD DATA CENTER A. - Gravity, tsunami, seismology, longitude and latitude, meteorology.
Catalogue of data, received by WDC.A during the period 1 July 1957 - 31 December 1970, 63 p, Washington, 1971.

261 - WORLD DATA CENTER A. - Rockets and satellites.
Catalogue of data, 1 July - 31 December 1970, 124 p, Washington, 1971.

262 - GARLAND G.P. - Chronique de l'Union Géodésique et Géophysique Internationale.
n°81, p.129-192, Paris, Décembre 1970.

Centre National pour l'Exploitation des Océans (C.N.E.X.O.)

263 - Bulletin d'Information n°25, 20 p, Paris, Janvier 1971.
264 - " " n°26, 27 p, Paris, Février 1971.
265 - " " n°27, 16 p, Paris, Mars 1971.

266 - GIBB R.A. & R.K. McCONNELL. - "Gravity measurements in Northern Ontario with maps :

n°25 - Moosonee
n°28 - Kowkash-Martin Falls
n°29 - Pickle Crow-Armstrong
n°30 - Wunnumin Lake
n°31 - Attawapiskat
n°32 - Akimiski Island
n°33 - Winisk River
n°34 - Severn River
n°35 - Cape Tatnam
n°36 - Henrietta-Maria".

Gravity map series, Earth Physics Branch, Dept. Energy, Mines & Resources, 10 p, Ottawa, 1970.

A total of 3,241 gravity stations, observed by the Dominion Observatory in the period 1949-1965, was used to compile ten Bouguer anomaly maps (1/500.000° scale) of northern Ontario. The major negative anomalies in the area are the Patricia Low which outlines an area of multiple intrusions of granite and the Niskibi River Low whose source is also considered to be intrusive granite. Major positive anomalies are underlain by the Cape Henrietta-Maria basement arch in the Hydson Bay Lowlands and the Kapuskasing Belt, an ancient zone of probable crustal rifting.

267 - WALCOTT R.I. & J.B. BOYD. - "The gravity field of Northern Alberta and part of northwest territories and Saskatchewan with maps :

n°103 - Lac la Biche - Peter Pond.
n°104 - Whitecourt - Athabasca.
n°105 - Grande Prairie
n°106 - Peace River
n°107 - Wabasca River
n°108 - Fort Vermilion
n°109 - Hay Lake
n°110 - Providence
n°111 - Great Slave Lake

Gravity map series, Earth Physics Branch, Dept. Energy, Mines & Resources, 13 p, Ottawa, 1971.

The report area covers National Topographic System sheets 85 S.E. and S.W., all of 84, 83°N.E. and N.W. and 73°N.W. and includes northern Alberta, part of Saskatchewan and a southern part of the Northwest Territories. The major anomaly of the report area is that related to the Rocky Mountains and is largely, if not entirely, due to the isostatic compensation for the load of the mountains. Other major anomalies are the Fond du Lac and Trout Mountain lows and that associated with the MacDonald Fault. Bouguer density profiling at Peace River, Alberta gives a Bouguer density for the Cretaceous rocks of 2.20 $\pm$.05 g/cm^3.

268 - SOBCZAK L.W. & J.R. WEBER. - "Gravity measurements over the Queen Elizabeth Islands and polar continental margin with maps :

n°115 - Queen Elizabeth Islands (East)
n°116 - Queen Elizabeth Islands (West)
(scale : 1/1.000.000°)

Gravity map series. Earth Physics Branch, Dept.Energy, Mines & Resources, 14 p, Ottawa, 1970.

The Dominion Observatory has made about 8.800 gravity measurements over the Queen Elizabeth Islands and Arctic Ocean between 1960-1968. Measurements were made both on land and on the sea-ice of the ocean and inter-island areas.

The Bouguer anomaly field shows that negative anomalies occur over sedimentary basins and mountainous areas, positive anomalies occur along moderately folded regions and large positive anomalies occur over the ocean. With the exception of the anomalies over the ocean and mountainous regions, the anomalies correlate well with
1) changes in lithologies of Paleozoic and Precambrian rocks,
2) evaporite and basic rocks, and
3) changes in thicknesses of clastic and carbonate sediments.

The Archipelago region west of 90°W longitude has a mean elevation of 15 m and an average Bouguer anomaly of 6 mgal and appears to be in isostatic equilibrium. This suggests that the large thickness (10 km) of clastic sediments is compensated.

