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N° 39

Novembre 1976

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- ANNOUNCEMENTS -

GRAVITY DATA BANK

The International Gravity Bureau (IGB) informs its Correspondents that the gravity data are now stored under processing system in the Data Bank of - BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES -.

The IGB thanks all Scientists for the contribution they already brought to the realization of this data base and, hopes that everyone will continue to send the new data so that the IGB could completely comply with the requests.

To make this task easier, the IGB kindly requests every one to comply so far as possible with the adopted format (cf. report : Progress report for the creation of a worldwide gravimetric data bank). Exceptionnally, if that were not possible, the IGB will make the necessary changes.

Particularly, if all the requested information were not recorded on magnetic tape, the complementary known parameters for a/or a group of stations could be provided on an extra technical form.

Le Bureau Gravimétrique International (BGI) informe ses Correspondants que les données gravimétriques sont maintenant stockées sous forme informatique dans la Banque des Données du - BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES -.

Le BGI remercie chacun de la contribution qu'il a déjà apportée à l'élaboration de base des données et, espère que chacun continuera d'envoyer ses données nouvelles afin que le BGI puisse répondre complètement aux demandes.

Afin de faciliter la tâche, il est demandé de se conformer autant que possible à la codification adoptée (cf. rapport : Progress report for the creation of a worldwide gravimetric data bank). Toutefois, si la transformation n'est pas possible, le BGI pourra exceptionnellement apporter les modifications nécessaires.

En particulier, si toutes les informations demandées ne sont pas enregistrées sur la bande magnétique, les paramètres complémentaires connus pour une/ou un ensemble de stations, pourront être fournis sur une fiche spéciale.

IGSN 71 Station Location Index Map

The International Gravity Bureau is very pleased to inform all Scientists that the Index Map showing the location of the IGSN 71 gravity stations is now available at our Office, due to the collaboration of the Defense Mapping Agency, Aerospace Center - Dr. Luman E. WILCOX.

It is a complementary document to the Special Publication N° 4 of the International Association of Geodesy titled : The International Gravity Standardization Net 1971 (IGSN 71), 1974.

This document - IGSN 71 Station Location Index Map - will be sent on request.

A participation in the mailing charges is required. The sum of : $ 3 or 15 French Francs is to be sent with the order to :

BUREAU GRAVIMETRIQUE INTERNATIONAL, Paris VI University,
4, Place Jussieu, tour 14, 75230 PARIS Cedex 05 (France).

VARIOUS INFORMATION

New Publication - MARINE GEODESY -

An International Journal of Ocean Surveys, Mapping and Sensing

Marine Geodesy is an interdisciplinary science, linking geosciences, marine sciences and space sciences, and provides the basic geographical / geophysical framework to which all ocean studies, technologies, and operations must relate. It is also the science which defines and establishes control points and related descriptive data within the ocean environment. Hence, the journal will devote itself to research and development related to precise measurements in the ocean, from space to the ocean, and the extension of terrestrial control into the ocean.

It will also address related areas of concern such as requirements, problems areas, and innovative applications of existing technology. Specific interdisciplinary subjects to be covered in the journal will include : topography and mapping, including satellite altimetry, bathymetry, and remote sensing ; positioning and precise navigation, including submersible navigation ; boundary demarcation and determination ; tsunamis ; geoïd determination ; marine instrumentation for range, depth, and angles ; ground truth and system calibration.

The journal will be published quarterly beginning in 1977. Institutional subscriptions will be priced at $ 40.00 , while personal subscriptions will be $ 20.00.

Dr. N.K. SAXENA, Editor in Chief
Department of Civil Engineering
University of Illinois at Urbana-Champaign
URBANA, Illinois 61801 (USA)

SYMPOSIUM ON NON-TIDAL GRAVITY VARIATIONS AND METHODS OF THEIR STUDY

Circular N° 1.

As a result of the agreement reached between the IAG National Committee of the Soviet Union and the Commissione Geodetica Italiana, the International Symposium on "Non-tidal gravity variations and methods of their study", originally planned to be held in Moscow in June, 1977, will instead take place at the same time in Trieste, Italy.

The Second Circular will give the precise dates and further information on the participation in the Symposium.

During the Symposium the following questions are to be discussed :

1. Theoretical aspects of non-tidal gravity variations.
2. Discussion on possible reasons causing non-tidal gravity variations :
    - 2.1. Dislocation of masses within the Earth.
    - 2.2. Variations in the speed of rotation of the Earth.
    - 2.3. Polar motion.
    - 2.4. Variation of the Earth rotation axis
    - 2.5. Dislocation of atmospheric and water masses
    - 2.6. Tectonic movements of blocks and plates
    - 2.7. Variation of the ground water level, soil humidity, density.
    - 2.8. Other possible reasons.
3. Results of non-tidal gravity variations studies of global, regional and local character, their interpretation.
4. Technical means and methods of non-tidal gravity variations studies.
5. National and international programs for the study of non-tidal gravity variations.

You are requested to inform us prior to the end of February, 1977 about your intention to take part in the Symposium and to give the title of the paper you propose to present. Will you please send this information to the address of Prof. Yu. D. BOULANGER, Soviet Geophysical Committee, Molodezhnaya 3, MOSCOW 117296, USSR.

For the local Organizing Committee
Prof. Antonio MARUSSI

Local Organizing Committee

- Prof. Maria Bozzi Zadro
- Prof. Icilio Finetti
- Prof. Antonio Marussi, Chairman
- Prof. Carlo Morelli

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TRAVAUX EN COURS AU BUREAU GRAVIMETRIQUE INTERNATIONAL

Le Directoire Scientifique du Bureau Gravimétrique International s'est réuni à Paris au mois de février 1976, à l'occasion de la réunion du Comité Exécutif de l'Association Internationale de Géodésie. Les décisions qui furent prises à cette occasion ont été déjà publiées dans le Bulletin d'Information précédent ; il paraît cependant nécessaire de tenir les gravimétristes au courant des projets en cours et de la marche des travaux d'exécution.

Au point de vue documentation générale, on a vu plus haut (announcement) que la banque de données (data bank) est prête à entrer en service et que le souci principal du Bureau sera de l'alimenter et de l'utiliser pour les besoins de la communauté internationale.

Le Bureau Gravimétrique exprime à ce sujet toute sa gratitude au Bureau de Recherches Géologiques et Minières (BRGM) qui a mis à sa disposition un analyste des plus compétents, un ordinateur et les crédits nécessaires.

Au point de vue des travaux courants, le Directoire Scientifique a approuvé les programmes suivants :

- Réseau fondamental

Le BGI collectionnera les fiches descriptives des stations fondamentales du réseau gravimétrique IGSN 71 en liaison avec le Department of Energy Mines and Resources - Earth Physics Branch - du Canada.

- Projet Africain.

Le Bureau Gravimétrique étudie la possibilité de rattacher tous les réseaux gravimétriques africains au système IGSN 1971.

- Répertoire des anomalies à l'air libre

Le Bureau Gravimétrique International doit préparer et tenir à jour un répertoire des anomalies à l'air libre par trapèzes de 1° x 1°, dans le système IGSN 1971 - Référence 1967.

