ASSOCIATION INTERNATIONALE DE GÉODÉSIE

BUREAU GRAVIMÉTRIQUE INTERNATIONAL

N° 22

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RECTIFICATIF CONCERNANT LES CARTES DE MESURES EN MER

(Bull. Inf. n°22, Mars 1970, Hors-texte)

MER DE NORVEGE

Carte récapitulative et cartes détaillées n°3 et 4.

"Des erreurs se sont glissées dans le report des zones levées par le Service Hydrographique de la Marine en mer de Norvège ; les cartes doivent être corrigées conformément à la carte ci-après p.I-4 (A).

Les résultats définitifs correspondants ont été publiés dans les Cahiers Océanographiques du 1er Mai 1970".

MER D'IRLANDE

Carte détaillée n°7.

Les travaux de l'Université de Birmingham au Sud de la Mer d'Irlande qui avaient été omis ont été indiqués sur la carte ci-après p.I-4 (B).

Information reportée sur carte 7

MER D'ARABIE

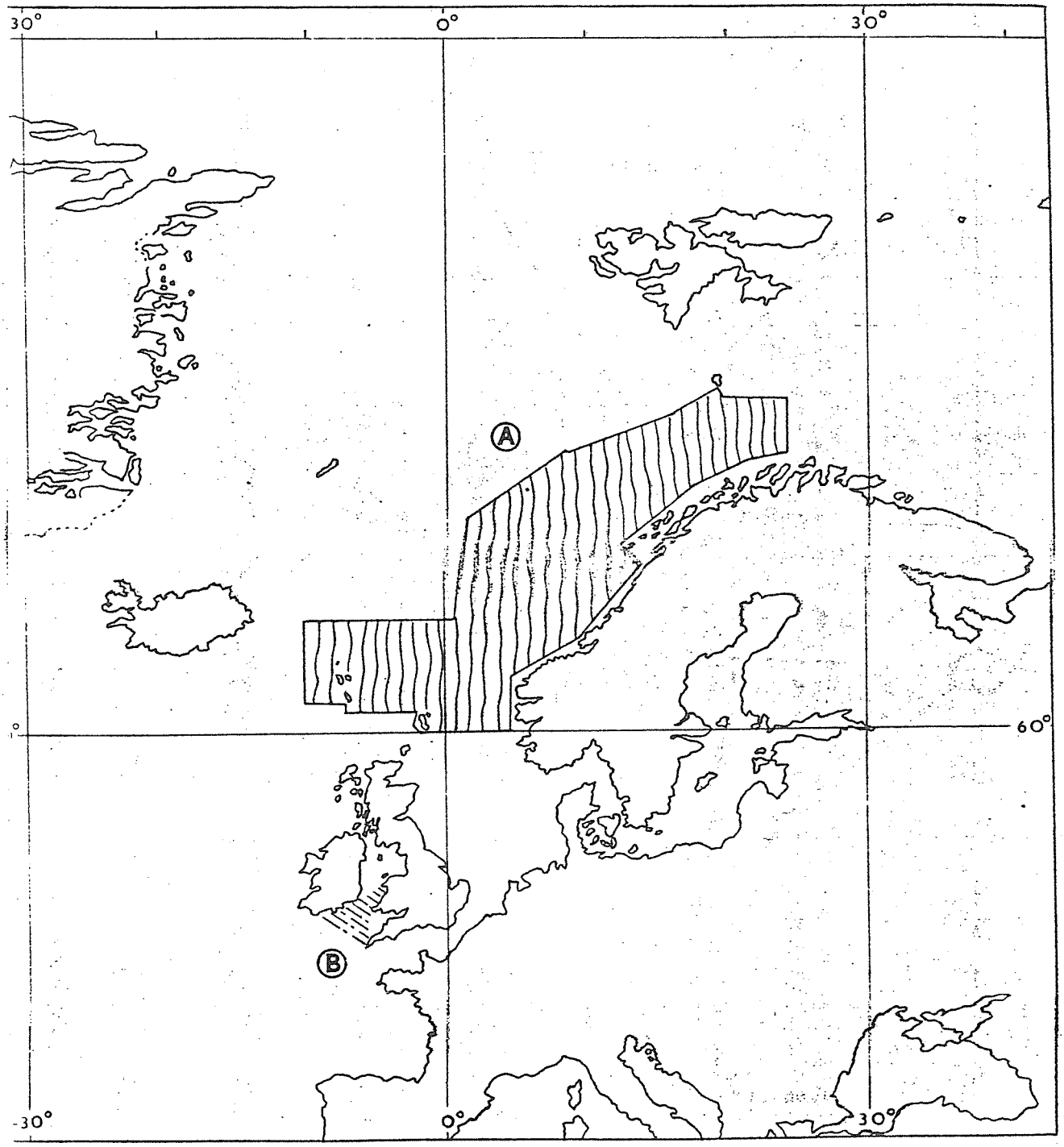
Carte récapitulative.

Les trajets effectués par l'Université de Cambridge (R.R.S. Discovery, Cruise 16) dans l'Océan Indien ont été rectifiés. (Voir la carte p.I-5).

~~Océan Pacifique~~ ~~Côte ouest du Canada~~

~~Carte récapitulative~~

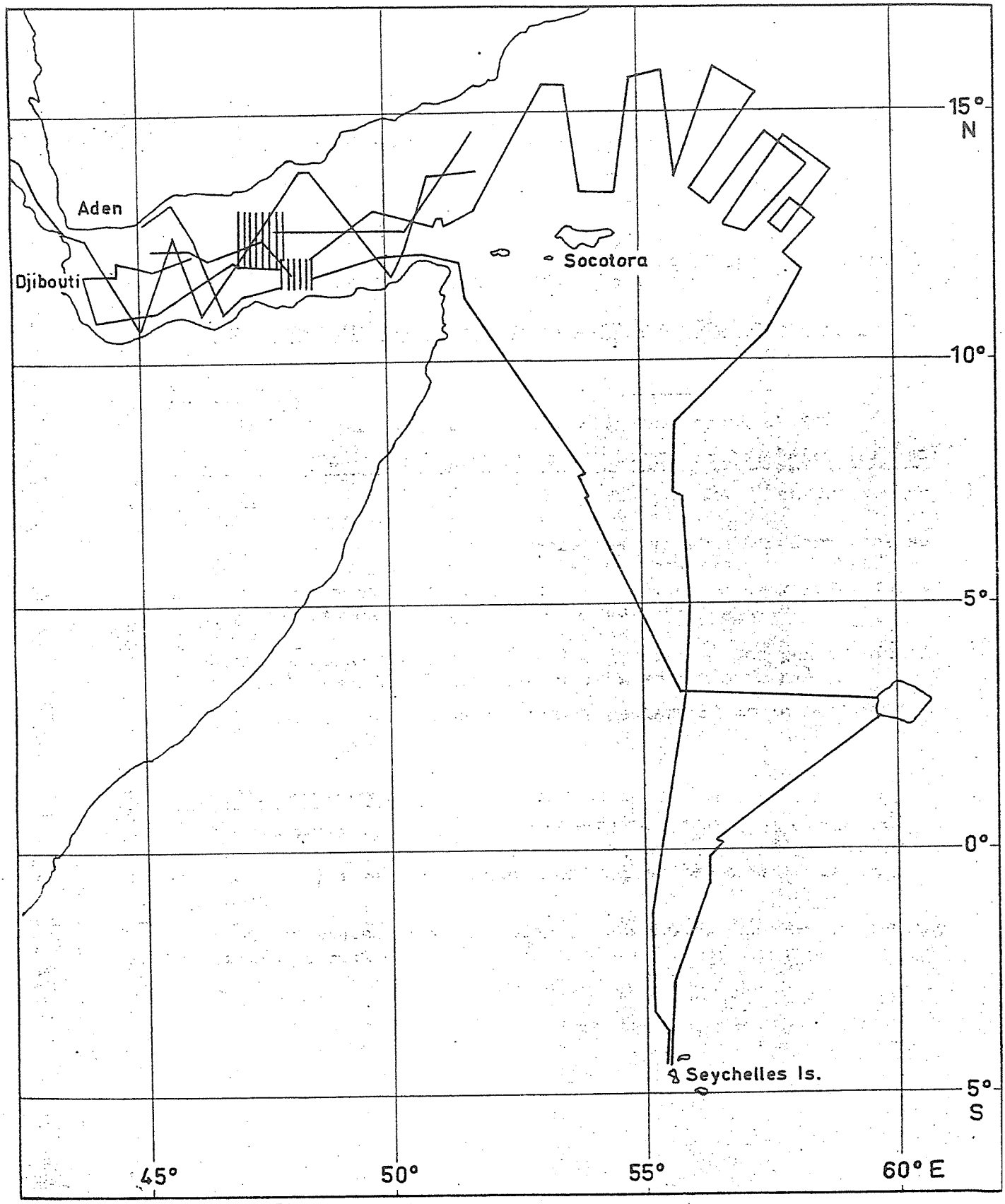
~~Une erreur s'est glissée dans le report de la surface prospectée par "Earth Physics Branch, Dominion Observatory". Les campagnes ne couvrent pas toute la surface indiquée~~



Ⓐ = SERVICE HYDROGRAPHIQUE de la MARINE (France)

Ⓑ = UNIVERSITY of BIRMINGHAM (Great-Britain)

UNIVERSITY of CAMBRIDGE



R.R.S. DISCOVERY

Cruise 16, Indian Ocean - January-May 1967

B U R E A U G R A V I M E T R I Q U E

I N T E R N A T I O N A L

Paris

-=-=-=-=-=-=-

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

Mars 1970

N°22

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- II -

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(Octobre à Décembre 1969, Janvier à Février 1970)
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- I -

1) COMMISSION GRAVIMETRIQUE INTERNATIONALE

Comme il a été dit dans le Bulletin d'Information n°21, la réunion de la Commission Gravimétrique Internationale se tiendra du 7 au 12 Septembre 1970, à Paris :

INSTITUT D'ASTROPHYSIQUE
98, Boulevard Arago
PARIS (XIVème)

En réponse à la circulaire de Décembre 1969, les suggestions suivantes ont été envoyées au B.G.I. :

- BARTA G. (Hungary)
  . In order to estimate the possible secular variation of the gravitational field it should be necessary to determinate the size and depth of the masses causing anomalies of the geoid. It would also be needed to separate the masses taking place in great depths, presumably in the Earth's core which, are able to cause quick/secular/variations from invariable/ or only during geological ages variable/masses to be found in the crust and mantle.

- BENZINEB B. & B. BORTAL (Tunisie)
. Extension du réseau gravimétrique mondial en Afrique du Nord.

- COLOMBO O.J.H. (Argentina)
. Gravity profiles and maps.

- ELSTNER C. (German Democratic Republic)
. On the variations of amplitudes and phase difference of two pendulums swinging on the same support.

- GOGUEL J. (France)
. La question essentielle à débattre sera de dresser un plan préliminaire pour l'établissement de bases absolues avec l'appareil Sakuma transportable, ou tout autre équivalent.

- HONKASALO T. (Finland)
. Measurement of secular tilting of the plumb line with a long pipe level.

- McCAHAN A.L. (U.S.A.)
. Discussion on standardization of procedures for reduction of shipboard gravity data.

- MORELLI C. (Italie)
. Couverture gravimétrique mondiale.
. Nouveaux éléments par mesures des satellites.
. Le champ gravimétrique de la lune.

- OKUDA T. (Japan)
. To make clear the problem concerning "Secular variation of gravity" it is requested that absolute measurement of gravity with sufficient accuracy should be carried out at the principal stations in the First Order Network.

- PETTERSON L. (Sweden)
. Discussion on computation and use of the terrain correction.

- STOYKO N. (France)
. Variation séculaire de la pesanteur par les mesures absolues.

- VOGEL A. (Sweden)
. Limitations of secular variations of gravity.

- WILLIAMS O.W. (U.S.A.)
. Combine any potential discussion of helicopter gravimetry under airborne gravity measurements.
. Include a new item. A discussion of unique (non-conventional) or novel applications of gravimetry and gravimetric instrumentation.

- I -

2) MESURES ABSOLUES DE LA PESANTEUR

A - Derniers résultats au Bureau International des Poids et Mesures, Sèvres

Pour la première fois le gravimètre absolu est en marche continuellement depuis sept mois et on obtient les résultats suivants au point de mesure A2 :

g_{A2} = 9,809 256 657	±	0,000 000 054	(Août - Sept. 1969)
g_{A2} = 708	±	106	(Oct. - Nov. 1969)
g_{A2} = 755	±	058	(2/2 Décembre 1969)
g_{A2} = 770	±	090	(1/2 Janvier 1970)

(A. SAKUMA, Janvier 1970)

B - Résultats de l'équipe FALLER (Wesleyan University) - Liaison intercontinentale.

Après avoir mesuré l'intensité de la pesanteur au N.B.S. (Gaithersburg) et au N.P.L. (Teddington), J.E. Faller, professeur à la Wesleyan University (Conn., U.S.A.), et deux de ses collaborateurs sont arrivés à Sèvres le 25 Juillet 1968 avec leur gravimètre absolu. Ce gravimètre utilise la chute libre dans le vide, sur environ 1m, d'un miroir trièdre trirectangle ; les distances parcourues sont mesurées par comptage de franges d'interférence ; la source de lumière est un laser He-Ne stabilisé. L'appareil a été installé sur le pilier "Sèvres , point A" par J.E. Faller et son équipe ; il y est resté jusqu'au 4 Août 1968. Les mesures ont porté sur environ 3 000 chutes. La réduction des observations a pu être faite au fur et à mesure sur l'ordinateur du Bureau (après traduction du programme)...

Cette expérience a assuré pour la première fois la liaison gravimétrique entre les continents américain et européen avec un instrument absolu ; elle a permis aussi la comparaison la plus directe qui soit entre deux gravimètres absolus différents.

Le résultat provisoire des mesures de J.E. Faller donne pour "Sèvres A", la valeur 9,809 259 5 ± 0,000 001 m/s^2, alors que la valeur que nous avons obtenue en août-septembre 1968, ramenée à "Sèvres A", donne 9,809 259 64 ± 0,000 000 19m/s^2.

(Procès-Verbaux du C.I.P.M., p.50, 1968).