269 - STACEY R.A. & J.P. STEELE. - "Geophysical measurements in British Columbia with maps :
n° 120 - Strait of Georgia
n° 121 - Juan de Fuca Strait.
(scale : 1/250.000°)

Gravity map series. Earth Physics Branch, Dept. Energy, Mines & Resources, 17 p, Ottawa, 1970.

Bathymetric, gravity and magnetic measurements are presented for the Strait of Georgia between Vancouver Island and the mainland of British Columbia, and for Juan de Fuca Strait between Vancouver Island and Washington, U.S.A. It has been concluded from the bathymetric data for the Strait of Georgia that most of the submarine topography dates from the Pleistocene epoch, although some of the larger channels may correspond to important faults which are probably older than Pleistocene. The majority of the Strait appears to be underlain by Cretaceous - Tertiary sediments concealed beneath a veneer of glacial debris. Below the Cretaceous - Tertiary sediments on the Vancouver Island side of the Strait are the largely volcanic sequences of Mesozoic age typical of the Island, and below the sediments on the mainland side of the Strait are plutonic rocks typical of the Coast Mountains complex. The boundary between the volcanic sequences and the plutonic rocks is marked by a prominent magnetic gradient along the centre of the Strait, and corresponds to a submarine topographic feature which suggests that a fault has been active since the early Tertiary. In the Juan de Fuca region, the geophysical evidence indicates that the east-west faults on Vancouver Island may extend across the continental shelf at the

western end of the area and may have controlled the formation of the Juan de Fuca submarine canyon. A minor fault along the axis of the Strait can be inferred from submarine geology, but this cannot easily be related to the major crustal change indicated by the gravity results.

270 - STEPHENS L.E., A.K. GOODACRE & R.V. COOPER. - "Results of underwater gravity surveys over the Nova Scotia continental shelf with map n°123 : Halifax-Burgeo". (Scale : 1/1.000.000°)
Gravity map series. Earth Physics Branch, Dept. Energy, Mines & Resources, 9 p, Ottawa, 1971.

During the summer of 1970, 692 underwater gravity stations were established on the Atlantic continental shelf of Canada. The areas surveyed include the Laurentian Channel, Cabot Strait, and parts of Saint Pierre Bank and the Scotia Shelf. Stations were located on a 15 km grid and detailed profiles were made across the Orpheus anomaly and across a diapiric structure north of Sable Island. During three cruises of the CNAV Sackville, Decca and radar were used as primary navigation aids.

The gravity data are presented as a Bouguer anomaly map. The anomalies generally strike in an easterly direction across the continental shelf. The dominant feature is the linear Orpheus anomaly which extends 250 km eastwards from Chedabucto Bay and is flanked to both north and south by positive anomalies. The Orpheus anomaly is probably caused by Carboniferous and younger sedimentary rocks whereon both flanking anomalies appear to be related to Proterozoic metavolcanic rocks with interspersed Devonian basic intrusions. A broad negative anomaly south of the Orpheus anomaly is probably underlain by a Devonian granite batholith. Between the Miquelon Islands and Cape Breton Island, a broad arcuate positive anomaly partly coincides with a Carboniferous basin delineated by seismic surveys. This high is attributed to dense, shallow structures within the pre-Carboniferous basement. The Laurentian Channel is a major structural feature which displaces and distorts the dominant easterly trends of several linear anomalies including the Orpheus anomaly.

273 - KNEISSL M. - "Karl LEDERSTEGER zum 70. Geburstag".
D.G.K., Reihe E : Geschichte & Entwicklung der Geod., H.n°13, 20 S, München, 1970.

275 - MINATO M. & M. HUNAHASHI. - "Origin of the Earth's crust and its evolution".
J. Faculty Sci. Hokkaido Univ., Ser. IV, Geol. & Mineral.
v. XIX, n°4, p.515-561, Sapporo, 1970.

The granitic rocks including migmatite, gneiss and palingenetic plutonics found in the axial core of the representative orogenic belts such as the Abean and Hidaka belts in Japan are now believed to have been originally geosynclinal deposits reformed by syn-orogenic igneous activities in a wide sense. From the author's own observation in the course of mapping in the respective fields above mentioned in Japan, and based on laboratory works, the authors now stand to accept a theory of granitization in making up granitic crust through orogenic process.

From various sources of geological information, the authors now stand to accept the existence of horizontal movement of the crust and repeated reformation of the crust in various ways in the geologic past, even though the details of the authors view may not be entirely as similar as the hypotheses of the continental drifting and ocean floor spreading.

276 - PAVONI N. - "Gesteinsmagnetische Untersuchungen in der Zone von Ivrea NW von Brissago".
Schweiz Mineral. & Petrogr. Mitteilungen, Band. 48, H.1,
S.295-296, Zurich, 1968.