Il préparera également une carte ou un répertoire des anomalies à l'air libre pour des trapèzes correspondant à des aires sensiblement équivalentes à 5° x 5° en adoptant la subdivision proposée par KAULA dans le "Journal of Geophysical Research" N° 71 (1966).

Dans la mesure du possible il s'efforcera de mettre au point une carte mondiale des anomalies de Bouguer.

Les lecteurs ont déjà été tenus au courant par la voie de ce Bulletin de la mise à jour des fiches signalétiques du réseau fondamental ; nous n'y insisterons donc pas davantage.

PROJET AFRICAIN

A partir du moment où l'on dispose d'un réseau mondial homogène de stations fondamentales, tel qu'IGSN 71, il est séduisant de l'utiliser à uniformiser les réseaux locaux ; les avantages de cette opération sont évidents :

a) Ces réseaux sont ramenés à une valeur correcte par rapport aux nouvelles mesures absolues, puisque toutes les mesures absolues connues à l'époque ont été prises en compte dans IGSN 1971.

b) Ils seront ou resteront homogènes entre eux.

c) On peut ainsi créer un véritable réseau de 2ème ordre développant IGSN 1971 et permettant le rattachement précis de tout levé gravimétrique nouveau à des bases plus proches.

Une première partie du travail a pu être menée à bien, du moins en ce qui concerne les calculs ; elle intéresse la plupart des réseaux observés dans les républiques africaines, dont les réseaux étaient rattachés au réseau ORSTOM (MARTIN, DUCLAUX ...). Il a été possible d'y rattacher également le réseau observé par J. LAGRULA en République Algérienne et d'en assurer la jonction avec le réseau ORSTOM dans le sud. On peut donc dès maintenant affirmer que sont rattachés à IGSN 1971, les réseaux suivants : République Algérienne, République du Sénégal, République du Mali, République Centrafricaine, République du Tchad, République Ivoirienne, Ghana, Zaïre, République Malgache. Dans la mesure où les stations peuvent être retrouvées et réoccupées, ce qui est évidemment fondamental et ne pourrait être vérifié que sur place, l'extension d'IGSN 71 à ces réseaux est donc possible et réalisée. Un petit catalogue de ces stations est en cours d'élaboration, malheureusement, on ne dispose pratiquement d'aucune fiche descriptive détaillée.

La question est différente pour les réseaux de l'Est Africain pour lesquels le Bureau Gravimétrique International ne dispose pas de la documentation nécessaire. Il fait donc appel à tous ceux qui seraient susceptibles de la lui procurer et demanderait qu'on la lui fasse parvenir ; en particulier, il désirerait vivement avoir la documentation relative aux réseaux suivants :
Egypte, Soudan, Ethiopie, Somalie, Uganda, Tanzanie, Mozambique , Kenya, Angola....

ANOMALIES A L'AIR LIBRE

Dans toutes les régions où le B.G.I. dispose de cartes fiables des anomalies de Bouguer, il procède à leur étude et au calcul des anomalies à l'air libre correspondantes, dans le système IGSN 71 - Référence 1967.

On escompte qu'un tel répertoire pourrait être présenté lors de la réunion de la Commission Gravimétrique Internationale en 1978. Bien entendu, on compare les valeurs obtenues à celles qui sont déjà publiées par d'autres organismes, et le document qui n'aura jamais et ne pourra jamais avoir qu'un caractère provisoire, proviendra d'une compilation générale de tous les documents en possession du BGI qui, bien entendu indiquera de la manière la plus explicite les sources exploitées quitte à les reproduire littéralement faute d'autres documents originaux.

Le répertoire 5° x 5° se déduira du répertoire 1° x 1°.

Le B.G.I. signale qu'il dispose, grâce à l'obligeance du Professeur RAPP (Ohio State University) d'une liste mécanographique donnant la répartition des aires géographiques couvertes dans la subdivision de KAULA et d'une copie du programme permettant de les calculer.

Pour l'étude du répertoire 1° x 1°, le B.G.I. fait appel à tous ceux qui pourraient mettre à sa disposition des cartes d'anomalies de Bouguer relatives à l'Afrique, couvrant notamment tous les Etats africains nommés plus haut, et serait reconnaissant à tous ceux qui peuvent lui indiquer les sources de documentation.

Les Géodésiens Africains pourraient lui faire parvenir ces renseignements, soit directement, soit pas l'intermédiaire du

Dr. A.M. WASSEF
UNITED NATIONS
Economic Commission for Africa
P.O. Box 3001
ADDIS-ABABA
(Ethiopia)

D'avance le B.G.I. les en remercie.

J.J. LEVALLOIS

WORKS IN PREPARATION AT THE INTERNATIONAL GRAVITY BUREAU

The Scientific Board of the IGB met at Paris in February 1976 during the meeting of the Executive Committee of the International Association of Geodesy. Decisions which were adopted at this time have been already published in the previous Bulletin d'Information, nevertheless, it seems necessary to keep the Gravimetrists informed of the projects in preparation and of the running of the tasks.

Regarding the general documentation, as mentioned hereafter, the data bank is ready to operate and the main worry of the Bureau is to provide the greatest possible number of data to the bank and to use it for the activities of the international community.

The IGB expresses all its gratitude to the BUREAU DE RECHERCHES GEOPHYSIQUES ET MINIERES which delegates for the IGB a highly qualified Analyst/Programmer and puts at its disposal a computer and financial supports.

As regards the general tasks, the Scientific Board gave its approval to the following programs :

- Fundamental Net

The IGB collects descriptive diagrams of the fundamental stations of the IGSN 71 in connection with the Department of Energy Mines and Resources (Earth Physics Branch) of Canada.

- African Project

The IGB is dealing with the possibility of readjustment of all African Gravity Networks in agreement with the IGSN 71 system.

- Index of mean free-air anomalies

The IGB has been asked to maintain and keep an up to date index of 1° x 1° mean free-air anomalies in the IGSN 71 - Reference 1967 System.

It will also produce a map or an index of the free-air anomalies for 5° x 5° squares, using the sub-division proposed by KAULA in : "The Journal of Geophysical Research", n° 71, 1966.

As far as possible, the IGB will try to establish a worldwide Bouguer anomalies map.

- The Scientists have already been aware of the updating of the descriptive forms of the fundamental network through the Bulletin d'Information.

AFRICAN PROJECT

Since we have at our disposal a worldwide homogeneous network of fundamental stations such as IGSN 71, it seems useful to unify the local networks ; advantages of this operation are obvious :

a) these networks are readjusted to a correct value with respect to the new absolute measurements as all absolute measurements known at this time have been taken into account in IGSN 71;

b) they will be or will stay consistent between them ;

c) consequently, we can establish a second order network developping IGSN 71 and enabling the precise readjustment of all new gravity plotting to the nearest bases.

A first part of this work has been worked out as regards the computations : it concerns most of the observed networks in the African Republics, of which the networks were tied up to the ORSTOM network (MARTIN, DUCLAUX ...). It has also been possible to tie up the network observed by J. LAGRULA in Algerian Republic and to make the connection with the ORSTOM network in the South.

From now we can say that the following networks are connected to IGSN 71 : Republics of Algeria, Senegal, Mali, Centrafrica, Tchad, Ivory Coast, Ghana, Zaïre, Madagascar.