Les résultats obtenus aux deux stations Sèvres et Teddington sont :

Sèvres, point A	980 925,95 ± 0,1 mgal
British Fundamental station (BFS)	981 181,86 ± 0,1 mgal (981 181,75 ± 0,13 mgal par Cook 1967)
Point A - BFS	- 255,91 mgal (- 255,71 mgal par Cook et Morelli).

Ces résultats ont été obtenus après une correction de - 0,03 mgal pour la diminution de longueur d'onde du laser, due à l'effet Doppler, suite à mon conseil.

(A. SAKUMA, Février 1969, d'après la lettre de J.A. HAMMOND, Wesleyan University).

C - Un nouvel appareil portatif pour mesurer la valeur absolue de la pesanteur est en cours de réalisation en France (Laboratoire central de Thomson-CSF).

L'article cité à la fin de la bibliographie (p.II-31, n°42) de LACOMBAT M. & G. PIRCHER , donne quelques détails relatifs à cet appareil.

- I -

3) MESURES EN MER

En Octobre 1969, le B.G.I. a envoyé une circulaire relative aux nouvelles mesures gravimétriques en mer.

Il remercie tous les Services qui ont donné des informations ; celles-ci ont permis de compléter la carte récapitulative :

SEA GRAVITY MEASUREMENTS, parue en Novembre 1966 (B.I. 14).

Les nouveaux tracés sont portés en rouge sur la carte récapitulative placée à la fin de ce Bulletin.

Comme cette carte est trop chargée en certains endroits*, des cartes à plus grande échelle ont été établies pour les régions suivantes :

- Atlantique Nord n°3 et 4,
- Atlantique Centre n°7.

A - CARTE RECAPITULATIVE

La carte est établie sur un fond publié par l'Admiralty, London (Index of Plotting Areas n°5330 ; equatorial scale : 1/36.000.000°).

Les données de la première édition ont été conservées en noir, elles comprennent :

- les mesures pendulaires individuelles en sous-marin,
- les mesures continues au gravimètre sur bateau de surface, (y compris les mesures près des côtes dans les océans).

On a différencié les emplacements des mesures pendulaires et les profils continus des mesures au gravimètre, par Nation (ou Grand Service). Dans le cas où plusieurs Nations ont participé à la même croisière, on a conservé la différenciation de l'organisme principal mais la participation des autres Services a été indiquée dans le texte.

* les nouvelles mesures étant partiellement indiquées,

Les compléments apportés à la première édition apparaissent en rouge et comprennent :

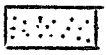
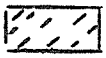
- Les mesures effectuées dans les mers intérieures (Mer Baltique, Mer du Nord, Mer Méditerranée...) qui ne figuraient pas dans la première édition.

- Les anciennes mesures pendulaires (Mer des Barents, région des Canaries...) qui avaient été omises dans la première édition.

- Les mesures récentes (surface-ship) y compris les mesures effectuées avec un gravimètre posé sur le fond (sea bottom).

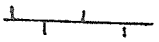
Un tableau récapitulatif des différents travaux permet d'identifier le tracé des profils gravimétriques, l'organisme qui les a effectués et la source d'information.

A T L A N T I C O C E A N

Region of gravity traverse	Organization		Reference
Rio de la Plata, 1966	Argentina		B.I.14, p.I-14
Hudson Bay Superior, Huron, Erie, Ontario Lakes Arctic Ocean St-Lawrence's Bay	Canada	- - - - - -	INNES, 13.11.69
St-Lawrence's Bay Grand Banks of Newfoundland Mid-Atlantic Ridge Newfoundland-Lesser Antillas	Canada	- - - - - -	HAYWORTH, 25.11.69
West of Greenland, 1967	Denmark		ANDERSEN, 6.1.67
Denmark - Iceland, 1968		.	ANDERSEN, 24.10.69
Skagerrak, 1965-66		—·· — ··—	ANDERSEN, 1966
Hamburg-Recife (Brazil) 1965	D.F.R.		B.I.16, 193
North Atlantic, 1966			B.I.16, 194
D.F.R.- Iceland		— ·· —	ROLL, 24.11.69
D.F.R. ⟶ West Afr. coasts 29°N (10°-30°W.G.)			ROLL, 24.11.69
Barents Sea, 1956	Finland	*	HONKASALO, 1962
Golfe de Gascogne, 1964	France		S.H.M., 17.2.70
Mer de Norvège, 1965-67			
Brest-Toulon, 1969 Golfe de Gascogne, 1969 Brest ⟶ 9°W.G., 1969 Brest-St-John's-Mer du Labrador-Açores-Lisbonne-Brest, 1969.	France	.....	SIBUET, 11.3.70

*Erratum :
This same sign has been used for SPAIN on the detailed map n°7.

South Coast of Ireland Southern Irish Sea	G.B.		DAVEY, 22.10.69
Gibraltar-South of Dakar Norway-Greenland-W. Iceland North Sea Irish Sea Ireland ⟶ 37°W.G.	G.B.	— · — · —	THOMAS, 17.11.69
Between Faeroes, Shetlands and Scotland Between Iceland and Faeroes Off the coast of Ireland	G.B.	— · — · —	BOTT, 23.12.69
Plymouth to 47°N-15°W.G. Off N.W. and S. of Ireland Great-Britain - Azores France (Britany)-W. Spain to Gibraltar	G.B.	— · — · —	WILLIAMS, 27.11.69
N. Atlantic off G.B., 1938-1946	G.B.	⊙	BROWNE & COOPER, 1950
North Sea, 1955	Nether.	◑	COLLETTE, B.I. mai 60, p.32
Atlantic Ocean, 1923-38	Nether.	○	VENING MEINESZ, 1948
Coasts of Surinam	Nether.	— — — —	BRUINS, 19.12.69
Norwegian Sea, 1957-58	Norway	▩	BAKKELID, B.I. mai 60, p.26
Between Canary Islands and Cap Vert Isl., 1962.	Spain	⊛	INST.GEOG.CAT., 1962

W. European and African coasts Denmark - Iceland E.S. American coasts Various surveys between N. Amer., Europe, Africa and South America	U.R.S.S.		BOULANGER, 28.11.69
Atlantic Ocean, 1936-59	U.S.A.		WORZEL, 1965
Gulf of Mexico, 1960-62	U.S.A.		Geophys., v.XXX, n°1
N. Atl. and Gulf of Mexico	U.S.A.		BOWIN, 12.12.69
Spitzberg-Norwegian coasts Iceland Iceland-Greenland-Canada N. Atl.-Dakar-S. Africa E. Atl.- Gul of Mexico W. of S. Amer. coasts Brazil - Capetown	U.S.A.		TALWANI, 26.11.69

P A C I F I C O C E A N

Region of gravity traverse	Organization		Reference
N.W. Canadian coast	Canada	≡≡≡	INNES, 13.11.69
Japan Sea	Japan	—/—/—/—	KAWAKAMI, 23.12.69
Around Japan Japan - Indonesia - W. Australia Kerguelen - Argentina - Antarctic and New Zealand	Japan	—/—/—/—	TOMODA, Nov. 69 B.I.16, p.II-4.
Japan - Aleoutians Japan-Hawaii-Solomon Is. Japon-Indonesia-Australia	Japan	—/—/—/—	TOMODA, Nov. 69
Japan - Solomon Is. E. Australia - New Zealand	Japan	—/—/—/—	B.I.16, p.II-5.
Australia - Antarctic New Zealand	Japan	—/—/—/—	B.I.16, p.II-6.
Japan - Hawaii Aleoutians, 1966	Japan	—/—/—/—	B.I.16, p.II-7.
Japan-Philippines, 1965	Japan	—/—/—/—	B.I.16, p.II-7.
Japan-Fidji-Society Isl. Hawaii - Japan W. S. American coasts	U.R.S.S.	┴┴┴┴	BOULANGER, 28.11.69
Aleoutians - Hawaii Aleoutians - Indonesia Hawaii - Australia Australia-Tasmania-N.Zealand W.USA-Fidji-Australia Chilian coasts ⟶ 90°W.G.	U.S.A.	———	TALWANI, 26.11.69

I N D I A N O C E A N

Region of gravity traverse	Organization	Reference
Timor Sea, 1967 1968	Australia	PRIOR, 9.1.70
Arabian Sea	G.B.	WILLIAMS, 27.11.69
Indonesia - W. Australia Japan - Malaisia - Ceylan-Kenya W. Australia - S. Africa Australia - Antarctic	U.S.A.	TALWANI, 26.11.69

C O N T I N E N T A L S E A S

Baltic Sea	Finland	HONKASALO, 1962
Black Sea	U.S.A.	BOWIN, 12.12.69
Mediterranean Sea	France	CNEXO, pub. CH01
	G.B.	WILLIAMS, 27.11.69
	Italy	OSSER. GEOF. SPER. Boll.Geof.v.X, n°32 Juin 1968
	U.S.A.	TALWANI, 26.11.69
	U.S.A.	BOWIN, 12.12.69
Red Sea	G.B.	WILLIAMS, 27.11.69
	Italy	MORELLI, 1962
	U.S.A.	TALWANI, 26.11.69
	U.S.A.	BOWIN, 27.11.69
Skagerrak	Denmark	ANDERSEN, B.I.16, 191

B - CARTES DETAILLEES N° 3, 4 et 7

Les fonds ont été faits à partir des Cartes Mondiales en 12 feuilles, projection de Mercator, échelle environ 1/14.800.000° à l'équateur, et réduits. Les feuilles 3, 4 et 7 sont placées à la fin de ce Bulletin ; elles couvrent l'Atlantique Nord.

Toutes les observations de pesanteur connues à ce jour ont été reportées :

- mesures par points (points pendulaires, gravimètre posé sur le fond). Dans les régions où les trajets sont nombreux les points n'ont pas été représentés,

- mesures à la surface,

- mesures dans les mers intérieures.

Le B.G.I. envisage de tenir à jour les 12 feuilles et d'envoyer à tous les organismes intéressés un tirage, grand format, afin de leur demander leur accord sur le report des tracés avant de présenter ces cartes à la réunion de la Commission Gravimétrique Internationale.

3) C - DETAIL DES INFORMATIONS RECENTES

ALLEMAGNE

Deutsches Hydrographisches Institut, Hamburg (D.H.I.)

1) Expédition Atlantique 1965 "Meteor" du 10.8.65 au 16.12.65

Le parcours suivi a été approximativement : Hambourg, Les Açores, le long du méridien 30°W.G., jusqu'à Récife (Amérique du Sud), en passant par Anker station et Fernando de Noronha.

Le retour s'est effectué approximativement le long du méridien 20°W.G. (avec un rattachement à Dakar).

(B.I.16, 193) *

2) Expédition Atlantique 1966 "Meteor", du 23.4.1966 au 9.7.1966.

Comprend les trajets suivants, approximativement :
- Profil E.W. le long des parallèles 52°-54°N de Hambourg au milieu de l'Atlantique (35°W.G.).
- Profils nombreux entre 33°5[illegible] - 36°35 W.G., 54° - 57°N.
- Profil aller et retour jusqu'en Islande.
- Profil W.E., vers les parallèles 57° - 58° jusqu'au Nord de l'Ecosse.

(B.I.16, 194)

3) Expédition Atlantique Nord, entre Hambourg et l'Islande.

"Shaded areas (see maps) indicate surveys of 3 to 12 miles spacing of the gravity profiles.

It is planned to continue the three-miles-spaced survey of the Iceland-Faeroes-Ridge in 1970."

(H.U. ROLL, 24.11.69)

* B.I.16, 193 : Bull. Inf. n°16, référence bibliographique n°193.

Bundesanstalt für Bodenforschung, Hannover (B.f.B.)

Cet organisme a effectué des mesures dans l'Atlantique Est
- Un relevé le long des côtes, de Hambourg à Casablanca.
- Des profil s détaillés autour du parallèle 29°, depuis la côte africaine jusqu'à 30°W.G. (Voir cartes).

Note :

"To complete this information, may it be mentioned that B.f.B. participated in the "Cruise Concrete" with S.S. "Aragonese" of SACLANT ASW Research Center, La Spezia, from October to December 1961. On this cruise in the Mediterranean sea (B.I. 14, 147) and Red Sea (B.I. 14, 172), gravity measurements were carried out also by the Osservatorio Geofisico Sperimentale, Trieste."

(H.U. ROLL, 24.11.69)

ARGENTINE

Facultad de Ingenieria y Servicio de Hidrografia Naval

Les mesures effectuées sur la plateforme sous-marine dans la Mer de la Plata (1963-64) qui avaient été simplement citées dans le Bull. Inf. n°14, p.I-14, ont été indiquées sur la Carte Générale.

AUSTRALIE

Dept. of Nat. Dev., Bureau of Mineral Resources, Geology and Geophysics

"There have been two B.M.R. gravity surveys completed on the N.W. coast of Australia since the 1965 Bonaparte Gulf Survey marked on your map". The northern part of the Timor Sea was performed in 1967 and the southern one in 1968.

(L.S. PRIOR, 9.1.70)

CANADA

Dominion Observatory, Ottawa.

"The greater part of our work at sea has been making measurements on the sea floor using underwater gravimeters and on the frozen surface of the Arctic Ocean using conventional lang gravimeters. The observatory has carried out only one survey off the west coast using ship borne gravimeters".

(M.J.S. INNES, 13.11.69)

- Arctic Ocean
  - 2 regions : 70° - 80° latitude, 95° - 140°W.G.
    82° - 84° " , 50° - 61°W.G.
  - at the pole and vicinity = 89° - 90° latitude : 30 measurements
  - along the traverse (60° meridian) to the pole : 20 "

- Pacific Ocean
  - Traverse along the West coast of Canada (53° - 57°), bottom and sea-surface measurements.

- The Hudson Bay
  - See details (Bull. Inf. n°22, p.II-14, n°470)
    (sea-bottom measurements)

- The Superior, Huron, Erie and Ontario lakes.

- The Gulf of St-Lawrence (sea bottom measurements).

(See maps)

Bedford Institute, Atlantic Oceanographic Laboratory (A.O.L., B.I.)

1) Tracks performed between 1966 and 1970.

"Apart from the few tracks in transit, our coverage has been mainly concentrated in three areas :
- The Gulf of St-Lawrence
- The Grand Banks of Newfoundland
- The Mid-Atlantic Ridge

within the outlines of the solid red line, gravity coverage has been made at a line spacing of generally 2 miles or less (up to 5 miles on the Grank Banks)".