It is shown that the magnetic anomaly W of Locarno, between the Centovalli and the Lago Maggiore is caused by the magnetization of the basic rocks, gabbrodiorites and diorites, of the Zone of Ivrea. These rocks show natural remanent magnetization of 300 - 1300 γ and reversible volume susceptibility of 0,5 x 10^{-3} to 10 x 10^{-3}.

277 - D.G.K., Reihe E, n°12, Veröff, Geod. Inst., n°18, Aachen, 1970.

a) LOSCHNER F. - "Helmert's Entwicklung und Bedeutung als Lehrer der Praktischen Geometrie".
S.3-14.

b) WOLF H. - "Die wissenschaftliche Ausstrahlung Helmert's in die Gegenwart".
S.15-31.

278 - LELGEMANN D. - "Untersuchungen zu einer genaueren Lösung des Problems von Stokes".
D.G.K., Reihe C : Dissert., H.n°155, 30 S, München, 1970.

- Einleitung
- Lösung der Integralgleichung des Störpotentials.
- Geoidundulation und Lotabweichungskomponenten.
- Ein Testbeispiel.
- Der mittlere quadratische Fehler der sphärischen. Approximation. Anwendungen auf das Störpotential der Erde.
- Vergleich mit den Lösungen von Sagrebin und Molodenskii.

279 - MONGET J.M. - "A new statistical treatment of gravity data".
B.G.I. & Centre Morphologie Mathématique, 24 p, Paris, 1970.

This paper presents the new linear estimation method of G. MATHERON, based on the concept of minimum variance. The important point is that it takes into account the regional trend, called "drift" in the present text. It is always of great interest, particularly in the case of interpolation of Bouguer anomalies.

The stress is also put on the structural use of the semi-variogram in the Earth Sciences. This new function is simply related to the well-known covariance function.

An illustrative application in automatic contouring is given.

280 - COMMISSION GEODESIQUE SUISSE - Procès-verbal de la 116ème séance tenue au Bernerhof à Berne le 23 Mai 1970.
Sté Helvétique Sci. Nat., 64 p, 1971 .

281 - BARLIK M. - "Quelques problèmes de la théorie de Bjerhammar".
Komitet Geod. Polskiej. Akad., Nauk., Geod. i Kart., t.XX, Z.1, p.3-18, 1971.

C'est un exposé de principes sur lesquels A. BJERHAMMAR a fondé son étude du champ de gravitation externe de la Terre. La déduction des formules et les propositions initiales de la théorie de Bjerhammar ont été analysées. De même, on a soumis à l'analyse les résultats d'application de la réduction des anomalies de gravité, du système de hauteurs théoriques et de déviations de la verticale, à la réduction des observations et à l'étude de la figure de la Terre.

282 - JOURNEL A. - "Rapport d'études sur l'estimation d'une variable régionalisée. Application à la cartographie automatique". Centre Morphologie Mathématique Fontainebleau, Thèse, 130 p, 1970.

Automatiser la reconnaissance d'une régionalisation c'est automatiser toutes les étapes d'une connaissance qui va de l'observation (relevé de données) jusqu'à l'exploitation recherchée, qui peut être par exemple la :

- visualisation d'une surface par cartographie.

Dans tous les cas d'exemples pratiques, les données effectives sont insuffisantes. Pour aboutir à l'exploitation recherchée il faudra à partir de ces données partielles induire un modèle, c'est-à-dire une représentation globale d'une réalité partiellement révélée. Ce modèle pourra servir lui-même à l'exploitation envisagée, ou fournir des estimations de la variable en des zones non reconnues. Ce qui revient à multiplier sans frais les données effectives.

283 - OBENSON G.F.T. - "Direct evaluation of the Earth's gravity anomaly field from orbital analysis of artificial Earth satellites". AFCRL-70-0201, Rep. n°129, Sci. Rep. n°3, 135 p, Columbus, 1970.

The equations of motion of an artificial Earth satellite are derived in terms of gravity anomalies. In practice, an adjustment using these equations should give more correct values for the gravity anomalies.

To check the adjustment equations derived, a set of 184 15° x 15° equal area mean gravity anomalies, together with the coordinates of some ground stations and Keplerian elements of certain satellites were assumed correct. Satellite orbits were generated, their positions being given by topocentric right ascension, declination, and range, assuming their motion to be affected only by the Earth's gravitational potential. Errors were introduced into the assumed correct elements, new orbits were generated and an adjustment was done to recover the introduced errors.