As far as the stations can be found again and reoccupied, which is obviously fundamental and could be controlled only on the spot, the expansion of IGSN 71 to these networks is consequently possible and has been realized. A booklet of these stations is in course of preparation, unfortunately detailed descriptive forms are lacking.

The question is different for the Eastern Africa networks for which the IGB has not the necessary documentation at his disposal.

We call again the attention of all Scientists who are able to provide publications and ask them to send it to the Bureau. Particularly, we need documentation regarding the following networks :
Egypt, Sudan, Ethiopia, Somalian Coast, Uganda, Tanzania, Zambia, Kenya, Mozambica, Angola.

FREE-AIR ANOMALIES

In all the areas for which the IGB has some reliable maps we proceed to their study and make computations of the corresponding free-air anomalies in the IGSN 71 system - Reference 1967.

We suppose that such an index could be presented during the next International Gravity Commission in 1978. Obviously, we make comparisons with the obtained values and those which have already been published by other Organizations. The document to be prepared will have but a provisional character only ; it is issued from a general compilation of all documents in files at the IGB and will indicate as clearly as possible the processed sources.

The 5° x 5° index will come from the 1° x 1° index. The IGB points out that, due to the cooperation of Prof. RAPP (Ohio State University), they can provide a listing showing the distribution of the geographical areas covered in the KAULA's sub-division and a copy of the program enabling to compute it.

For the study of the 1° x 1° index the IGB calls all Scientists who could put at its disposal anomaly maps on Africa, covering particularly all the African Nations already mentioned here-above and will be grateful to those who could let it have the sources of documentation.

African Geodesists could supply gravity information either directly to the IGB, or through Dr. A.M. WASSEF, United Nations, Economic Commission for Africa, P.O. Box 3001, ADDIS-ABABA (Ethiopia).

Thanks to all for any sort of cooperation.

J.J. LEVALLOIS

AN ATTEMPT TO USE LA COSTE-ROMBERG MODEL G GRAVIMETERS AT THE MICROGAL LEVEL

B. DUCARME [*], K. HOSOYAMA [**], M. VAN RUYMBEKE [***] and T. SATO [**]

SUMMARY

High precision gravity measurements have been made between some fundamental stations of the belgian gravity network in the vicinity of Brussels. Three La Coste-Romberg model G gravity meters belonging to the ILO and the ORB were used with special electronic read out techniques. Special attention was paid to the levelling and changes in external temperature were minimized.
A ten microgals accuracy was always achieved.

1. INTRODUCTION

In the instruction manual of La Coste-Romberg model G meters the maker announces a 10 microgals (μgals) accuracy for his gravimeters. With instruments equipped with the electronic read out, it is however easy to reach a 1 μgal reading precision and to measure gravity changes up to 50 mgals with a precision of a few microgals, if the levelling is ensured to 5". Systematic errors due to the gravimeter itself (spindulum errors for example) are not taken into account. Nevertheless the discrepancies observed between gravimeters operating simultaneously were of the same order.

2. READING ACCURACY

One microgal is equivalent to 0.1 division of the reading dial. The classical reading technique is a zero method.
The reference wire seen through the ocular of the microscope is sent back to an adopted fixed reading line of the scale by turning the dial of the micrometric screw acting on the upper attachment point of the main spring. Because of backlash effects all displacements must be finished clockwise. In this way the reading precision is rather small, some tenths of a dial division. The personal errors can be rather high.

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[**] International Latitude Observatory, Mizusawa, Japan

[***] Observatoire Royal de Belgique - Université de Liège

A great improvement is introduced by the electronic read out. A capacitive transducer generates a voltage proportional to the displacements of the mass. A built-in galvanometer is used to monitor this electronic output and its zero can be adjusted to correspond to the adopted reading line. Then it is easy to send back this indicator with precision to zero by turning the dial and obtain in this way an accurate reading of the gravity changes. The galvanometer also introduces a good damping of the industrial and micro-seismic noise.

Nevertheless two sources of reading errors are still existing

- a personal error in the zero of the galvanometer,
- an interpolation error between two dials divisions.

It is a reason why a new reading technique has been developped based upon the use of small residual voltages and full dial divisions readings. A digital voltmeter is connected to the electronic output through a band reject filter (Wenzel, 1973) centered around a six seconds period in order to eliminate the microseismic noise. To minimize interpolation errors we are only using full divisions of the dial, for which the reading precision is the best. The small residual voltages are easily converted into fractions of micrometric divisions by a prior calibration. As the sensitivity of the electronic output is usually adjusted to 10 mV by dial division a very simple digital voltmeter with a 1mV resolution and a good zero stability will insure a reading accuracy of 0.1 division or 1 μgal. An example of this reading technique is given in table 1. The best accuracy is obtained by successively taking a reading by excess and by defect as seen in the table. The microgal accuracy is indeed really reached. By using an higher electronic sensitivity one could improve the resolution but the reading stability does not seem to be good enough to justify such a sophistication.

3. LEVELLING ACCURACY

Those who are using LCR meters for tidal registrations well know that the long term stability of the levelling is poor. It is partly due to the small spacing between the feet but also to some creep in the two spirit levels used. The sensitivity of these levels is weak, (50" by division). The screw pitch of the feet is rough and it is not easy to level the instrument with a precision of 0.1 division as requested for the microgal accuracy (see table 2 and Gerstenecker 1973).

To improve the levelling we fix the gravimeter on a plate base as used for quartz horizontal pendulums of Verbaandert-Melchior type.

Their stability is excellent as shown by the results of these pendulums recording clinometric tides with a precision better than 0"001. Moreover, the plates have one fixed food and two levelling screws at right angles. This characteristic allows us to tilt independently the longitudinal and the transverse levels of the gravimeter and makes easier not only the setting up of the instrument but also the check of the position of the minimum of sensitivity to tilting for both levels.

The plates have a feet spacing of 273 mm and the screw's pitch is of 0.5 mm. This makes an accurate levelling easier. The fixed foot ensures that we are always measuring at the same height above the ground.

4. LEVELLING CHANGES

Nevertheless an important source of levelling errors is still existing which is directly linked to the working conditions in the field. Changes in the external temperature badly affect the levels. The positions of the minimum of sensitivity to tilting and the bubble lengths of LCR 402 are given in table 3 for three different temperatures. When the temperature is decreasing not only the bubble length is changing but also its central position is shifting. This phenomenon is only an apparent drift of the levels. Indeed, when transferring the gravimeter from a room at 15°C to a vault thermostatized at 25°C, the levels originally set at the minimum of sensitivity for the room temperature, spontaneously drifted to the position previously determined in that vault as being the minimum of sensitivity. Nevertheless these apparent changes of the level setting with temperature is certainly the main limitation of the precision in field micro-gravimetry. To minimize their effects some caution are recommended :

1°) Check the position of zero. sensitivity to tilting at about the mean temperature during the measurements.

2°) For high precision measurements choose to link indoor or outdoor stations and avoid mixing them.

3°) To reduce thermal shocks during transportation protect permanently the meter by wrapping some foam around it.

5. THE CHOSEN GRAVITY STATIONS

In 1974 we had the opportunity to make simultaneous measurements with LCR 336 belonging to the Observatoire Royal de Belgique (ORB) and with the LCR 305 from the International Latitude Observatory (ILO) of Mizusawa, Japan. In 1975 another measuring party started using again LCR 305 from ILO and LCR 402 from ORB. We intended first to check a 30 mGals gravity base established by ORB in the vicinity of Bruxelles between the fundamental vault of the Observatory and the top of the monument of the Lion of Waterloo (Ducarme 1974, Table 5).