(R.T. HAWORTH, 25.11.69)

2) Programme : Hudson 70

Geophysical/ Geological Survey off the West coast of Queen Charlotte Islands during Hudson 70 expedition.
Phase VII, June 20 - August 1, 1970.

"A geophysical survey is being carried out in the northeast Pacific during Hudson 70 expedition. The area to be surveyed lies immediately west of Queen Charlotte Islands and north of Vancouver Island. The northeast Pacific Ocean has attracted a great deal of attention from geologists and geophysicists all over the world during the past twenty years. The main reason for this is the diversity of the tectonic structures which lie immediately off the west coast of North America and which are very different from those off the east coast.

The area where the proposed survey is to be carried out has undergone extensive tectonic activity and many earthquake epicentres lie in the southern part of the area. It has been postulated that a major fault runs on the western end of this area and ultimately crosses onto the continent north of Queen Charlotte Islands. It is believed that Juan de Fuca Ridge which lies west of Vancouver Island is truncated by this fault. A detailed geophysical survey of this area should delineate such a fault.

The geophysical survey to be carried out in the area west of Queen Charlotte Islands is divided into two phases. During phase I (June 20 - July 11), gravity, magnetic, and bathymetric, and seismic reflection measurements will be made at line spacing of 5 miles (E.W. traverses to 136°W.G.). Navigational control throughout the survey will be maintained using Satellite, Omega and Loran receivers. The second phase (July 19 - August 1) will be devoted to detailed gravity, magnetic, bathymetric and seismic reflection surveys of areas of interest located by CSS HUDSON during Phase I. Navigational Control during these detailed surveys will be maintained using Radar Transponder Buoys and Satellite receivers. Besides detailed surveys during this phase some dredging, coring and heat flow measurements and two ship seismic refraction work are to be carried out.

It is intended that a second ship (CSS PARIZEAU) will be used as a support ship during the second phase...".

(S.P. SRIVASTAVA)
(Marine Geophysics Group, A.O.L., B.I.)

DANEMARK

Geodaetisk Institut, Copenhagen

- Gravimetric survey in the open sea West of Greenland between 61° and 62°N.

"The anomalies rest on Copenhagen 981.557.91 mgal in agreement with the Kneissel-Marsahn adjustment (1962) and the Cassinis formula

The determination of geographic positions was based on Deca received from a portable Deca chain belonging to the Royal Danish Hydrographic Department. The depths along the tracks were recorded by means of conventional echo soundings".

(E. ANDERSEN, 6.1.67)

- In summer 1968 surface sea gravity measurements have been carried out in the North Atlantic Ocean between Iceland, Sholand and Norway.

"The observation data themselves are now being prepared to give gravity anomalies, which will be published in the normal way by Geodetic Institute. The publication will appear in 1970".

- Concerning our future projects I can tell you that we plan to carry out sea gravity measurements in interior Danish waters at least during 1970".

(E. ANDERSEN, 24.10.69)

- The surface-ship gravity measurements in the Skagerrak (1965-66) are indicated on the detailed maps. The publication is mentioned in Bull. Inf. n°16, p.II-17, n°191.

ESPAGNE

Les mesures pendulaires faites en 1950/51 entre les Iles Canaries et les Iles du Cap Vert qui n'avaient pas été mentionnées en 1966, ont été reportées sur les nouvelles cartes (34 points).

Rapport sur les travaux géodésiques exécutés par l'Institut Géographique et Cadastral, Toronto, Sept. 1957.

ETATS-UNIS

The Lamont-Doherty Geological Observatory carried on gravity observations at sea extending on all the oceans.

1) Tracks of R/V VEMA (cruise 17-22) 1960-1965 and tracks of R/V R.D. CONRAD (cruise 8-10) Nov. 1963 - June 1964 were indicated formerly in the B.I.16, p.II-4 and II-8.

2) New tracks since 1965 are mentioned on the maps (red lines).

3) On the world map (next page) detailed gravity studies are indicated. Particularly, in the area of the Indian Ocean, "the Lamont is preparing in cooperation with several other institutions a free-air gravity map as a part of the International Indian Ocean Atlas which is being edited by Dr Udintsev of the U.S.S.R.
The "constructed" free-air anomaly map will be published shortly : the projection used is Mercator and the scale is 2" = 1° longitude at a contour interval of generally 25 mgal".

(M. TALWANI, 26.11.1969)

Texas A and M University

"We have no new sea gravity measurements to report at this time. Interest in sea gravity at Texas A & M University has been renewed with the acquisition of a satellite navigation system and we hope to develop an active program once again".

(D.A. FAHLQUIST, 21.11.1969)

Previous measurements of 1960-62 in the Gulf of Mexico have been indicated on the detailed map n°7.

(Geophys. v.XXX, n°1, 1965)

The University of Texas, Dallas.

"The map showing open sea gravity measurements shows some profiles (Agulhas Bank area) observed during 1962 by the Bernard Price Institute of Geophysical Research, University of the Witwatesrand, Johannesburg, South Africa as having been made by the Graduate Research Center at Dallas, Texas".

(A.H. HALES, 13.11.1969)

In the publication "Surface ship gravity measurements in the Agulhas Bank area, South of South Africa", K.W.T. GRAHAM & A.H. HALES, it is noted that some of the reductions were made at the Graduate Research Center, Dallas.

Woods Hole Oceanographic Institution

1) Gravity measurements aboard the R/V Chain.

- Western North Atlantic Ocean - cruise #70, 12 July to 2 August 1967 (B.I.20, p.I-13.
- cruise #73, 6 to 26 September 1967 (B.I.22, 438).
- North Atlantic Ocean and Caribbean Sea - cruise #75, 16 October to 19 December 1967 (B.I.22, 1).

2) Cruise Atlantis II - Medoc 69

- Mediterranean Sea and Black Sea : see details in B.I.20, p.I-17. and general map.

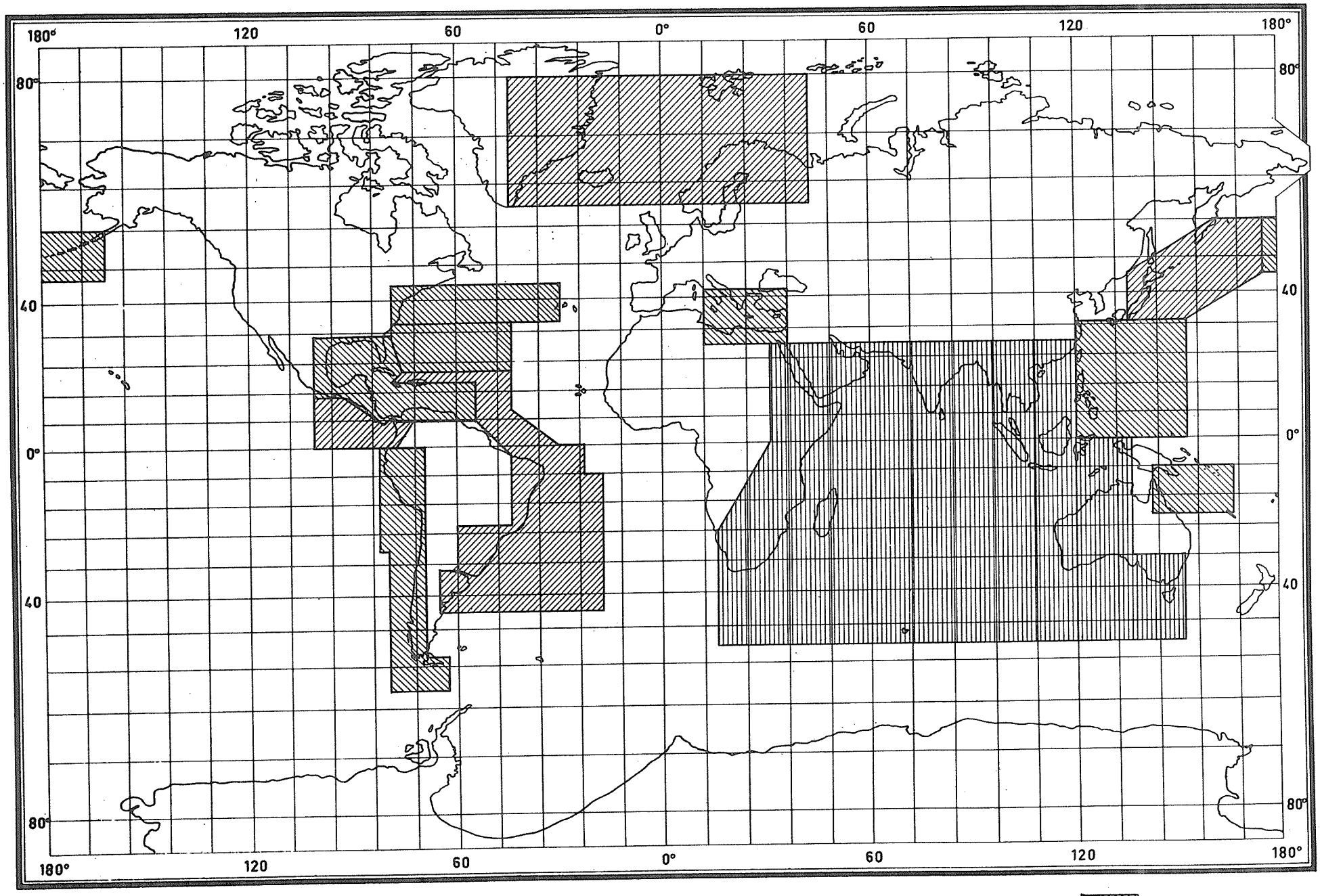
FINLANDE

Geodetisk Institute, Helsinki

- On the detailed maps we have mentioned the gravity measurements made in the Continental Sea of Finland with a gulf underwater gravimetr in the year 1956 : 178 underwater stations were measured in the Gulf of Bothnia, the Baltic Sea and the Gulf of Finland.

- The gravity measurements of the Barents Sea, which were not mentioned in 1966, are indicated both on the general map and on the detailed maps. 21 stations were measured with the gulf underwater gravimeter in 1957.

Details of these surveys can be remarked in "Gravity survey of Finland in the years 1945-1960", by T. HONKASALO, Ver. Finn. Geod. Inst., n°55, Helsinki, 1962.



Free Air Anomaly maps constructed

Free Air anomaly map in progress
(With other institutions)

Maps in progress

FRANCE

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

Les mesures sont effectuées à bord du "JEAN CHARCOT" avec le gravimètre G.SS2 n°15.

- Traversée Brest-Toulon du 24 au 29 Janvier 1969 (Pub. CH01), (B.I.20, p.I-19).

- Campagne "Gestlante III" dans le Golfe de Gascogne du 24 Avril au 3 Mai 1969 (Pub. CH02).

- Campagne d'essais du 10 au 13 Juin 1969 au large de la Bretagne jusqu'à 9°W.G. (Pub. CH03).

- Campagne "Noratlante", du 3 Août au 2 Novembre 1969:

le "Jean Charcot" a parcouru un total de 12.500 miles marins. (Bull. CNEXO 7/8, Juillet - Août 1969). "Nous avions en permanence la sismique réflexion par le procédé "Flexotir" ou "Air-Gun", la topographie, le magnétisme et la gravimétrie".

Route Brest - St-Jean de Terre Neuve - Mer du Labrador
St-Jean de Terre Neuve - Açores - Lisbonne - Brest.

"Des incidents mécaniques sur la première partie du parcours ont entraîné des trous dans les profils gravimétriques".

(J.C. SIBUET, 11.3.1970)

Service Hydrographique de la Marine (S.H.M.)

- Mesures en Mer de Norvège à bord du "PAUL GOFFENY" en 1965-67 à l'aide d'un gravimètre Askania G.SS2.

- Mesures dans le Golfe de Gascogne, 1964.

GRANDE-BRETAGNE

Hydrographic Department, Taunton.

The recent gravity results obtained by this Department concern approximately the following regions :

- Track between Gibraltar and Guinea.
- Tracks in the North Atlantic, from Norway to Island and beyond. (37°W.G.).

- Surveys in the North Sea, Irish Sea and beyond (36°W.G.).

"In addition, four gravity ranges were established in United Kingdom waters :

- two in the Approaches to the Clyde,
- one in the North Sea and,
- the fourth in the Approaches to Plymouth."

(D. THOMAS, 17.11.1969)

University of Birmingham, Department of Geology

"About 2000 km. of gravity traverses have been recorded using a Graf Askania sea gravimeter and covering the southern Irish Sea and an area out to about 100 kms. off the south coast of Ireland. The line spacing is about 20 km.".

(F.J. DAVEY, 22.10.1969)

University of Cambridge, Department of Geodesy and Geophysics

a) R.R.S. Discovery, cruise 16, Indian Ocean, January - May 1967,

- in the Eastern part of Mediterranean Sea,
- in the Red Sea and,
- in the Indian Ocean to the Seychelles Island.

b) R.R.S. Discovery, cruise 23, 1968.

- from Plymouth to the detailed survey (47°N - 15°W.G.).

c) R.R.S. John Murray cruise, November 1968.

- from Douarnenez (France) to La Coruña (Spain)

d) R.R.S. John Murray cruise, April 1969.

- off the South of Ireland

e) R.R.S. Discovery, cruise 29, August - October 1969.

- from Great Britain to Azores Islands,
- off the North-West of Ireland.

Data are available except for the cruise 29 (data not yet reduced).

(C.A. WILLIAMS, 27.11.1969)

University of Durham, Department of Geology

The recent work of this Department is extending on the following regions :

- Between Faeroes, Shetlands and Scotland (R.R.V. John Murray 1967-1968 ; H.M.S. Hecla 1965).
- Between Iceland and Faeroes (R.R.V. John Murray 1967).
- Off the coast of Ireland (R.R.V. Discovery 1966).

"However I can let you know that the surveys are either in process of publication or under preparation for publication as follows :

1. The North British shelf work has been presented as a Bouguer anomaly map for publication in "Nature" and the article should come out in a few weeks time.

2. The Porcupine Bank survey has been submitted to Deep Sea Research by Dr. Gray and Dr. Stacey and should be published within a few months time at most.