Two solutions to recover the input anomaly errors were done. In the first solution, only the errors around perigee for geocentric satellite heights less than 8000 km were properly recovered. An analysis of the second solution showed that assuming 10 mgals as the maximum acceptable difference between the input and recovered errors, 102 of the 184 anomaly errors were properly recovered. The rms value of the residuals from these 102 errors was $\pm$ 5.7 mgals.

Taking the results in general together with the statistical tests made and the satisfactory recovery of the input errors of other elements besides anomalies, this method of directly evaluating gravity anomalies by analyzing satellite orbits can be regarded as feasible.

284 - RAPP R.H. - "A general combination of satellite and gravity data for position and gravity field determinations".
AFCRL-70-0343, Rep. n°133, Sci. Rep. n°6, 25 p, Columbus, 1970.

This report is concerned with the combination of terrestrial information and satellite information for the determination of geocentric station positions alone, or geocentric station positions and gravitational potential coefficients. The method uses terrestrial information such as astronomic latitude and longitude, gravimetrically derived deflections of the vertical and height anomalies, with an adopted reference figure to define a geocentric position. The satellite data will include geocentric station positions and potential coefficients. The two models formed in this paper use a datum shift vector as the intermediate quantity. All equations for the necessary computations are made with no numerical results being obtained at this time.

285 - MEISSL P. - "Probabilistic error analysis of airborne gravimetry".
AFCRL-70-0396, Rep. n°138, Sci. Rep. n°8, 103 p, Columbus, 1970.

An error analysis based on second order stochastic process theory is performed for airborne gravimetry. Only gravimetry in the traditional sense is considered as opposed to gravity-gradient methods. Stochastic error models are developed and computer programs for the final formulas have been written. Sample computations indicate that gravity averages over about 100 km may be seriously affected by undetected variations in height, velocity, and azimuth, as well as by deviations from the optimal filter due to lack of knowledge about the medium frequent portion of the power spectra of gravity variation and noise.

286 - BROWN D. - "Near term prospects for positional accuracies of 0.1 to 1.0 meters from satellite geodesy".
AFCRL-70-0501, Final Rep., 92 p, Bedford, 1970.

An investigation is made into four specific approaches to geodetic positioning that hold promise for improvements in accuracies by an order of magnitude over accuracies to be expected from the geodetic satellite programs of the 1960's.

287 - EHLERT D. - "Rechenprogramme für die Ausgleichung kleiner Dreiecksnetze".
D.G.K., Reihe B : Angew. Geod., H. n°176, 143 p, Frankfurt, 1970.

Les programmes pour la "Compensation de petits réseaux de triangulation" sont présentés, décrits et expliqués au moyen d'exemples de calcul. Il s'agit de programmes auxiliaires du groupe de la "Compensation de réseaux de triangulation" destinés à rendre possible les calculs de contrôle et la vérification des poids affectés aux observations. Ils permettent la compensation de petits réseaux de triangulation comprenant un maximum de 85 points nouveaux. Il est admis d'observer des directions libres de corrélation, des azimuths de Laplace et des distances. Les coordonnées des points du réseau peuvent être reliées l'une à l'autre par des équations conditionnelles linéaires.

290 - GOSTOLI J. - "Etude et construction d'un dispositif d'asservissement pour un gravimètre LaCoste - Romberg.
Enregistrement numérique de la marée gravimétrique".
Fac. Sci., Univ. Strasbourg, Thèse, 76 p, 1970.

291 - MITWALLI M.A. - "Interpretation of the low gravity anomaly in NE Kordofan, Western Sudan".
Boll. Geof., Teor. Appl., v. XI, n°41-42, p.119-126, 1969.

A gravity survey in the NE part of the Kordofan Province in Western Sudan revealed the presence of a large negative anomaly. This anomaly is associated with a rift valley feature, which is postulated to relate with East rift pattern.

The total anomaly consist of two main components : one due to infilling sediments of the depression, and the other due to the rifting action on the rocks of the shield. Five profiles are interpreted to calculate the thickness of the sediments ; a model for the rift feature is also presented.

292 - MITWALLI M.A. - "Interpretation of some gravity profiles from Western Sudan".
Pure & Applied Geophys., v.80, n°III, p.184-192, 1970.

Gravimetrically determined stations in the province of Kordofan, Western Sudan, are interpreted. Boreholes and surface geology are employed, and a Gier Algol print-plot programme has been used. The interpretation shows that the granite mass increases in average thickness from 2000 m in the west to about 20000 m in the east. A dyke-like pattern of gneisses and schists is observed.