Next we wanted to connect some of the geophysical vaults that could be used for absolute gravity measurements and to check the gravity difference given in IGSN 71 between the main Airport Gravity Point (Brussels S) and the Fundamental Station of the Belgian Network (Brussels A). All the sites occupied are listed in table 4. Some intermediate stations have been introduced to check the coherency, as for example W1 at the bottom of the Monument of Waterloo and IGM 69 taken from the fundamental network of the Institut Géographique Militaire (IGM).

The complete structure of the network is given in figure 1. Table 6 is a summary of the gravimetric profiles. One should note that the main connections were made between stations having a small thermic gradient, i.e., indoor or outdoor. See for example ORBI-BRU TR on one side and ORB2-W5, ORB2-Sc17B on the other. It is a reason why an outdoor gravity point is generally provided for each of the geophysical observatories at Uccle and Louvain-la-Neuve. The direct connection between the outdoor and indoor station is then obtained very quickly to minimize thermal effects. Even so these links are often very difficult to measure very accurately as seen for example from the results given in table 7 for ORB1-ORB2. The drift is always irregular. Likewise on the profile ORB2-W5. The drift is changing much between the car transportation to the foot of the Monument (W1) and the ascension of the stairs to the summit (W5). It explains the poor coherency of the measurements made before 1974 as seen in table 5.

6. CONCLUSIONS

Detailed results are given in table 6. The coherency between the various LCR instruments is very good as seen from table 7. On the main connections the mean discrepancy is 2.10^{-4} on a total measured variations of more than 100 mGals.

If we compare our results to the previous measurements we find for the main connection ORB1-BRU TR a very good agreement with the value derived from IGSN 71. On the other hand, we know that errors have been made for the connections ORB1-ORB2 for which one finds values ranging from 0.55 (IGSN 71) to 0.76 mGal (IGM), but all the measurements since 1967 have given 0.62 mGal (see also table 5).

If we compare the LCR results with those given by the Worden instruments (table 8) we find a systematic difference of the order of 10^{-3}. We must emphasize that the Worden meters used had not been calibrated against IGSN 71.

The precision of measurements obtained with our method, is certainly better than 10 µGals as shown by the mean square errors (m.s.e.) on one back and forth measurement given in table 6a and 6d. The relative accuracy of the net evaluated from the comparison of various instruments is of the order of 0.05 per cent.

From our experience the best accuracy is achieved by using an impersonal reading technique and by ensuring an active and passive protection against thermal and mechanical shocks.

We thank here the Institut Géographique Militaire and the Institut d'Astronomie et de Géophysique Georges Lemaître from the University of Louvain for their help throughout our work.

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TABLE 1

READING TECHNIQUE USING SMALL RESIDUAL VOLTAGES

GRAVIMETER LCR 402 75/11/07

10 mV = 0.1 counter unit = 1 dial unit.
The output sensitivity is about 1 mV by µgal.

Station	Hours	Minutes	Counter Readings	Residuals mV	Corrected Readings
ORB1	15	51	45887,80	- 6	45887,86
		53	887,90	+ 4	887,66
		54	887,90	+ 5	887,85
		55	887,80	- 4	887,84
ORB66	16	01	45880,40	- 5	45880,45
		03	880,50	+ 4	880,46
		05	880,40	- 5	880,45
ORB1	16	13	45887,80	- 9	45887,89
			887,90	+ 2	887,88
			887,80	- 7	887,87

TABLE 2

EFFECT OF TILT ON MEASURED VALUES OF G

Tilt α	Δg theor [x] (ugals)	g obs [xx] (µgals)
- 30"	- 10.8	- 11.5
- 20"	- 4.9	- 4.5
- 15"	- 2.9	- 3.0
- 10"	- 1.2	- 1.0
- 5"	- 0.3	- 0.2
0"	0	0
5"	- 0.3	- 0.2
10"	- 1.2	- 0.9
15"	- 2.9	- 2.7
20"	- 4.9	- 5.0
30"	- 10.8	- 10.5

[x] $$\frac{dg}{d\alpha} = - g\ \mathrm{tg}\,\alpha \simeq - g\,\alpha$$

$$\Delta g = - g \int_0^{\alpha} \mathrm{tg}\,\alpha\ d\alpha = g \ln \cos\alpha - g \frac{\alpha^2}{2}$$

1 µgal error is equivalent to a levelling error of ± 9" around the point of minimum of sensitivity to tilting. It corresponds to ± 0.2 division of the levels.

[xx] The observed data were measured with special levels (20" by division) installed on the base of LCR 402.

TABLE 3

SHIFT OF THE SETTING OF THE LEVELS WITH RESPECT TO TEMPERATURE (LCR 402)

T°	Longitudinal level				Transverse level			
	L	R	l	c	RE	FR	l	c
5°	-2.5	2	4.5	-0.25	-2.5	1.4	3.9	-0.5
15°	-2.	2	4.0	0.	-2.	1.5	3.5	-0.25
25°	-1.5	2	3.5	0.25	-1.5	1.5	3.	0

L : left side of the bubble
R : right side of the bubble
RE : rear side of the bubble
FR : front side of the bubble
l. : total length
c : relative position of the bubble center.

TABLE 4

LIST OF THE GRAVIMETRIC POINTS

Number	Name	Latitude N	Longitude E	Altitude m	Equivalence in IGSN 71
1180/1	ORB1	50°47'55"	4°21'29"	98,03	BRUSSELS A
1180/2	ORB2	47'55"	27'28"	101,62	BRUSSELS B
1180/3	ORB55D	47'55"	21'28"	98,0	
1338/1	IGM 69	42'10"	30'8"	68,85	
1348/1	Scl7a	39'44"	37'21"	145,09	
1348/2	Scl7b	39'44"	37'21"	146,68	
1420/1	W1	40'47"	24'13"	135,75	
1420/5	W5	40'44"	24'13"	177,00	
1930/1	BRU TR	53'53"	29'10"	48.03	BRUSSELS S

TABLE 5

THE CALIBRATION BASE AT WATERLOO

a) Summary of the measurements performed between 1967 and 1973.

Grav.	ORB1-ORB2	N	ORB2-W1	N	W1-W5	N	ORB2-W5
Askania (143)	-0.62	1					
LCR (258,336)	-0.60	1	-19.56	2	-11.04	2	
North American (43,48)	-0.63	2	-19.59	2	-11.02	2	
Worden (399,453)			-19.56	4	-11.02	4	
MEAN	-0.62	4	-19.565	8	-11.025	8	-30.59

b) Summary of the measurements performed in 1974 and 1975.

LCR (305,336,402)	-0.62	4	-19.57	5	-11.00	3	-30.57

c) Accepted values

	-0.62		-19.57 ± 0.005		-11.01 ±0.01		-30.58 ± 0.015

N : Number of ties.