3. The gravity work between Iceland and the Scottish mainland is being prepared as a paper and will be submitted to the Geophysical Journal within the next few months".

(M.H.P. BOTT, 23.12.1969).

University of Glasgow

"The gravity measurements at sea made by members of the geophysical section of Glasgow University are all made in near-coastal waters along the west coast of Scotland. Our immediate plans for the next three years will consist of detailed work on this part of the Continental shelf, using a bottom gravity-meter. It is not appropriate for representation on the map sent by you as the area is much too-limited".

(A.C. McLEAN, 21.10.1969)

ITALIE

Osservatorio Geofisico Sperimentale, Trieste

"The sea gravity measurements performed by O.G.S. up to 1968.5 (covering the Mediterranean Sea) are published in our "Bollettino di Geofisica Teorica ed Applicata", n°38, 1968.

To this one must add other two cruises for about 24.000 miles in Sicily Channel from lat. 35°N to lat. 38°N and in Ionian Sea from 36° to 40°N and from longitude 16° to 20°E. Another cruise is under way to extend toward South the survey in Ionian Sea.

The reconnaissance survey is being published together with Dr. Allan of Saclant (probably within March 1970) and the more detailed survey in Tyrrhenian Sea will be published separately, probably near the above date. The Adriatic Sea survey is already published (Bollettino n°41-42)".

(C. MORELLI, 31.10.1969)

JAPON

Geographical Survey Institute (G.S.I.)

The new gravity measurements of G.S.I. have been already mentioned in B.I.16, p.II-4 and II-7, the following regions are surveyed :

- between Japan and Philippines Islands, 1965,
- between Japan, Aleoutians Islands and Hawaii Islands.

Detailed surveys, near Japan, in Japan Sea and in the area 38°N, 140° to 145°E.G., are made in collaboration with the Hydrographic Office on the Marine Surveying Ship "TAKUYO" (1964-65).

Hydrographic Department, Marine Safety Agency, Tokyo (H.D.)

In response to your circular, we are pleased to inform you as follows :

1. The Hydrographic Department of Maritime Safety Agency, has presently the following schemes which are to include gravity measurements at sea :

- As a part of publication scheme (1967-1976) of "Basic Map of the Sea" series to cover the whole adjacent waters around Japan, gravity anomaly charts are to be published together with bathymetric, submarine structural and total magnetic intensity charts.
- Underwater surveys by our Underwater Research Vessel "Sinkai" (displacement : 90 tons) to be started from 1970 fiscal year, in which gravity measurements at the bottom of the sea will be included.

2. Tracks along which gravity measurements at sea were carried out by the Hydrographic Department from 1965 to 1969 inclusive, are situated in the seas around Japan and were made aboard the TAKUYO in 1965 and the MEIYO in 1968.

3. The ship-board gravity meter currently used at our Department is T.S.S.G. (Tokyo Surface Gravity Meter)".

(K. KAWAKAMI, 23.12.1969)

Ocean Research Institute, University of Tokyo (O.R.I.)

The new surveys of this Institute are extending on the following regions :

- Pacific and Indian Oceans : Japan, Melanesia, Eastern Australian coast, New-Zealand and towards the Antarctic to 50°E.G. (1964-1965). (B.I.16, p.II-4, 5, 6).

- An extensive work was done in the Pacific Ocean between Japan, Australia, New-Zealand and Antarctic, and a cruise was made from Japan to South America and New-Zealand.

(Y. TOMODA, November 1969)

PAYS-BAS

Technische Hogeshool, Delft.

The following measurements have been indicated on the map :

- underwater gravity measurements in the North Sea (J.B. COLLETTE) (B.I. Mai 1960, p.32),

- recent measurements near Surinam.

(G.J. BRUINS, 19.12.1969)

Note :

This Laboratory will participate in a geological geophysical expedition in the Caribbean Sea, named "Cicar" from 1970 to 1972.

(G.J. BRUINS, Avril 1969)

U.R.S.S.

The route map of ships, on which gravity determination were made, have been indicated on the maps (Atlantic, Pacific Oceans).

(J. BOULANGER, 28.11.1969)

3) D - BIBLIOGRAPHIE DES TRAVAUX RELATIFS AUX MESURES EN MER

La liste suivante comprend les publications relatives aux mesures en mer parvenues au B.G.I. depuis le Bulletin d'Information n°14 (Novembre 1966). Elle regroupe les publications disséminées dans la bibliographie parue dans les Bulletins d'Information n°15 à n°22. (B.I.15...22).
Le classement a été fait par pays d'origine de la publication.

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DEUTSCHES HYDROGRAPHISCHES INSTITUT - Forschungsschiff "Meteor".
Fahrt n°4 : .) Nordatlantischer Ozean.
) Berichte über die Wissenschaftlichen Arbeiten.
1966. (B.I.16 - 194).

BROCKS K. - "Die Atlantische Expedition 1965 (IQSY) mit dem Forschungsschiff "Meteor".
Forschungsberichte 11, Gravimétrie p.171, p.84-91, Wiesbaden, 1966.
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Askania Warte, H.n°71, 20 S, Berlin, 1968. (B.I.19 - 98).

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Atlantic Ocean. Lab. Bedford Inst., 58 p, Dartmouth, N.S., 1968. (B.I.19 - 770).

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ETATS-UNIS

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3) E - GRAVITY MEASUREMENTS BY THE ATLANTIC OCEANOGRAPHIC LABORATORY BEDFORD INSTITUTE 1967-1969

R.T. HAWORTH

(Marine Geophysics, Atlantic Oceanographic Laboratory)

Note : On February 1st, 1968, the Bedford Institute of Oceanography was rechristened the Bedford Institute, the latter to be the collective name of the campus incorporating the Atlantic Oceanographic Laboratory (the Atlantic Region establishment of the Marine Sciences Branch of the Federal Department of Energy, Mines and Resources) and the Marine Ecological Laboratory (the Dartmouth Laboratory of the Fisheries Research Board of Canada).

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Multidisciplinary Hydrographic-Geophysical Operations

Since 1966, the Atlantic Oceanographic Laboratory at the Bedford Institute has greatly increased its gravity coverage of the eastern continental margin of Canada. This has been largely due to the collaboration existing between the Marine Geophysics group and the Hydrographic Section of the Institute. The prime responsibility of the AOL Hydrographic Section is charting all navigable waters within the Atlantic Region as applicable to navigation requirements. The Region is defined as Canada's Atlantic Seaboard, the Gulf of St-Lawrence east of Pointe des Monts, Hudson Bay and eastern Arctic. The surveys conducted by the Section satisfy requirements in navigation, fisheries and mineral exploration. All positioning of the ship is done by Lambda (Low Ambiguity Decca) in the range/range mode, this providing the most accurate navigation available in the areas surveyed so far. After a mutual study by the two groups, of each others surveying

techniques, it was decided that the two disciplines could be combined to produce a highly effective multidisciplinary survey operation covering the Canadian east coast continental margin with measurements of bathymetry, gravity and magnetics.

The method of operation now existing is that the Hydrographers carry out an initial survey of their proposed survey area at a line spacing of 2 or 4 miles, depending upon the density of measurements required to give good geophysical control. With the completion of this multidisciplinary portion of the survey, the hydrographers continue surveying the same area at a reduced line spacing, this being 1/2 or 1 mile line spacing at water depths less than 50 fathoms. During this latter portion of the cruise geophysical studies are carried out as opportunity and manpower permits. The data collection and reduction operation has now passed into the hands of the Hydrographic Section and a series of Natural Resources Charts are to be produced by them, with editions covering Bathymetry, Gravity (Free Air Anomaly) and Magnetics (Total Field). At present only the 3 editions of sheet 14956 are available (latitude : 45° - 46°N, longitude : 46° - 48°W.G.). Requests for these charts (price $ 1.00 each) and those to be published in the future may be made to :

Hydrographic Chart Distribution Office
Department of Energy, Mines & Resources
OTTAWA, Canada.

While the routine data collection, reduction and chart production are in the hands of the Hydrographic Section, responsibilities for the initial planning of the geophysical aspects of the multidisciplinary cruises and their data interpretation still lie with the Marine Geophysics Group. This development is still in its infancy to the extent that the Hydrographic Section is still learning the techniques of geophysical surveying and data reduction. Meanwhile, Marine Geophysics is still attempting to exploit the positioning facilities provided by the surveys, in increasing the accuracy of sea surface gravity measurements as limited by the calculation of the Eötvös correction.

Surveys Completed

GRAND BANKS

The area surveyed in 1966 and 1967 lies approximately between longitude 53°W and 44°W and latitude 45°N and 48°N. The most interesting features of the gravity charts reveal :

(1) Very steep horizontal gradients (up to 12 mgals per km).

(2) A large "low" near the central portion of the survey area (minimum of - 35 mgals with general low area extending over approximately 1° x 1°).

(3) A very extensive "high" in the north central portion of the survey area (maximum of + 136 mgals with general high area extending over approximately 1° x 1°).

(4) A positive zone of + 60 to + 80 mgals associated with the Flemish Cap.

(5) A belt of circular positive features with amplitudes from 20 to 100 mgals lying within and parallel to the 100 and 1000 fathom contour lines.

The top of the Grand Banks, especially within the 50 fathom contour is remarkably flat ; therefore the steep gradients of the gravity field are due to major variations in the density distribution and/or structure of the subsurface rocks. This, coupled with the fact that the magnetic field in the same area is very smooth, indicates that the density variations are due to changes in structure within the sedimentary rock section. The gravity "lows" that are relatively small in areal extent are believed to be due to salt structures, while the large low in the central portion of the survey area is believed to be a basinal type feature with a total sedimentary rock thickness probably in excess of 6 km. In the area of survey two 30 miles and one 150 mile refraction seismic lines were shot. Six distinct refraction layers were mapped with the following velocities : 1.67, 1.84, 2.69, 4.59, 5.40 and 6.03 km/sec. The highest velocity probably identifies crystalline basement rock in this area. As expected from previous investigations, a thickness of sedimentary rock in excess of 3 km was found in the vicinity of the long profile near 45°N and 49°W.

GULF OF ST-LAWRENCE

In 1968 and 1969, the multidisciplinary cruises were carried out in the Gulf of St-Lawrence. Surveying of the eastern portion of the Gulf has only been completed during the past few months and no interpretation of these data has yet been made. In the northeastern area, the gravity map covering part of the western flank of the Canadian Appalachians is featureless when compared with the gravity map of the Grand Banks which comprise part of the eastern flank. In the southeastern area the gravity field is more complex and is dominated by a large negative free air anomaly of - 100 mgals (Bouguer anomaly of approximately - 60 mgals). The directional trend of this anomaly is N.E. - S.W. as anticipated if associated with the Appalachian system. The anomaly is terminated at its western extend by a series of high frequency anomalies trending N-S. This indicates that the geological structure of the area is complex and interpretation of these data will proceed in the near future.

Regional Geophysical Surveys

MID-ATLANTIC RIDGE

In 1968, the third Institute expedition to the Mid-Atlantic Ridge continued the comprehensive geophysical survey of the area between 45° and 46° which began with the voyage of RRS Discovery II in 1960. Two ships were used in this survey to provide a shooting and receiving ship for a seismic experiment carried out on the eastern flanks of the ridge. Satellite navigation provided absolute positioning of the survey and radar transponder buoys were moored to provide accurate navigation within the survey area. 9000 kilometres of bathymetric, magnetic and gravity measurements were made at a spacing of less than 2 miles to complete the detailed survey of the western flank of the Ridge. In addition some 4000 kilometers of surveying were completed on the eastern flank. The total coverage is now approximately between 45°N and 46°N from 26°30'W to 30°W. All the gravity data obtained during the three expeditions have now been compiled and the data adjusted. Free air anomalies have been calculated for the entire region and calculation and interpretation of the Bouguer anomaly is proceeding. The associated seismic refraction data will be used in model studies to be made on the crustal structure of the 3° by 1° area. Preliminary gravity results from the combined surveys were included in a paper presented at the 50th Annual General Meeting of the American Geophysical Union (A.G.U.).

THE BAY OF FUNDY

3,700 kilometres of gravity, magnetic and bathymetric data acquired in the Bay of Fundy (between 66°W and 67°10'W from 44°10'N to 45°10'N) have been processed and reduced to free air gravity anomalies and total magnetic field. Computation of Bouguer anomalies is in progress after which a full interpretation of the data will be made.

HUDSON STRAIT

Gravity data on two tracks to and from Hudson Bay have been reduced and are being used in an interpretation of the structure of Ungava Bay and Hudson Strait based on all geophysical observations in this area. Preliminary results of this work were presented at A.G.U.

WESTERN NORTH ATLANTIC

A series of N-S traverses on which geophysical data are collected is being carried out in the Western North Atlantic. Magnetics and bathymetry

coverage now extends along traverses 55°W to 67 1/2°W at 2 1/2° intervals. Gravity data are available along only two of these (55°W and 57 1/2°W) but this coverage is to be extended along 65°W and 70°W early in 1970. These data are gathered as a cooperative project on an annual hydrographic training cruise in this area.

Environmental Tests

SATELLITE NAVIGATION CRUISE (BAFFIN 022-69)

Extensive trials and comparisons between the ITT and Magnavox satellite navigation receivers were carried out on this cruise. Due to the excellent navigation facilities available (incorporating positioning by automatically recorded D.R., satellite fixes, Decca, Hi-fix, Omega and VLF) it was hoped to isolate some of the errors involved in the measurement of gravity at sea. Our two Askania sea gravimeters were operated on the same Anschutz gyrostabilized platform, each gravimeter being connected to a separate cross-coupling analogue computer. Unfortunately the weather was so good and the ship motion so limited that the errors encountered were wery small.

Laboratory Tests

The extension of the laboratory wing of Bedford Institute in 1969 has included the provision of two laboratories dedicated solely to gravity studies. One is used as a "quiet laboratory" with a floor level platform isolated from the building. Another platform, provided for seismic studies, is coupled directly to bedrock and is also isolated from the building. No vibration testing has yet been performed on either of these platforms to determine the extent of their isolation. When this has been done, consideration will be given to setting up a gravity reference station on each of these platforms.