TABLE 6

MEASURED GRAVITY DIFFERENCES
EXPRESSED IN MILLIGALS

a) IGSN 71 stations

	LCR 305 1974	N	LCR 336 1974	N		MEAN
ORB1 - ORB2 1180/1-1180/2	-0.627 ±0.003 s = 0.009	4	-0.625 ±0.002 s = 0.002	4		-0.626 ±0.003
ORB1 - BRU TR 1180/1-1930/1	23.883 ±0.004 s = 0.009	4	23.882 ±0.002 s = 0.004	4		23.883 ±0.003

b) Calibration base

	LCR 305 1974	N	LCR 336 1974	N	LCR 305,402 1975	N	
ORB2 - W1 1180/2-1420/1	-19.573	2	-19.560	1	-19.575	2	-19.571 ± 0.007
W1 - W5 1420/1-1420/5	-10.997	2	-10.999	2			-10.998 ± 0.005

c) Uccle, Louvain-la-Neuve

	LCR 305 1975	N	LCR 402 1975	N		
ORB2 - Scl7b 1180/2-1348/2	-24.134	2	-24.127	2		-24.131 ± 0.003
Scl7b-IGM69 1348/2-1338/1	20.515	3	20.489	1		20.506 ±0.009
IGM69 - W1 1338/1-1420/1	-15.957	2	-15.936	2		-15.950 ± 0.007
W1 - Scl7b 1420/1-1348/2	-4.558	2	-4.553	1		-4.556 ±0.002

d) Microgravimetric ties

	LCR 402 1975	N
ORB1 - ORB66 1180/1-1180/3	-0.784 ±0.002 s = 0.003	5
Scl7a - Scl7b 1348/1-1348/2	-0.322 ±0.001 s = 0.002	6

N : Number of back and forth measurements
s : Standard error.

TABLE 7

COMPARISON BETWEEN THE LCR METERS

	LCR 305 (mGals)	LCR 336 (mGals)	LCR 305 - LCR 336 (microgals)
ORB1 - ORB2	0.627	0.625	+ 2
ORB1 - BRU TR	23.883	23.882	+ 1
ORB2 - W5	30.570	30.559	+ 11
Total	55.080	55.066	+ 14 or $2.5\ 10^{-4}$

	LCR 305	LCR 402	LCR 305 - LCR 402
ORB2 - SC17B	24.134	24.127	+ 7
ORB2 - W1	19.576	19.574	+ 2
ORB2 - IGM69	3.619	3.638	- 19
Total	47.329	47.339	- 10 or 2.10^{-4}

TABLE 8

COMPARISON BETWEEN THE MEAN OF LCR GRAVIMETERS AND THE WORDEN GRAVIMETERS USED BY THE NATIONAL GEOGRAPHIC INSTITUTE

	LCR	WORDEN 399	DIFF. W-LCR	IGSN 71
ORB1 - ORB2	- 0.62	- 0.62	0.00	(0.55)
ORB1 - BRU TR	23.88	23.91	0.03	23.88
		WORDEN 608		
ORB2 - SC17B	-24.13	-24.16	0.03	
ORB2 - IGM 69	3.63	3.63	0.00	
Total	52.26	52.32	0.06	

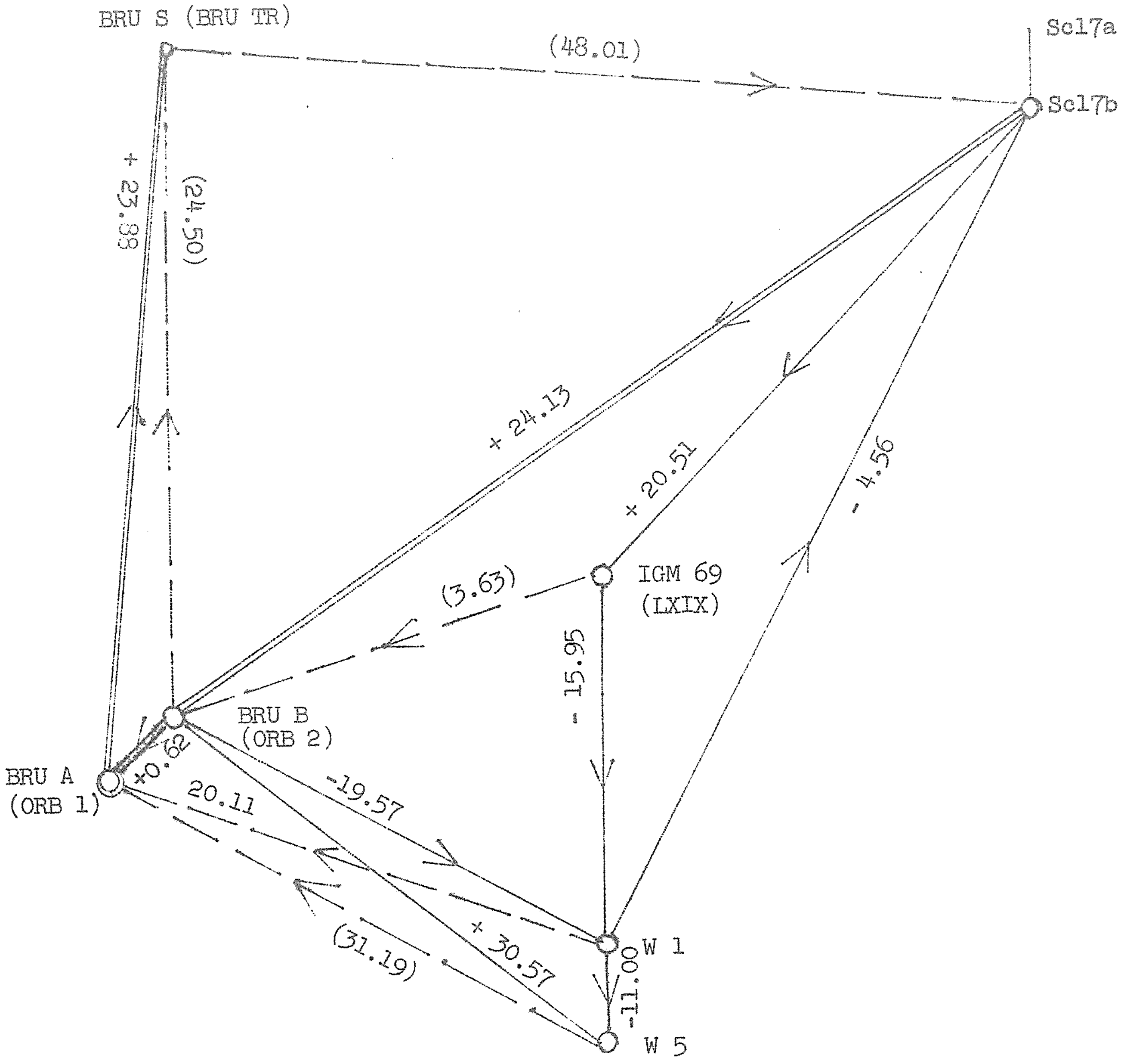

Fig. 1

MICROGRAVIMETRIC NETWORK REALIZED WITH THE LA COSTE-ROMBERG GRAVIMETERS
N° 305, 336, 402

Dashed lines indicate that no direct measurement has been made with LCR meters.

Stronger lines indicate high precision ties with at least two LaCoste working together. These ties are known with a precision of a few microgals.

ORB 1 - ORB 2	ORB 1 - BRU S	ORB 2 - Scl7B
0.626 ± 0.003	23.883 ± 0.004	24.131 ± 0.003

PROGRESS REPORT FOR THE CREATION OF A WORLDWIDE GRAVIMETRIC DATA BANK

by

J.P. LEPRETRE

BUREAU GRAVIMETRIQUE INTERNATIONAL

Nov. 1976

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ABSTRACT

This report presents the new orientation for the storage of gravimetric data in the data bank of the BRGM (Bureau de Recherches Géologiques et Minières) according to the propositions of the Working Group n° 1 (Meeting IGB of 23-24-25 February 1976 - Paris).

From amongst the various stages in this work, we are essentially concerned here with data acquisition, the definition of parameters and their codification.

At the end of this report we give three examples of Questions and Answers based on the data bank.

INTRODUCTION

The Gravimetric Bureau stores gravimetric data on punched cards using two codes :

- the BGI code as defined in the "Bulletin d'Information" N° 5, issued by the BGI, December 1963. We have partly adopted this code for the description of recordings. Two cards contain the information of each station ;

- the "calculation" code which uses only part of the data of the BGI code.

All the data (land data) stored on punched cards by the BGI are now stored on magnetic tapes.

In this paper we give an example of Questions and Answers using the structure of the bank (see 1st process report). In this paper we describe the new structure of the records, this new definition took into account propositions of the W.G. n° 1.

I - CHARACTERISTICS OF THE TAPES SUPPLIED FOR THE DATA AQUISITION

These are 9 track 1,600 B.P.I. tapes. Each station is described on fixed length records, and these records could be blocked.

Anyone who will send magnetic tapes to be stored in the data bank shall define the exact format of one record with the length of each parameter.

The record must be created using an alphanumerical system (Code EBCDIC).

In this example of records, for each type of gravimetric station, to schematize one octet or one character and its position in the record, we will speak of a column.

When the user will send data, he must define the codification adopted for each parameter if this codification is different of that in this paper.

II - ORGANIZATION OF THE DATA BANK

As a first stage, scheduled over five years, we envisage a data bank which could take up to 5 million gravimetric stations. This figure supposes an average collation of about 1 000 000 stations per year. It represents a wide estimate since the present stock of the B.G.I., 600 000 has been acquired over about ten years.

Internal structure of the bank (cf. fig. 3)

The classification of the gravimetric stations within the bank is based on a geographical arrangement of squares of 10°. The entire surface of the earth is thus divided into 640 squares (fig. 1). Within this classification, the squares are redivided into squares of 1°.

At the level of the squares of 1°, data is divided according to three types of station:

- the reference stations; (B)
- the current stations (sea); } (A)
- the current stations (land).

A) *The current stations for land and sea*

These stations provide all the standard gravimetric data. Several types may be distinguished, according to their origins: (parameter: SYSTEM OF REFERENCE):

- old marine data;
- new marine data;
- old land data;
- new land data.

"New" data are those which are converted (old obs.) or connected(future obs.) to the IGSN 71, whilst all others are known as "old" data.

N.B.: When a new network of bases - more recent and more accurate than that of IGSN 71 - has been set up, then the present "new" data will become "old" data, or will be cancelled. Correction programmes will arrange their reclassification automatically.

At the station level, access to data is via the latitude and longitude and system of reference parameters.

With knowledge of these parameters or keys, it is possible to select either one station on its own or a group of stations in a well-defined region.

The organization of this bank may be represented by fig. 3.

B) *The reference stations*

The separate classification of reference stations is also envisaged. They will be identified by their geographical coordinates and their identification number. We also distinguish two types according to their origins -
- old reference station : others than IGSN,
- new reference station : IGSN 71
Several values of g are therefore possible for one and the same station.

III - LIST OF PARAMETERS TO SUPPLY FOR A GRAVIMETRIC STATION

Remarks

In this paragraph we give the list of parameters under a recording format for:

1 - the reference stations,

2 - the sea gravimetric stations,

3 - the land gravimetric stations with:

a) a select list,

b) a complete list.

The descriptions of the common parameters to these five lists are given in the complete list § III-3-2.

For each list we describe only its specific parameters.

Each list will be presented under a recording format, it will be very useful to present your information in this format with blanks when the information is unknown.

III.1 - List of parameters for a reference station (Tab. 1)

Col. 1 System of reference

This parameter indicates the system of reference in which the value is given:

1 - local system,

2 - Potsdam system,

3 - System IGSN71.

Col. 2-8 Latitude (see p. 10)

Col. 9-16 Longitude (see p. 10)

Col. 17 Accuracy of position (see p. 10)

Col. 18-25 Date of the measure

e.g. 01 March, 1975 will put 19750301.

Col. 26-27 Type of observation (see p. 11)

The minus sign is put in column 26.

Col. 28-34 Altitude of the station (to 0.1 metre) (see p. 11)

Col. 35 Accuracy of altitude (see p. 11)

Col. 36-43 Observed gravity (see p. 12)

Col. 44 Accuracy of gravity (see p. 12)

Col. 45-48 Standard error

This parameter indicates the value of the correction in 1/1 000 mgal.

Col. 49 System of numbering for the reference station (see p. 13)

This parameter indicates the adopted system for the numbering of the reference station:

1 - for numbering adopted by IGSN71,

2 - for numbering adopted by BGI,

3 - for numbering adopted by Country

for a country it is very important to adopt the same system of numbering for the reference and current stations.

Col. 50-56 Reference station (see p. 13)

This station is the base station to which the station described here is referred. This parameter is given for all reference stations which are not of first order.

Col. 57 Determination of the altitude (see p. 18)

Col. 58-61 Geological information

Col. 62-64 Apparatus used (see p. 20)

The minus sign is put in col. 62. (see p. 22)

Col. 65-68 Country code - See Edition 1973 of Times Atlas.

Col. 69-75 Number IGSN71

Col. 76 System of numbering

It concerns the value mentioned col. 77-84.

See code col. 49.

Col. 77-83 Number BGI or National

The number of the reference station could be specific to a country, but in this case it is very important to have the same numbering put in the parameter "REFERENCE STATION" for the current station of this country.

Col. 84-89 Source information

Country which supplied the data

Col. 90-109 Province - Location

This parameter indicates the name of the province or of the town where the measure has been made.
The maximum length of the name is 20 characters.

Col. 110-129 Site of measure

It indicates the exact site of the measure.
The maximum length of the name is 20 characters.

Col. 130-132 Number of external ties

Ext. - Number of connections to stations with differing IGB numbers.

Col. 133-135 Number of internal ties

Int. - Number of connections to stations with the same IGB number.

Col. 136 Code description

Blank - sketch is unknown
1 - no description
2 - obsolete
3 - restricted access
4 - deleted station
5 - destroyed station
...

III.2 - LIST OF PARAMETERS FOR SEA MEASUREMENTS (tab. 2)

Col. 1 System of reference

It is the system to which this station is referred :
1 - local system,
2 - Potsdam system,
3 - System IGSN 71.

Col. 2-8 Latitude (see p. 10)

Col. 9-16 Longitude (see p. 10)

Col. 17 Accuracy of position (see p. 10)

Col. 18-29 Date

Col. 18-21	Year
Col. 22-23	Month
Col. 24-25	Day
Col. 26-27	Hour (G.M.T.)
Col. 28-29	Minute

Col. 30-32 Type of observation

Col. 30-31 (see p.11, col. 18 and 19, n°4... 7).