While our two Askania sea gravimeters have been land based, work has been carried out to determine some of the torsional parameters of the measuring system, and in particular its linearity. This work was necessary on two counts. A proposal has been made to produce a completely digital processing system for the sea gravimeter. To do this, the digital filter employed must be tailored precisely to the linearity of the gravimeter measuring system. Secondly, the investigation of cross-coupling errors in gravity measurements at sea suggested that there might be an

asymmetry in these errors and that this might be attributed to the non-linearity of the meter. The investigation demonstrated a non-linearity in the system which will have to be compensated for in the proposed digital processing system.

The cross-coupling computer originally built in 1965 has been modified, redesigned and completely rebuilt. It underwent extensive sea trials in its revised form early in 1969 and has been employed in correction of gravity data in the field ever since. With the continuous computation and logging of cross-coupling error data, on line correction for these errors is now feasible.

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(Octobre à Décembre 1969)
(Janvier - Février 1970)

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LISTE DES PUBLICATIONS

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421 - BULLETIN GEODESIQUE de l'ASSOCIATION INTERNATIONALE DE GEODESIE, n° 93, 1969.

a) A.I.G. - Symposium commun des commissions de la nouvelle compensation de la triangulation européenne et du réseau européen sur satellites artificiels (Paris, 24 Février - 1er Mars 1969) -.
p.213-233.

b) KOVALEVSKY J., F. BARLIER & I. STELLMACHER. - "Liaison Nice - Beyrouth, à l'aide des observations du satellite D1.A".
p.235-242.

c) SLEIGH R.W., C.C. WORRALL & G.H.L. SHAW. - "Crustal deformation resulting from the imposition of a large mass of water".
p.245-254.

d) MATHISEN O. - "Determination of deflection of vertical with a small instrument".
p.283-286.

"Deflection of vertical is known at only about 50 of 335 first order stations in Norway. Information about the deflection is necessary at a great number of stations for computation of the geoid. The transportation of heavy astronomical instruments is, due to the topography, difficult in many areas in Norway. Determination of deflections by astro methods with a small type of instrument has therefore started as an experiment, and such observations were carried out at seven stations in 1968. Both components of the deflection are determined in one clear night with an accuracy of about 1".

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*Les numéros font suite à ceux indiqués dans le Bull. Inf. n°21, Novembre 1969.

e) de WITTE L. - "Altitude extension of the three anomalous gravity components".
p.287-306.

"The extension of the components of anomalous gravity to points outside the globe is usually based on application of Stokes' Gravity Formula and its derivatives, possibly in combination with the use of Poisson's integral Theorem. The principal deterministic errors in these processes are those due to the effects of unmapped areas where boundary value data are non-existent and those dependent on the treatment of the relatively large uncertainties in zeroth order terms. To reduce these errors significantly below their values in current practices, the following extension procedure has been developed :

The radial component is found from :

$$-\left(\frac{\partial T}{\partial r}\right)_h = (\Delta g)_h + \frac{2T_h}{r}$$

where Δg is extended by Poisson's Theorem, without removal of zeroth order effects and the anomalous potential T_h is obtained by the use of a spherical harmonic reference gravity model of degree and order seven and application of Stokes'formula to the residual anomalous gravity, with intentional truncation of the surface integration at the first zero crossing of the Stokes kernel function.

The angular components of anomalous gravity or deflections of the vertical are computed explicity as the slopes of the geoidal height surface. The geoidal heights are obtained by dual application of Stokes' formula, while again employing the seventh degree reference model and truncation at the first zero crossing".

f) DUFOUR H.M. - Compte-rendu du livre, bibliographie : H. WOLF - "Ausgleichungsrechnung nach der Methode der Kleinsten Quadrate".
p.320.

424 - ACADEMIE DES SCIENCES U.R.S.S. - Références bibliographiques : Géodésie.
Ser. 52, t.10, 45 p, Moscou, 1969 (texte russe).

425 - ACADEMIE DES SCIENCES U.R.S.S. - Références bibliographiques : Géophysique.
t.10, 178 p, Moscou, 1969 (texte russe).

427 - STACEY R.A., L.E. STEPHENS, R.V. COOPER & B.G. BRULE. - "Gravity measurements in British Columbia with map : n°88 - British Columbia coastal area".
Grav. Map Ser., Dom. Obs., 11 p, Ottawa, 1969.

"Gravity map n°88 covers the coast area of British Columbia and includes the continental shelf, Vancouver Island, the Queen Charlotte Islands and the fiords of the mainland. The Bouguer anomalies have been contoured at 10 mgal intervals and are based on gravity measurements every 12 to 15 km. The terrain corrections have been computed using either a rectangular or a circular graticule or a combination of both depending on the scale of the available topographic maps.

The major features of the gravity field are : a positive Bouguer anomaly along the western edge of the area, which is associated with the change from continental to oceanic crust, and a negative anomaly along the Coast Mountains which is attributed to the thickening of the continental crust below these mountains. Over the eastern part of the Queen Charlotte Islands, Hecate Strait, Queen Charlotte Sound and Vancouver Island, changes in the Bouguer anomaly values have been related to density variations in the surface rocks".

428 - The Geophysical Journal of the Royal Astronomical Society, v.18, n°2, 1969.

a) HASEGAWA H.S. - "A study of the effects of the Yellowknife crustal structure upon the Pooda of teleseismic events".
p.159-176.

"The short-period P codas of seven earthquakes and four underground nuclear events recorded in the Yellowknife region of the Canadian Shield are analysed both in the time and in the frequency domains. In the time domain, the application of a "P-detection" filter to the earthquake events facilitates the identification of several phases (pP and sP) in the first 25s of the P coda. The application of this filter to two nuclear events (originating at the Nevada Test Site) assists in the separation and in the identification of the crustal reverberations at the respective sources. In the frequency domain studies, the application of the spectral ratio test to six earthquake events resulted in poor agreement between the theoretical and the experimental spectral ratio curves ; closer agreement was obtained for the nuclear events. Since the earthquake events did not possess the appropriate type of waveform for the spectral ratio test, it is not possible, at this stage, to pass judgment as to whether or not the crustal layering at Yellowknife fulfills the requirements of Haskell's matrix theory.

Signal-generated-noise studies are based on the observation of P-generated SH and SV waves. Anomalous P-SH conversion is much less in this region than in the sedimentary basin of central Alberta. However, there are indications of appreciable anomalous P-SV conversion ; the source is likely in the lower part of the crust and possibly in the upper part of the mantle at Yellowknife".

b) ASADULLAH KHAN M. - "General solution of the problem of hydrostatic equilibrium of the Earth".
p.177-188.

"If de Sitter's hydrostatic equations are developed independent of the external potential theory, the hydrostatic geopotential coefficient J_h occurs explicitly on the right-hand side of these equations. Since this J_h has to be treated as an unknown in the solution of the problem, it becomes rather difficult to solve these hydrostatic equations independently, regardless of which of the dynamical parameters associated with the Earth is taken as the initial datum. The solution of these equations is possible, however, with the help of a boundary condition derived from the external potential theory which neither assumes nor discounts the presence of equilibrium conditions in the Earth's interior. If a general solution is constructed on these lines, the three particular solutions, usually quoted in literature, stem from it in the wake of the appropriate assumptions. Of course, out of these the only meaningful solution is that corresponding to the polar moment of inertia as the initial datum. It is essential that the solution be constructed in this way in order to demonstrate clearly the correct structure of the problem of hydrostatic equilibrium.

The anomalous gravity field of the Earth referred to the hydrostatic figure is compared with that referred to the international reference ellipsoid".

c) JACOB A.W.B. - "Crustal phase velocities observed at the Eskdalemuir seismic array".
p.189-198.

"The phase velocities of crustal P waves across the seismic array at Eskdalemuir have been measured. 71 events within a radius of 180 km were used and an array processing computer program designed to handle the data makes allowance for the curvature of the wave-front and the altitude variations between the seismometers. The phase velocities resulting from this analysis, when plotted against distance from the array, indicate that the crust around Eskdalemuir exhibits a vertical velocity gradient from approximately 5.5 km s^{-1} at the surface to 6.0 km s^{-1} at about 12 km followed by a sharp increase to about 6.4 km s^{-1}".

429 - REIT B.G. - "On the numerical solution of the gravimetrical integral equation of Bjerhammar".
Royal Inst. Tech., 36 p, Stockholm, 1967.

"In this report an analysis is made of the different mathematical problems arising in practical applications of the new gravity reduction theory of Bjerhammar.

The body of the report is to a great extent concentrated upon the solution of the basic integral equation of the theory. Different methods of solutions developed by A. Bjerhammar and W. Förstner are discussed. An improvement of the methods is suggested, which makes it possible to introduce a great number of unknown coefficients in the linearized equations without being forced to increase the order of the approximating polynomials. The transformation of the integral equations from the sphere to the plane is analysed in detail. Finally, new formulas are derived, making it possible to integrate the so-called x- and y-parameters for an arbitrary location of the actual point of computation.

431 - INSTITUTO GEOGRÁFICO E CADASTRAL - "Cadernos tecnicos e de informacao". Trabalhos gravimetricos no Arquipelago da Madeira".
IGC 15, CDU 526.7 (469.8) n°13, 14 p, 1968.

Description des stations de 1er ordre. Résultats des 28 mesures gravimétriques. Cartes d'anomalies à l'air libre et de Bouguer.

432 - INSTITUTO GEOGRÁFICO E CADASTRAL - "Cadernos technicos e de informacao, Trabalhos gravimetricos no Arquipelago dos Açores".
IGC 15, CDU 526.7 (469.9) n°14, 44 p, 1968.

Description des stations de 1er ordre. Résultats des 227 mesures gravimétriques. Cartes d'anomalies à l'air libre et de Bouguer pour chaque île.

433 - FISCHER W. - "Erstellung eines Kontrollnetzes ueber das Schweizerische Schwerenetz mit LaCoste-Romberg gravimetern".
Schweiz. Geod. Kom., 9 p, 1969.

435 - KOLBENHEYER T. & M. SMISEK. - "Die Colletteschem Diagramme für die Zweiten Ableitungen U_{zz} und U_{zx} des Schwerepotentials".
from : Contr. Geophys. Inst. Slovak Acad. Sci., v.1, p.9-14, Bratislava, 1969.

436 - YEREMEYEV V.F. - "An investigation of some methods of calculating plumbline deflections on an Earth model".
CNIIGAIK, 17 p, Moscow.
Presented at the Symposium on Physical Geodesy, Prague, Sept. 22-27, 1969.

437 - OSTACH O.M. & I.P. PELLINEN. - "Determination of Stokes' constants of the Earth from gravity anomalies".
CNIIGAIK, 9 p, Moscow.
Presented at the Symposium on Physical Geodesy, Prague, Sept. 22-27, 1969.

438 - BOWIN C. & T.C. ALDRICH. - "Gravity data obtained during Chain Cruise 73".
WOODS HOLE OCEAN. INST., Ref. n°69-15, 18 p, 1969.

"Profiles, tabulations and charts are presented of principal gravity facts, free-air gravity anomalies, and simple Bouguer gravity anomalies obtained in the western North Atlantic Ocean during R/V Chain Cruise 73".

See Bull. Inf. n°21, p.II-22, n°371, for the results of the R/V Chain Cruise 70.

439 - CAHIERRE L. - Comptes rendus du COMITE NATIONAL FRANCAIS DE GEODESIE ET GEOPHYSIQUE, Année 1968, 136 p, 1969.

441 - VELKOBORSKY P. - "On the solution of the Molodenskii boundary value problem using successive approximations".
Geophys. Inst. Czechosl. Acad Sci., Prague.
from : Studia Geophys. & Geod. v.13, p.259-266, 1969.

"Gravimetric methods of determining the figure of the Earth can be divided into two groups. The first employs an auxiliary surface - the geoid. The second employs the so-called quasi-geoid as an auxiliary surface. Its main advantage is in that it only uses surface measurements and that it does not require knowledge of the structure of the Earth's crust. This method was treated in §.1. The results display an accuracy of the order of the Earth's flattening. The purpose of this paper is to show that this method can be applied theoretically to reach an arbitrary accuracy".

442 - GAPOSCHKIN E.M. - "Improved values for the tesseral harmonics of the geopotential and station coordinates".
Smithsonian Inst., Astr. Obs., 23 p, Cambridge, Mass.
Presented at the XIIth meeting of COSPAR, Prague, May 1969.

"Baker-Nunn data on 24 close earth satellites, laser data from the five satellites with retroreflectors, and range and rate data from the GRARR system are combined in a global solution for gravity-field parameters and station coordinates The data base represents a significant improvement on previous work with increased accuracy and better distribution. The gravity field is given complete to 14th degree and order, and more than 29 station nets are determined".

443 - YEREMEYEV V.F. & M.I. YURKINA. - "About solution of equations that define the gravitational field and shape of the Earth". .
CNIIGAIK, 17 p, Moscow.
Presented at the Symposium on Physical Geodesy, Prague Sept. 22-27, 1969.

"Good accuracy in calculations of plumb-line deflections on the Earth's surface and of other elements of the gravitational field can be obtained through elimination of the influence of topographical masses and of a certain regional field (Pellinen, 1962, 1969). In his papers, mentioned here in brackets, Pellinen describes, in a general way, a deduction of first corrections to Stokes' approximation for elements of an anomalous field. Now, the authors have set themselves the task of investigating several methods suitable for deduction of approximations of any desirable accuracy to the mentioned elements. From this point of view they have examined a modification of Neumann's solution of integral equation (1877), and the method of Molodensky".

CENTRE NATIONAL POUR L'EXPLOITATION DES OCEANS (C.N.E.X.O.).

444 - Bulletin d'Information, n° 1, 18 p, Janvier 1969.
445 - " " n° 4, 12 p, Avril 1969.
446 - " " n° 5, 14 p, Mai 1969.
447 - " " n°7/8, 12 p, Juillet-Août 1969.
448 - " " n° 9, 14 p, Septembre 1969.
" " n°10, 17 p, Octobre 1969
" " n°11, 14 p, Novembre 1969.
" " n°12, 11 p, Décembre 1969.

449 - Recherches gravimétriques en mer, recueil n°4, 1965-1967.
Institut d'Astronomie de l'U.R.S.S., Moscou, 1969.

a) STROEV P.A. - "Mesures gravimétriques de L.V. Sorokine dans les bassins des mers du Japon et d'Okhotsk en 1937".
p.5-9.

b) PANTELEEV V.L., I.N. JIVITAIA & K. ISMATKHODJAEV. - "II, théorie, méthode et appareillage pour les mesures gravimétriques en mer, analyse des caractéristiques statistiques des accélérations perturbatrices".
p.10-21.