Col. 32 The minus sign will specify observations which have not been made at the surface of the sea, but of which the g values have been reduced to this surface :

- case of all measurements in a submarine - the published values are those obtained at the surface - ;
- case of several measurements with an underwater gravimeter on the bottom. ("Gravity expeditions 1948-1958", v.V, part II, Delft, Pays-Bas)

Col. 33-34 Type of depth under the gravimetric point

This parameter concerns the depth given columns 35 - 41.

1 - depth obtained with a cable (meters)
2 - manometer depth (")
...
4 - corrected acoustic depth (corrected from Mathews' tables, 1939)
5 - acoustic depth without correction obtained with sound speed 1500 m/sec. (or 820 brasses/sec.)
6 - acoustic depth obtained with sound speed 800 brasses/sec. (or 1463 m/sec.)
...
...
9 - depth interpolated on a magnétic record
10 - depth interpolated on a chart.
...

Col. 35-41 Depth (to 0,1 m)

Minus sign in column 35.

Col. 42 Accuracy of depth

The adopted code is the same as the one described in the complete list for the parameter "Accuracy of altitude" (p.11).

Col. 43-44	Mathews' zone When the depth is not corrected depth, this information is necessary. For example : Zone N° 50 for the Eastern Mediterranean Sea.
Col. 45-51	Altitude of the station (to 0,1 m), also for aerial measurements (see p.11)
Col. 52	Information about gravity given in columns 53 - 60 1 - Gravity with only instrumental correction, 2 - Gravity is the corrected gravity (instrumental and Eötvös correction) but not corrected by cross-coupling effect, 3 - Gravity is the corrected gravity (instrumental, Eötvös and cross-coupling correction) 4 - Gravity is the corrected gravity and also compensated by cross over profiles. ...
Col. 53-60	Gravity (corrected or compensated) to 0.01 mGal according to the indication col. 52.
Col. 61-68	Observed gravity (to 0,01 mGal) without Eötvös correction
Col. 69	System of numbering for the reference station (see p. 13, col.45)
Col. 70-76	Reference station (see p.13, col. 46-52). The number is given according to the indication col. 69.
Col. 77-83	Calibration information (see p. 14-15) In the same system of numbering as that of the reference station.
Col. 84-88	Free-air anomaly (to 0,1 mGal) computed against the reference formula given col. 123

Notes on anomalies at sea (cf. Bull. Inf. 1961, p.65-70)

1) In all cases of sea measurements, the "free-air" anomaly will be the difference between the value of g at the surface of the sea (observed or reduced value) and the theoretical value of g on the same surface.

That anomaly is equal to : $g - \gamma'_0$ (g observed at the surface)

$g_p' - (0.3086 - 2\ (0.0419\ \delta)).\ p' - \gamma'_0$ ($g_{p'}$ observed at the depth p')

$0.3086p'$ taking into account the distance at the centre of the Earth as in Earth measurements.

$2(0.0419\,\delta p')$taking into account the double attraction of the mass of water between the sea and the surface through the observation point.

2) Some authors have taken for the "free-air" reduction :

a) $g_{p'} - 0.3086\,p'$ (distance at the centre of the Earth as in Earth measurements),

b) $g_{p'} - 0.3086\,p' + 0.0419\,\delta\,p'$

(taking into account the attraction of one spherical layer)

δ = density of the water = 1.00 to 1.04.

Col. 89 Accuracy of free-air anomaly

It seemed useful to keep a column for that because several publications dealing with sea gravity measurements only mention that accuracy.

0 error ≤ 0.05
1 0.05 < error ≤ 0.1
2 0.1 < error ≤ 0.5
3 0.5 < error ≤ 1.0
4 1.0 < error ≤ 3.0
5 3.0 < error ≤ 5.0
6 5.0 < error ≤ 10.0
7 10.0 < error ≤ 15.0
8 15.0 < error ≤ 20.0
9 error higher than 20 mGal

Col. 90 System of position

0 unknown
1 Decca
2 visual observation
3 radar
4 Loran A
5 Loran C
6 Omega or VLF
7 Satellite.

Col. 91-99 Designation of the survey (letters or numbers)

It will be used for marine data according to the different campains.

Col. 91 Source of information

1 - Publications
2 - Limited publication (Catalogue)
3 - Listing
...
5 - Punched cards
6 - Magnetic tape

Col. 92-93 Name of the ship - For example, 2 first letters.

CHarcot
COnrad
VEma
HEcate
MEteor

Kt (Komet)
KOurtchakoff
VItiaz
...

Col. 94-99 (6 columns)
Characteristics of the cruise, variable according to each Organization.
Name and (or) numbering of the campain (sometimes with number of leg).

Ex. K 6173 = cruise Hécate K 6173
Nat 04 = North Atlant. Charcot 04
Polym 1 = Polymède 1
53 123 = 53e Exp. Vitiaz, leg 123

In the last example (only figures) a blank separate the 2 numbers (expedition and leg).

Col. 100-106 Country Code (7 columns)

It is the name of the country for which the measurements are made.

Ex. IGB Code :

Col.100-101 Name of the country as for the continental measurements

Col.102-106 Indexation in the IGB Library

Col. 107-109 Velocity of the ship (to 0.1 knot, i.e, 1 mile/h)

Col. 110-113 Topographic correction (to 0,1 mGal) computed according to the indication mentioned in columns 124-125.
Minus sign in column 110 if necessary.

Col. 114-118 Eötvös correction (to 0,1 mGal)
Minus sign in column 114 if necessary

Col. 119 Conditions of apparatus used :

1 = 1 gravimeter only (no precision)
2 = 2 gravimeters (no precision)
3 = 1 gravimeter only (without cross-coupling correction)
4 = 2 gravimeters (influenced by the cross-coupling effect) with the same orientation,
5 = 2 gravimeters (influenced by the cross-coupling effect) in opposition,
6 = 1 gravimeter (compensated for the cross-coupling effect)
7 = 1 gravimeter non subject to the cross-coupling effect
...

Col. 120-122 Apparatus used (see p. 21)

Col. 123 Theoretical gravity formulae used in the reduction (see p. 15-16)

Col. 124-125 Information about the topographic correction indicated in columns 110-113.

1 - correction computed for a radius of about 5 km (zone H de Hayford)
2 - correction computed for a radius of about 30 km
3 - correction computed for a radius of about 50 km
4 - " " " " " 100 km
5 - " " " " " 167 km
...
11 - correction computed from about 1 km to 167 km
12 " " " " 2,5 km "
13 " " " 5,2 km "
...

Col. 126-128 Density of the oceanic crust adopted in the computation of the topographic correction.
For example : 2,8 or 3,0. ...

III.3 - LIST OF PARAMETERS FOR LAND GRAVIMETRIC STATION

We propose two lists :

- A select list which includes the minimum of parameters ;
- A complete list which will be consulted if the user does not find the parameter in the select list.