Conclusions :
"1) Les accélérations perturbatrices des navires de surface sont des phénomènes aléatoires avec une fréquence dominante nettement marquée obéissant à une loi de distribution normale

2) Les 800-900 ordonnées relevées sur la courbe d'accélération toutes les secondes ne permettent de calculer avec certitude que les 3 - 4 premières oscillations de la fonction de corrélation amortie.

3) La densité spectrale calculée d'après la transformation de Fourier ne peut être déterminée dans tous les cas qu'avec d'importantes erreurs systématiques et ne fournit qu'une représentations qualitative de la répartition des énergies suivant les fréquences.

4) La densité spectrale dans la plupart des cas se présente comme une courbe symétrique s'approchant d'une portion de sinusoïde.

5) A des fins d'utilisations pratiques, la densité spectrale définie à 5 % près peut être approchée par un "triangle" de décrement 0,07 Hz et une fréquence centrale précisée à 0,08-0,160 Hz près.

6) Pour les systèmes dynamiques possédant une caractéristique de fréquence définie à mieux que 3 % dans l'intervalle de fréquence de régime, le remplacement de la courbe du spectre par des triangles n'introduit pratiquement pas d'erreurs supplémentaires".

c) BOBROV J.V., V.A. GLADUN & A.S. KUZMIN. - "Station d'essai de l'Institut Sternberg (GAI Sh)".
p.22-28.

d) BELOV J.P., E. ISAEV & S.A. USAKOV. - "Méthode des réductions isostatiques grâce à une calculatrice électronique"
p.29-36.

e) STROEV P.A. & A.G. GAJNANOV. - "III, Expéditions gravimétriques en mer organisées par l'Université de Moscou, études gravimétriques dans la partie occidentale de l'Océan Pacifique"
p.37-47.

f) AGAPOVA G.A. A.G. GAJNANOV, E.P. KALININA & P.A. STROEV. - "IV, Résultats des mesures gravimétriques dans les océans et l'Antarctique, caractéristiques statistiques de certains profils géophysiques, marins".
p.48-57.

g) GAJNANOV A.G. & P.A. STROEV. - "Champ gravitationnel et structure de l'écorce terrestre dans la partie centrale de l'Océan Pacifique".
p.58-66.

h) BERESNEV A.F., A.G. GAJNANOV, B.M. KOUYLUN & P.A. STROEV. - "Interprétation des résultats géophysiques de la zone de transition de la mer du Japon".
p.67-79.

i) VASCILOV J.J., A.G. GAJNANOV & P.A. STROEV. - "Structure intercalée de l'écorce terrestre et de la couche superficielle d'après les résultats gravimétriques dans les mers du Japon, d'Okhotsk et de Behring".
p.80-90.

"Les paramètres de massifs les plus précis ont été obtenus pour la mer d'Okhotsk et les Kouriles où l'on a pu étudier assez en détail le comportement des couches de sédiments peu denses. A partir de ce qui précède, on peut conclure :

1) Les hétérogénéités de densité importantes observées non seulement dans l'écorce terrestre mais surtout dans le manteau supérieur disparaissent au-delà d'une profondeur de 220 km. Pour le massif d'Okhotie méridionale, bien étudié le long de sa faille septentrionale, les écarts de densité n'apparaissent que dans le manteu supérieur et disparaissent au-delà de 20 km (niveau Mohorovičič).

2) Les limites inférieure et supérieure d'hétérogénéité de densité (et par suite les profondeurs de pénétration des failles de séparation) tendent vers certaines limites qui sont en particulier les limites de Mohorovičič et de Konrad. Se basant sur l'analyse statistique des résultats de gravitation on peut supposer que ces limites existent également dans le manteau supérieur dans le bassin considéré aux profondeurs 50-60, 120-140 et 190-220 km.

3) La profondeur des failles verticales dans les zones de transitions des chaînes d'îles augmente lorsque l'on passe de l'Océan vers le continent et l'importance des écarts de densité des blocs suit la loi inverse.

4) Lors de leur formation, les blocs ont utilisé le réseau de failles existant, fait confirmé par l'aspect polygonal de certains massifs vus en plan. Ils délimitent les massifs dans les hauts fonds marins et les massifs linéaires des îles.

5) De nombreuses failles sont "aveugles" quant à leur rôle en tant que limite d'hétérogénéité de densité dans l'écorce terrestre et le manteur supérieur.

6) Les formations structurales méridiennes des alignements australo-asiatiques et asiatiques en bordure du Pacifique jouent un grand rôle dans l'histoire géologique des régions du fait que ce sont des formations anciennes pénétrant jusqu'à des profondeurs de 100 - 150 km.

7) D'après l'importance des écarts de densité les massifs des mers de Behring et Okhotsk sont assez semblables et se différencient des massifs de la mer du Japon. Les faibles écarts de densité des blocs de la mer du Japon sont plus caractéristiques de structures continentales que de zones transitoires entre le continent et l'Océan".

j) FROLOV A.I. - "Densité des roches du bouclier du glacier de l'Antarctide d'après les données géophysiques".
p.92-100.

450 - WOLF H. - "Prädiktion und Punktausgleichung".
Sond. : Zeit. Vermessungswesen, 94, J., H.5, S.165-169, Bonn, 1969.

"The procedures of prediction and of the common adjustment are interchangeable. Here the prediction problem has been connected with an over-determined adjustment problem. Both give just the same solution vector if certain relations of orthogonality are arranged. Rules are given of how to express a prediction problem in terms of observation equations and, vice-versa, a usual adjustment problem with unknowns in terms of prediction equations. As to the use of the prediction method for the purpose of "Digital terrain models" in photogrammetric highway-planning a proposal is made".

451 - KRARUP T. - "A contribution to the mathematical foundation of physical geodesy".
Geod. Inst., Med. n°44, 80 p, Copenhagen, 1969.

452 - VYSKOCIL V. - "Statistical characteristics of linear transformations of gravity anomalies"
Geophys. Inst. Czechosl. Acad. Sci.,
from : Studia Geophys. & Geod., v.13, p.252-258, Prague, 1969.

453 - BAARDA W. - "A testing procedure for use in geodetic networks".
Netherlands Geod. Comm., v.2, n°5, 97 p, Delft, 1968.

"In this paper an outline for the continuation of the work in I.A.G. Special Study Group n°1.14 is given, based on the paper "Statistical Concepts in Geodesy". As a first step, a testing procedure for geodetic networks is discussed, using one-sided F-tests ; a definition of the concept "reliability of geodetic networks" is proposed".

454 - PELLINEN I.P. - "Estimation and application of degree variances of gravity".
CNIIGAIK, 11 p, Moscow, 1969.
Paper presented at the Symposium on Physical Geodesy, Sept.22-27, Prague.

455 - GRAFAREND E. - "The Gaussian structure of gravity field".
17 p, 1969.
Presented at the Symposium on Physical Geodesy, Sept.22-27, Prague.

"For correlation functions of order two of the stochastic gravity field, important for prediction and filter theory, a characteristic differential equation of elliptic type of order four is found. Its solution are discussed for GAUSSIAN correlation functions of mass density and of gravity and lead to two main results :

a) A GAUSSIAN correlation function of mass density gives a NON-GAUSSIAN correlation function of gravity.

2) Only for NON-GAUSSIAN correlation functions of mass density of type HERMITE polynomials there is a GAUSSIAN correlation function of gravity. This theoretical result is in agreement with the computation of 160 000 experimental digitized data of F.N. FRENKIEL and P.S. KLEBANOFF. (The Physics of Fluide 10 (1967) 507-520)".

456 - GROTEN E. - "On the covariance function of the terrain correction".
11 p, Münich, 1969.
Presented at the Symposium on Physical Geodesy, Sept.22-27, Prague.

"Statistical aspects of the computation of the gravimetric terrain correction for digital gravity prediction in high mountains are discussed. Some results obtained for a test area in the Northern Alps are shown".

457 - MORITZ H. - "A general theory of gravity processing".
AFCRL-69-0258, Sci. Rep. n°1, Rep. n°122, 57 p, 1969.

"A unified least-squares method permits the estimation of the gravity anomaly field from discrete (terrestrial gravity measurements) or continuous (aerial gravity profiles) data affected by random errors of measurement. This method serves both for predicting the gravity anomaly at points where there are no measurements, and for filtering the data for these random errors. It comprises the usual prediction from errorless data as a special case. The general case of inaccurate data may be reduced to this special case by applying a preparatory least-squares filtering to the data. Details are worked out both for point and profile measurements. The case of n parallel gravity profiles is mathematically reduced to the case of gravity measurements at n points by applying a Fourier transform. Along-track, across-track and combined filtering of aerial gravity measurements and their use for estimating the gravity anomaly field are studied. A method for eliminating systematic errors is given".

460 - DENCE M.R., M.J.S. INNES & P.B. ROBERTSON. - "Recent geological and geophysical studies of Canadian craters".
Contr. Dom. Obs., v.8, n°25, 24 p, Ottawa, 1968.
from : Shock Metamorphism of Natural Materials.

"Field studies were carried out at four craters in Canada in 1965 and early 1966. Diamond drilling operations were conducted at the previously investigated West Hawk Lake and Deep Bay craters, while reconnaissance surveys recovered data supporting an impact origin for Pilot and Nicholson Lakes in the Northwest Territories...

The presence of shocked materials confirms an impact origin for all 4 craters, raising the number of meteorite craters on the Canadian Shield to twelve. The presence of central uplifts at Deep Bay and Nicholson Lake reveals that the change from simple to complex crater structure, for craters formed in granitic gneisses, takes place at a crater diameter somewhere between 2.5 and 5.5 miles (4 to 9 km). Because Pilot Lake falls in this size range, a drilling program to determine its structure is desirable".

466 - NATIONALKOMITEE FUR GEODASIE & GEOPHYSIK DER DEUTSCHEN DEMOKRATISCHEN REPUBLIK. - "Die Wissenschaftlichen Ergebnisse der deutschen Spitzbergenexpedition 1964 - 1965".
Geod. Geoph. Veroff., R.III, H.9, 35 S, Berlin, 1969.

469 - Contributions from the Dominion Observatory, v.4, n°29, Ottawa, 1968.

a) BEALS C.S. - "Theories of the origin of Hudson Bay":
On the possibility of a catastrophic origin for the great arc of Eastern Hudson Bay".
from : Sci., History & Hudson Bay.
p.1-15.

b) TUZO W. - "Theories of the origin of Hudson Bay :
Comparison of the Hudson Bay arc with some other features".
from : Sci., History & Hudson Bay.
p.31-49.

470 - INNES M.J.S., A.K. GOODACRE, A. ARGUN WESTON & J.R. WEBER. - "Gravity and isostasy in the Hudson Bay region".
from : Sci., History & Hudson Bay.
Contr. Dom. Obs. v.8, n°10, 26 p, Ottawa, 1968.

"In this paper the results of all gravity data for Hudson Bay and surrounding land areas are presented. The major features of the gravity anomaly field are examined in terms of earth structure and isostasy, with particular attention being given to :

a) the gravitational effect of the sedimentary rocks underlying the Bay and of the variations in crustal thickness determined seismically,

b) the extension into the Bay of several gravitational features observed on land, and,

c) the lack of isostatic balance of the crust due to glacial loading.

In summary it can be said that a) the main variations of the Bouguer anomaly field in Hudson Bay cannot be reconciled easily with depths to the crust mantle boundary as determined seismically, but find a satisfactory explanation in terms of structures within the crust. b) Palaeozoic and recent sediments within the Bay have little effect on the total anomaly field".

471 - KOPAL Z. - "Relative heights of photographic features of the Moon" AFCRL-69-0421, Sci. Rep. n°1, 77 p, 1969.

"The aim of the present scientific report is to give an account of the methods and results obtained between July 1967 and December 1968 in pursuit of the main objectives of work sponsored by contract F61052-68-C-0002.

The first part of this report is concerned with a development of the new method of star-calibrated lunar photography, which we have pursued since October 1967 to improve the basic data for studies of the shape of the Moon, and of its physical librations.

The second part describes the constructed astrometric camera which secures high quality stellar images for the plate calibration and the third part outlines the computer programme for the reduction of the photographic plates.

The final part, concerned with astrometric studies of the natural satellites of other planets of the solar system, concludes our effort in the field and gives details of the new results obtained for Jupiter V in published form".

472 - The Geophysical Journal of the Royal Astronomical Society. v.18, n°3, 1969.

a) EGYED L. - "Physik der festen Erde". p.331, C.R. by A.H. Cook.

b) MUELLER I.I. - "Spherical and practical astronomy as applied to Geodesy". p.331, C.R. by A.H. Cook.

473 - The Geophysical Journal of the Royal Astronomical Society. v.18, n°4, 1969.

a) DAHLEN F.A. - "The normal modes of a rotating elliptical Earth-II near resonance multiplet coupling". p.397-436.

"Certain of the Earth's poloidal and toroidal elastic-gravitational normal mode multiplets may be strongly coupled to another multiplet by the Earth's rotation and ellipticity of figure. This paper uses Rayleigh's variational principle to specify the selection rules for strong mode coupling and to examine the nature and effects of this mode coupling. It is found that some of the normal modes of a slowly rotating, slightly elliptical Earth model may consist of about half

poloidal type motion and half toroidal type motion. This strong coupling can severely hinder the problem of proper mode identification and measurement of the angular frequencies of oscillation of the Earth's normal modes".

b) JEFFREYS H. - "Theory of probability".
p.439, C.R. by McNally.

477 - The Geophysical Journal of the Royal Astronomical Society.
v.18, n°5, 1969.

a) MATHER R.S. - "The free air geoid for Australia".
p.499-516.
(already mentioned in Bull. Inf n°21, p.II-9, n°337).

b) MATTEWS D.H., A.S. LANGHTON, D.T. PUGH, E.J.W. JONES, J. SUNDERLAND, M. TAKIN & M. BACON. - "Crustal structure and origin of Peake and Freen Deeps, N.E. Atlantic".
p.517-542.

"Peake and Freen Deeps are elongate structures some 30 nautical miles long by 7 miles wide situated near 43°N 20°W on the lower flanks of the Mid-Atlantic Ridge. Seismic reflection records show that underneath about 400 fm of layered sediment the bedrock lies at a depth greater than 3600 fm in Peake Deep and 3300 fm in Freen Deep ; the surrounding seafloor is at about 2100 fm. Freen Deep is the eastern end of King's Trough, a flat floored feature some 400 fms deeper than the adjacent seafloor The Trough extends 220 miles west-north-westwards towards the crest of the Mid-Atlantic Ridge. The area is aseismic and heat flow is normal ; there is no displacement of the crest of the mid-ocean ridge on the projected line of King's Trough. Gravity and magnetic surveys have been made. With minor exceptions, magnetic anomalies are not due to bodies elongated parallel with the structure, which, therefore, cannot be a volcanic collapse caldera. Seismic refraction results in the Peake-Freen area show that the crust is not thinned under the deeps although the Moho may be depressed by 2km. Bouguer anomalies also suggest that the Moho is flat and does not rise to compensate the deeps. Models consistent with gravity and seismic information suggest there is a dense block in the upper mantle under the area. Since no reason to ascribe the origin of the structure to tear faulting has yet been acquired, it is interpreted in terms of overthrusting perpendicular to the deeps, followed by inversion of the lower part of the thickened basaltic crust to eclogite, and its subsequent sinking into the mantle".

479 - FUJITA N. - "Recent vertical displacement in coast of Japan estimated from the annual mean sea level"
Bull. Geog., Surv. Inst., v.XIV, Part I, p.17-28, Tokyo, 1969.

"Recent vertical displacement in the coast of Japan is obtained from the secular variation of annual mean sea level. It has been said that the crustal movement has the order of 100 km in scale. The result obtained shows the patterns with the scale of 1,000 km. In the first half of the 20th century the coast facing the Pacific Ocean seems to have kept subsiding with the maximum speed of 5mm/yr and the coast of the Japan Sea hardly shows any vertical displacement. In the recent 10 years (1955-65) the north-eastern Japan coast facing to the Pacific Ocean subsides at the rate of 5mm/yr . The other coast of Japan wholly tends to uplift. The uplift of 5mm/yr are found in the southern coast of Japan, the western Chugoku district and the western Kyushu district. Especially, it is notable that the southern part of Kii peninsula have kept uplifting. The change of secular variation in the vertical displacement exists around 1950. It is interesting whether the abrupt change of secular displacement was related with the great earthquakes occured around 1950".

480 - MALZER H. - "Measurements of vertical gradients of gravity"
Typewriten paper, 6 p, Karlsruhe, 1969.

481 - MORITZ H. - "Preliminary computations for the geodetic reference system 1967".
Tech. Univ. Berlin, 9 p, 1969.
Presented at the Symposium on Physical Geodesy, Sept.22-27, Prague.

482 - NIBLETT E.R., K. WHITHAM & B. CANER. - "Electrical conductivity anomalies in the mantle and crust in Canada".
The application of modern physics to the Earth and planetary interiors, p.155-172, 1969.

483 - HONKASALO T. - "Report of special study group n°5:11 of the I.A.G. - Geophysical interpretation of gravity anomalies".
11 p, 1969.
Presented at the Symposium on Physical Geodesy, Sept.22-27, Prague.

484 - GROTEN E. - "Absolute orientation of an astrogeodetic geoid section and its correlation with geophysical data".
14 p, Münich, 1969.
Presented at the Symposium on Physical Geodesy, Sept.22-27, Prague.

"Using the spherical harmonics development (14,14) of the disturbing potential as obtained by Rapp (combination of satellite with terrestrial gravity data) the absolute orientation of the astrogeodetic geoid section of West Germany was determined. The results are compared with corresponding data as obtained on other ways and correlation with geophysical information is pointed out".

485 - BJERHAMMAR A. - "Isometric anomaly"
4 p, Stockholm, 1969.
Presented at the Symposium on Physical Geodesy, Sept.22-27, Prague.

"In classical geodesy different gravity anomalies have been used for a solution of the gravimetric boundary value problem. Of special interest have been the anomalies according to Bouguer & Rudzki but mostly the free air anomaly has been used. Some geodesists have preferred the more complicated isostatic anomaly. We are here going to use the free air anomaly in order to obtain an estimate of the density of disturbing mass. Later this density estimate is used for a direct solution of our gravimetric boundary value problem".

486 - BURSA M. - "Geopotential, geoidal surface and Earth's figure parameters as determined from satellite and terrestrial data".
9 p, 1969.
Presented at the Symposium on Physical Geodesy, Sept.22-27, Prague.

"The fine structure of the Earth's gravity field cannot be obtained from satellite observations only and that makes a combined solution with the use of all convenient terrestrial geodetic data necessary.

A combined determination of following characteristics of the field has been discussed : the value of the geopotential on the geoidal surface, the scale factor for lengths, geoidal heights as well as the basic figure parameters".

487 - BURSA M. - "On the correlation between deflections of the vertical and axes of zones of increased macroseismic mobility".
9 p, 1969.
Presented at the Symposium on Physical Geodesy, Sept.22-27, Prague.

"On the territory of Czechoslovakia the deflections of the vertical were determined at more as at 1000 points using the method of removing and restoring topography. The corrections to the zero-approximations were computed using Pellinen's formula which can be interpreted as removing and restoring practically all topographical masses above sea level or condensing these masses to the equipotential surface passing through the point being investigated. The process of removing topography plays an auxiliary role only with a view to exact application. However, the $\bar{\xi}$, $\bar{\eta}$ - values obtained after removing topography can be interesting from a geophysical and geological point of view. The paper is limited to the correlation between the $\bar{\xi}$, $\bar{\eta}$ general representation and the axes of zones of increased macroseismic mobility. The axes of these zones agree in general with the fundamental tectonic dislocation lines".

488 - OSTACH O.M. - "The procedure for astronomical gravimetric levelling". 7 p, Moscow, 1969.
Presented at the Symposium on Physical Geodesy, Sept.22-27, Prague.

"The procedure is proposed for calculating the quasigeoidal elevation between the astronomic points A and B, said procedure not requiring that an accounting area of the gravity anomalies is strongly the same for both astronomic points. The gravity anomalies should be accounted in a circular area with the radius R around each astronomic point. It is sufficient to accept the radius R to be equal to 31-41, with 1 being a half distance between the astronomic points.

This technique strongly fits to the basic principle of astronomo-gravimetric levelling ; the effects of unaccounted part of gravity anomalies on the quasigeoidal heights should be in a relative agreement with the plumb-line deflections.

This technique is much flexible as compared to the ordinary one using the elliptic template because this technique enables to obtain the quasigeoidal elevation between the any astronomic points simply, but the distance between these astronomic points must be less the definite limit. For this procedure the usual circular templates for calculating the gravimetric deflections of the vertical and quasi-geoidal heights must be used. As the computation for some astronomic points are of the same kind and independent such computations can simply be automatized.

The technique is tested with a model repeating the conditions of the area having a severe anomaly. The computations have indicated that the results to be obtained using the elliptic template and with method suggested are close to one another".

491 - YEREMEYEV V.F. & M .I. YURKINE. - "About conditions of solvability of Molodensky's problem and a transformation of his integral equation". 16 p, Moscow, 1969.
Presented at the Symposium on Physical Geodesy, Sept.22-27, Prague

"Provided that the effect of centrifugal force is excluded from the Earth's gravity field the residual field can be determined relatively to the reference ellipsoid to be a level for a potential of attraction. The curvilinear orthogonal coordinate system was used in such an approach, said system being described by Hobson and used by Molodensky in studying the normal field. Investigation of the solvability conditions (homogeneous boundary equation) was dealt with a differential equation of the first order. The solution of that equation is regular in the infinity, but it does not obey the Laplace equation. Thus, solution of the problem proved to be the unique one. In a limiting approach to the reference sphere there will appear three linearly independent functions obeying the Laplace equation. This result was indicated by Molodensky. It has not been proved that it was closed.

If the centre of such a reference-ellipsoid is placed at the Earth rotation axis a difference from the ordinary way for gravimetric derivations will lie only in an another procedure for accounting the centrifugal force, while the solvability conditions will be the same. Having established relationship between the disturbing potential T and density φ for a single layer using the formula

$$T = \int \frac{\varphi}{\eta} \, ds + 2 (W_o - V_o) \frac{R}{\varrho}$$

where : W_o - the gravity pontential at the initial point of levelling,

V_o - potential on the reference gravimetric ellipsoid,

ϱ - radius - vector of the point,

R - the Earth's mean radius,

The difference $W_o - V_o$ can be excluded from the Molodensky's integral equation facilitating the solution and simplifying the grade equations.

These equations will be further simplified, if the centre of reference gravimetric ellipsoid is placed at the point where the equatorial plane of the geodetic ellipsoid intersects the Earth rotation axis. Then, to connect the gravimetric ellipsoid to the geodetic coordinate system and to derive the potential W_o it will in principle be sufficient to derive the gravimetric quasigeoidal height and plumb-line deflection components at a single point having the known geodetic coordinates".

492 - CORON S. - "Gravity anomalies as a function of elevation : some results in Western Europe"
Geophys. Monograph n°13. The Earth's crust and upper mantle, p.304-312, 1969.

"Results of Bouguer anomalies against to heights for various regions of Europe : Alps, Central Massif (France), Norway, Sweden, islands (Corsica and Sardinia).

In conclusion

1) As a first approximation, the proportionality factor c between Bouguer anomalies and elevations can be considered constant ; this is actually so :
a - for zones of limited extent and,
b - for the variations of mean values related to large areas (Europe (1° x 1°) or to groups of stations of the same elevation.

2) In practice, this factor c varies with altitude : it decreases for high elevations.

3) It also varies according to the geographic conditions of the neighboring regions.

4) The value of the factor c rarely equals the ideal value 1.1 (density 2,67), which corresponds to the isostatic compensation of a plate layer".

493 - Preliminary report of the Hakuho Maru Cruise KH-68-3, July - August 1968, Northwest Pacific Ocean.
Ocean Res. Inst., Univ. Tokyo, 1968.

a) TOMODA Y. & al... - "Outline of gravimetry, magnetism and bathymetry". p.8-27.

"The cruise KH-68-3 was extended from Japan to the 180° meridian between 35° and 45° of latitude.

Three sets of shipborne gravity meters were installed on board the ship...

The results of grid survey on the Sinko Seamount have been studied : it is remarkable that the flat tops of these Seamount are not reflected to the free air gravity anomaly...".

b) SEGAWA J. & T. IGARASHI. - "Gravity data processing". p.28-40.

"The data obtained from T.S.S.G. punched on the 8-bit perforating paper tapes are processed by use of the Facom 270-20 high speed electronic computer which is equipped on board the ship. The computer

is so designed as can be used for real time processing as well as for Batch processing. On this cruise, however, only the Batch processing has been attempted.
The actual program is written in Facom 270-20 programing words FASP for the T.S.S.G. gravity analysis".

c) SETO T. - "G.S.I. type surface ship gravity meter". p.41-46.

"Measuring the total gravity with three vibrating strings including the effect of horizontal acceleration due to the ship's movement which is recorded by a horizontal accelerometer independently.

Preliminary results : According to the comparison between T.S.S.G.'s results and hand calculated values read from the analogue record upon several lines, it may be said that both results are quite parallel but have constant discrepancies which may be caused from the incomplete corrections of horizontal acceleration and nonlinear (f^2) effect.

Estimated drift which is determined by comparing data on the one way and return at the same position (38-00N, 163-59E) is about 1.6mgal/day".

494 - Bulletin Géodésique de l'Association Internationale de Géodésie, n°94, Paris, 1969.

a) MARCHANT R. & L. JONES. - "Résultats de recherches dans le domaine de l'étude statistique des erreurs de nivellement" p.365-380.

b) MONGET J.M. - "Une nouvelle méthode d'analyse statistique des données gravimétriques".

"It is obvious that the mean free air anomaly over the whole Earth is equal to zero, but in practice, it is always necessary to interpolate gravity in a local area where there is no reason to set such an hypothesis.

A new statistical theory already built by a French Professor, Dr. Matheron, unables to avoid this difficulty

- First, by estimating in an optimal way the trend effect of the anomaly in local sense : $M\{\Delta g\}$,
- Then, by substracting this average value, we may use a classical method applicable to centered anomalies such as minimising the standard error of interpolation.

"Krigeage" theory seems to be also well suited to prediction calculations by using correlations between gravity and other geophysical data".

495 - MELCHIOR P. - Marées terrestres.
Bull. Inf. n°55, p.2610-2687, Bruxelles, 1969.

496 - USANDIVARAS J.C. & B. DUCARME. - "Analyse des enregistrements de marée terrestre par la méthode des moindres carrés.
Obs. R. Belgique, Comm. Ser B, n°45 Ser. Geophys. n°95,
from : Bull. Acad. R.B., 5e Sér., t.LV, n°6, p.560-569, 1969.

"A partir de toutes les valeurs horaires de la marée lues sur les enregistrements et après multiplication par l'étalonnage, on construit les équations d'observation pour les différences de deux lectures successives.

La résolution du système s'effectue par les formules classiques de la théorie des moindres carrés ce qui permet un calcul rigoureux des erreurs quadratiques moyennes sur les inconnues.

La méthode est très souple car elle permet d'analyser des enregistrements présentant des interruptions de longueur arbitraire".

497 - Association Internationale de Géodésie - Commission permanente des marées terrestres, Bibliographie IV, 1966-1969.
Obs. R. Belgique, p.193-234, Bruxelles, 1969.

498 - Geological Survey of Northern Ireland - Gravity map of Northern Ireland.
Bouguer anomalies map, scale : 1/253.440 , 1967.

GEOFISICA INTERNACIONAL.
Revista de la Union Geofisica Mexicana, Auspiciada por el Instituto de la Universidad Nacional Autonoma de Mexico.

499 - MOOSER F. & M. MALDONADO-KOERDELL. - "Pene-contemporaneous tectonics along the Mexican Pacific Ocean Coast".
v.1, n°1, 20 p, Mexico, 1961.

500 - LOMNITZ C. - "Stresses and strains in the interior of a non-evolutive planet".
v.1, n°2, p.22-26, Mexico, 1961.

505 - v.7, n°2, Mexico, 1967.

a) BULLEN K.E. - "Seismic and related evidence on the structure of the Earth's upper mantle".
p.31-42.

b) FERRAES S.G. - "Statistical analysis of time-intervals of successive Earthquakes in Mexico City".
p.43-52.

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1 - BOWIN C., T.C. ALDRICH & A. WERTHEIMER. - "Gravity data obtained during Chain Cruise 75".
WOODS HOLE OCEAN. INST., Ref. n°69-16, 65 p, 1969.

"Profiles, tabulations, and charts are presented of principal gravity facts, free-air gravity anomalies, and simple Bouguer gravity anomalies obtained in the North Atlantic Ocean and Caribbean Sea during R/V Chain Cruise 75".

See p.II-7, n°438, for the results of the R/V Chain Cruise 73.

2 - KUBOTERA A., N. SUMITOMO, H. TAZIMA & S. IZUTUYA. - "A gravity survey on Aso Caldera Kyushu district, Japan".
Geophys. Inst., Sp. Contr. n°8, p.83-89, Tokyo, 1968.

"A gravity survey at 292 points in an area of about 1700 km^2 over the Aso volcanic region was made by using Worden and LaCoste & Romberg geodetic gravimeters from 1964 to 1966.

Bouguer gravity anomalies over this area are characterized by a strong negative anomaly on the Aso caldera and positive anomalies on the south-western flank of somma of the Aso caldera.

The gravity low of the Aso caldera shows characteristic feature of the "low anomaly type caldera" as is pointed out by Yokoyama.

On the south-western flank of the somma of the Aso caldera, the oldest formation consists of semi-shist (Sanbagawa System) and outcrop of basalt is also being found by geological surveys. The gravity high which reaches to 22 mgal at the center coincides with the distribution of basaltic formation. It reveals, therefore, the high density of material such as basaltic or metamorphic rocks.

The underground structure of the Aso caldera was computed from the observed gravity data by using the sin x/x method.

For the computations, models of basement layer and overlying layer, reasonable density contrast between two layers and the depth of datum-plane were assumed. Thus, several models were obtained which are, however, the first approximated ones".

3 - MORITZ H. - "Uber die Verwendung der Geländekorrektion zur Lösung des Problems von Molodenski".
D.G.K., R.A : Hohere Geod., H.n°63, 45 S, München, 1969.

4 - HEITZ S. - "Transformationen zwischen ellipsoidischen Koordinatensystemen".
D.G.K., R.A : Theor. Geod., H.n°64, 31 S, Frankfurt, 1969.

"First the author gives general equations for the transformation of the ellipsoidal longitudes, latitudes and heights between two systems basing on different reference ellipsoids in an arbitrary relative orientation. Then he deals with the determination of the six elements of relative orientation, especially in consideration to the transformation of geoid representations".

9 - BONATZ M. - "Ergebnisse gravimetrischer Parallelregistrierungen in der Erdgezeitenstation Bonn 1967 (68)".
D.G.K., R.B : Angew. Geod., H.n°170, 70 S, München, 1969.

"The results of gravimetric earthtide recordings with the Askania-Gravimeters GS 11 n°116 and GS 12 n°85a from 1.1.1967 till 26.1.1968 are opposed to each other and compared with the previous results obtained in

the station Bonn. For the amplitude quotients and phase lags of the main partial tides the preliminary total results are given. Using an electronic recording amplifier and meter screw calibration with change of the measurement range an augmentation of the internal accuracy was reached compared with other recording systems with also indirect calibration. The results in the station Bonn show again the necessity of researches to find new sources of systematical errors".

12 - REIGBER C. - "Zur Bestimmung des Gravitationsfeldes der Erde aus Satellitenbeobachtungen".
D.G.K., R.C : Dissert., H.n°137, 129 S, München, 1969.

13 - BREUER P. - "Rundungsfehler bei direkter Auflössung geodätischer Gleichungssysteme".
"Rounding errors in solving geodetic equations by direct methods".
D.G.K., R.C : Dissert., H.n°136, 47 S, München, 1969.

"Rounding errors in the adjustment of large geodetic networks are of great interest. This paper investigates the influence of rounding errors introduced during the course of computing using electronic computers. Several algorithms to solve linear equations were proved, e.g., GAUSS, CHOLESKY, GRUBER-JORDAN, Pivoting...".

28 - AMERIGHI PULITI M.C. & R. GALETTO. - "Experimental studies on the expression of the polynomials best approximating the error surface of the strips in the Reichenbach polygon".
Politecnico di Milano, Istit. Geod., Topog. e fotog. "Gino Cassinis". Pub. n°182, p.61-92, 1969.

"First of all a description is given of the method for adjusting the blocks of strips, that we use at present. This method is based on the independent adjustment of the three x, y, and z coordinates by means of a second degree polynomial formula.

The aims of the experimental research carried out on the results of six triangulations (partly analytical and partly analogical) relating the experimental polygon of Reichenbach are then exposed. The main aims are to check how a second degree polynomial formula can fit in the correction of the systematic errors and to verify whether their influence on the results of adjustment can be reduced by the use of a third degree polynomial formula.
We have also tried to establish the role that the different terms of the polynomial formula play in the adjustment".

29 - FLOYD G.F. - "Gravimeter filters".
Geophys., v 34, n°6, p.968-973, 1969.

"In order to obtain accurate gravity measurements from ships or aircraft, it is necessary to remove the "noise" effects of platform accelerations by filtering. At the same time, the filter must track the changing gravitational field, the "signal" or signal errors will result. Thus, there is the optimization problem of designing filters which maximize noise reduction without introducing signal tracking errors. The best class of filters for this purpose is defined in terms of what is called a zero signal-error constraint, which specifies that the filter must track any parabolic input with no error except a known time delay. Since the noise to be eliminated is such that a low-pass filter is required, study of the transfer functions was restricted to that type filter in light of this constraint. It was found that only the Butterworth filter with $n \geq 2$ is satisfactory. The problem of physical realization of an optimum filter was investigated by setting appropriate constraints on attenuation at the cut-off frequency and the envelope at the impulse response".

30 - MAJEWSKA M. - "Laboratory calibrating of narrow range of scale of Sharpe's gravimeter n°228G by means of the tilting method".
Proc. of the Inst Geod. & Cart., t.XVI, Z.2(38), p.115-127, Warszawa, 1969.

"In the Laboratory of the Institute of Earth Physics in Moscow the author carried out by means of the tilting method a laboratory calibration of the narrow measuring range of the Sharpe gravimeter n°228G, of Canadian production.

The author calibrated this gravimeter, as well as two further gravimeters, by using a Soviet-conceived device called the GAE frame. This examination was based on experiments made by two Soviet experts, K.J.Kozjakowa and R.B. Rukawisznikow.

All in all, the author made 19 series of measurements for the narrow measuring range - seven at + 20° C temperature and six each in a thermochamber at the temperatures + 5° C and + 35° C. The gravimeter coefficient k was determined by applying the formula :

$$g_{re} = k.n_k + f(n_k) + g_{ro},$$

where g_{re} = the true change in gravity acceleration due to tilting, k = a value given in mgal for one division of the gravimeter scale, n_k = the gravimeter reading, and g_{ro} = a constant characteristic of the given series of measurements.

The values obtained in determining k and f(n) for the different temperatures mentioned are given in tables 3, 4, 5, 6, 7, 8.

As the result of the examinations made in the thermochamber the author verified the dependence of coefficient k for the Sharpe gravimeter n°228G upon the temperature. In the range from + 5°C to 20°C the variableness of the coefficient per 1°C was found to be + 0,000004mgal per division, while in the range from + 20° C to + 35°C it is + 0,000002 mgal per division.

The character of the pattern of the scale division of the examined gravimeter is illustrated by a chart for function f(n) ; its values have been calculated as means from the values obtained from all temperatures taken into account".

31 - Trav. Inst. Geophys., Acad. Tchécosl. Sci.
Geofys. Sbor. 1967, n°263-287, v.XV, Praha, 1968.

a) KUCERA K.. - "Zur Berechnung des ersten gravimetrischen Korrektionsgliedes in der Methode von Molodenskij".
n°264, p.51-65.

b) SIMON Z. - "Bestimmung magnetischer Koeffizienten eines Pendelapparates vom Fechnerschen Typ".
n°265, p.67-76.

c) VYSKOCIL V. - "Some remarks on the accuracy of numerical interpolation of geophysical quantities".
n°266, p.77-90.

"The interpolated value g_{int} at an arbitrary point P can be determined from the Lagrange formula, in which g_i are the values at observation points and q_i are Lagrange's coefficients. The error $m(g_{int})$ of the value g_{int} is the result of four partial errors. The first partial error m_1 expressing the effect of mean square errors $m(g_i)$ of "observed" values g_i is given by relation. The magnitude of errors m_1 depends on the values :

$$A = \left\{ \sum_{i=0}^{n} q_i^2 \right\}^{1/2}$$

which are given for equidistant observation points in Tab.1. It is shown that methods of interpolation, using polynomials of higher

degree, do not guarantee more accurate results by themselves. The condition can be considered as a criterion for the applicability of interpolation formulae. The second partial error m]]is the error of the method of interpolation. The third mmis caused by errors in the co-ordinates x, y of point P and of the observation points. The values of some geophysical quantities depend on the altitude h. Partial error mmmust be considered when the function g(x, y,h) is interpolated as a function of two variables x, y and the altitudes h are neglected".

d) KOLBENHEYER T. - "Das gravitationsfeld eines homogenen Vielecks". n°267, p.91-106.

e) BERÁNEK B. - "Verification of the method of quantitative interpretation of anomalies of the second derivatives of gravity on theoretical models". n°268, p.107-130.

32 - INSTITUTO GEOGRAFICO Y CATASTRAL - "Red de observaciones con gravimetro de la Provincia de Gerona". 36 p, Madrid, 1969.

33 - BYL J. - "Eine Methode der Feineigungsmessung in der Erdgezeitenforschung und bei der Untersuchung rezenter Krustenbewegungen". Sond. : Z. Feingerat. H.4, 1969. Mitteil. Geod. Inst. Potsdam, n°106, 6 S.

34 - BUSCHMANN E. - "Zufällige und systematische Fehler in geodätisch-astronomischen Zeitbestimmungen". Geod. Inst. Potsdam, n°25, 135 S, 1969.

"Geodetic-astronomical observations of longitude and latitude are the foundation of researches on the rotation and polar motion of the Earth and on horizontal crustal movements. The results of the observations are strongly influenced by accidental and systematic errors. This concerns mainly the observations of longitude (time). It was the aim of the investigations, to find out the predominating cause of the errors and therefrom the further direction of research.

The results of about 3.000 time observations are used. They were made at the time service station of the Geodetic Institute Potsdam during the period of 1957 to 1963 by 9 observers with 4 transit instruments and 1 Danjon prismatic astrolabe. The tests are applied to the internal and external mean square errors as well as to the deviations of the individual observations from the smoothed time systems of the observers, the instruments and the station.

The results show clearly, that the instrumental caused errors predominate. The meteorological caused errors are unimportant.

Evidently the improvement of the instruments is the most important task in the future. Only then smaller effects can be determined with sufficient reliability'.

36 - BYL J. "Die Bestimmung der Vertikalkomponente der Erdgezeiten". (Le calcul de la composante verticale des marées terrestres).
Sond. : Z. Vermessung. 3/69 & 4/69.
Mitteil. Geod. Inst. Potsdam, n°113, 8 S.

37 - ARNOLD K. - "Zur Eindeutigkeit und Konvergenz des Ausdrucks für das gravimetrische Zusatzglied".
Sond. : Gerl. Beit. Geophys. 78, H.4, 1969.
Mittel. Geod. Inst. Potsdam, n°108, S.273-282.

"It is proved that the expression for the gravimetric correction term is both unique and convergent in any case and for any topography".

38 - ARNOLD K. - "Zur Konvergenz der Kugelfunktionsentwicklung für das Potential der Erde im Aussenraum".
Sond. : Gerl. Beit. Geophys 78, H.5, 1969.
Mittel. Geod. Inst. Potsdam, n°110, S.369-372.

"Substituting the Earth's surface by a sphere and neglecting terms of the order 10^{-7} to 10^{-8} in the geopotential it is proved that the spherical harmonics development for the geopotential converges in the whole external space of the Earth and on the Earth's surface".

39 - CAHIERRE L. - Comité National Français de Géodésie et Géophysique, Comptes-rendus, année 1968.
136 p, Paris, 1969.

40 - GARLAND G.D. - Chronique de l'Union Géodésique et Géophysique Internationale.
n°78, p.225-288, Paris, 1969.

41 - LAGAAY R.A. - "Geophysical investigations of the Netherlands Leeward Antilles".
Verhand. KKL Nederl., Akad. Wetensch. Natuurkunde, v.XXV, n°2, 86 p, Amsterdam, 1969.

42 - LACOMBAT M. & G. PIRCHER. - "Un nouveau procédé pour la mesure absolue de la pesanteur".
Mesures, régulation, automatisme, p.63-65, 1969.

"La méthode de mesure utilise un repérage interférométrique du mouvement d'un corps soumis à la pesanteur. Ce corps, élément d'un interféromètre, est un trièdre "coin du cube" dont les propriétés optiques maintiennent l'alignement du faisceau lumineux de l'interféromètre pendant la chute.

La source optique qui éclaire l'interféromètre est un laser à gaz hélium néon monomode, c'est-à-dire émettant une seule fréquence stabilisée qui a été préalablement étalonnée au B.I.P.M. par rapport à celle de l'émission du krypton 86 excité.

La visibilité des franges et le rapport signal sur bruit sont tels qu'il est possible de repérer dynamiquement la position du trièdre avec une précision du centièmre de frange...

Pour des relevés rapides et répétitifs, il est intéressant de s'imposer des intervalles L_1 et L_2 qui soient multiples entiers de la demi longueur d'onde, soit $\frac{\lambda}{2}$ et de numériser la mesure de temps. On évite de cette façon les mesures d'excédents fractionnaires et la résolution du gravimètre dépend essentiellement de la précision de la mesure du temps...

Dans le cas de nos expériences, les compteurs d'intervalles de temps, pilotés par une horloge à quartz de dérive inférieure à 5.10^{-10} par jour, ont une résolution de 10 nano-secondes...".