III.3.1 - SELECT LIST (Tab. 3)

Col. 1	System of reference
Col. 2-8	Latitude
Col. 9-16	Longitude
Col. 17	Accuracy of position
Col. 18-19	Type of observation
Col. 20-26	Altitude of the station
Col. 27	Accuracy of altitude
Col. 28	Type of altitude
Col. 29-35	Altitude of the ground
Col. 36-43	Observed gravity
Col. 44	Accuracy of gravity
Col. 45	System of numbering for the reference station
Col. 46-52	Reference station
Col. 53	Information about isostatic anomaly
Col. 54-56	Apparatus used
Col. 57-60	Terrain correction
Col. 61-62	Information about the topographic correction indicated in columns 57-60 (see p. 8bis)
Col. 63-65	Density used for the topographic correction
Col. 66-71	Source of information

III.3.2 - COMPLETE LIST FOR A CURRENT GRAVIMETRIC STATION (Tab. 4)

Col. 1 System of reference (g values)

This parameter indicates the system to which this station is referred :

1 - Local system,

2 - Potsdam system,

3 - System IGSN 71.

Col. 2-8 Latitude

In degrees, and 1/10.000 of degree

Minus sign for southern latitude put before the first figure.

Col. 3-4 - degrees

Col. 5-8 - 1/10.000 of degree

Col. 9-16 Longitude - The reference meridian is Greenwich

In degrees and 1/10.000 of degree.

Minus sign for longitude W.G. put before the first figure.

Col.10-12 - degrees

Col.13-16 - 1/10.000 of degree

Col. 17 Accuracy of position

The site of the gravity measurement (single measurement or mean result) is defined in a circle of radius r.

0 no information on the accuracy
1 $r \leqslant 20$ m (approximately 0'1)
2 $20 < r \leqslant 100$
3 $100 < r \leqslant 200$ (approximately 0'1)
4 $200 < r \leqslant 500$
5 $500 < r \leqslant 1000$
6 $1000 < r \leqslant 2000$ (approximately 1')
7 $2000 < r \leqslant 5000$
8 $5000 < r$
9 ...

Col. 18-19 Type of observation

Col. 18 A minus sign distinguishes the pendulum observations from the gravimeter ones.

Col. 19

0. Current observation of detail or other observation of a 3rd or 4th order network.
1. Observation of a 2nd order national network or of a secondary national network.
2. Observation of a 1st order national network or of a primary national network.
3. Observation being part of a national calibration line.
4. Individual observation at sea.
5. Mean observation at sea (or in the air) obtained from a continuous recording.
6. Coastal ordinary observation (harbour, bay, sea-side,..).
7. Harbour base observation.
8. ...
9. Observation being part of international work (international 1st order network, official calibration lines), obtained from specialized publications.

It seems difficult to make a rigorous classification owing to the various ways of establishing gravity networks. However, in the above-mentioned system punches 9, 7 and 3, 2, 1 will mean stations more accurate than those defined as 0, 4, 6.

Col. 20-26 Altitude of the station

It concerns the g value mentioned later (Col. 36-43).
Adopted unit: decimeter.

Col. 20 Sign of the altitude. Minus sign for an observation below sea level.

Col. 21-26 Altitude in decimeters.

Col. 27 Accuracy of altitude (mentioned Col. 20-26)

The error e on the altitude will be defined by the following code:

1	$e \leq 0.1$ m
2	$0.1 < e \leq 1$
3	$1 < e \leq 2$
4	$2 < e \leq 5$
5	$5 < e \leq 10$
6	$10 < e \leq 20$
7	$20 < e \leq 50$
8	$50 < e \leq 100$
9	error superior to 100 m.

Col. 28 Type of altitude mentioned Col. 20-26

(or geographical characteristics of the site in view of the gravity reductions). h_s = altitude of the station.

0. Ordinary measurements at the earth's surface on land.
1. Tower, building.
2. Mine, tunnel.
3. At the bottom of a lake. $h_s > 0$
4. At the surface of a lake.
5. On a glacier.
6. On land, under the zero level.
7. Below ground. $h_s < 0$
8. At the bottom of the sea or a lake.
9. At the surface of the sea. $h_s = 0$

Col. 29-35 Altitude of the earth's surface at the vertical of the station

Adopted unit: decimeter.

In some cases defined in columns 20-26 the altitude of the ground is not the same as the altitude of the observation station; this information is necessary to permit the gravimetric reductions.

Therefore, the meaning of the here-mentioned altitude will depend on the case of column 28:

in the above-defined cases 0 and 6
= same value as the altitude of the station,
in the above-defined cases 1, 2 and 7 (tower, tunnel, mine)
= altitude of the external surface of the ground,
in the above-defined cases 3 and 8 (bottom)
= altitude corresponding to the mean altitude of the lake or altitude zero (ocean),
in the above-defined cases 4 and 9
= altitude of the bottom of the lake or depth of the sea,
in the above-defined case 5 (glacier)
= altitude of the rock surface.

The standard signs are the same as those used for the altitude of the station (Col. 20-26). The altitude is expressed in decimeters.

Col. 36-43 Observed gravity (to 0.01 mgal)

Col. 44 Accuracy of gravity

(when all systematic corrections have been applied)

0	standard error ≤ 0.05 mgal
1	0.05 < error ≤ 0.1
2	0.1 < error ≤ 0.5
3	0.5 < error ≤ 1.0
4	1.0 < error ≤ 3.0
5	3.0 < error ≤ 5.0
6	5.0 < error ≤ 10.0
7	10.0 < error ≤ 15.0
8	15.0 < error ≤ 20.0
9	error superior to 20 mgal.

This error corresponds to the apparent relative accuracy of the measurement deduced from the closing or the adjustment of the networks.

Col. 45 System of numbering for the reference station

This parameter indicates the adopted system for the numbering of the reference station:

1 - for numbering adopted by IGSN71,

2 - for numbering adopted by BGI,

3 - for numbering adopted by country.

in the case n°. 3 it is very important to adopt the same system of numbering in the description of the reference station.

Col. 46-52 Reference station

This station is the base station to which the concerned station is referred. This station will be:

- generally the reference station of the national network (principal or auxiliary site: exterior point, airport);

- sometimes, a station of the primary national network, a harbour (measurements at sea);

- in a very few cases (prospecting gravity surveys), an ordinary station which would later be connected onto the national reference station.

The numbering of the station is according to the parameter given Col. 45.

BGI numbering

For those stations, the following system has been adopted:

- 6 columns to define the site of the station;

- a 7th column to differentiate the various values adopted at each site by the observers (the number of those values being considered as smaller than 10).

a) Definition of the site (fig. 1 and fig. 2)

a.1) The three first figures mean the square of 10° in which the station is located.

Those three figures are given by the following formulae, according to the quadrant: (fig. 2)

for quadrant I $36 + 36 (\Phi x) - \lambda x$
for quadrant II $1 + 36 (\Phi x) + \lambda x$
for quadrant III $325 + 35 (\Phi x) + \lambda x$
for quadrant IV $360 + 36 (\Phi x) - \lambda x$

Φx = figure of the tens of degrees of latitude without taking the sign into account.

λx = number of tens of degrees of longitude, including the figure of the hundreds without sign. e.g.: 168° = 16.

This method allows a regular and continuous numeration of geographic squares of 10°. So the square of the northern hemisphere are numbered from 1 to 324 and those of the southern hemisphere from 325 to 648 (fig. 1).

a.2) The 4th and 5th figures signify:

the figure of the units of degree (latitude),
the figure of the units of degree (longitude).

Therefore, those 5 figures differentiate the site of the station by square degree.

e.g.: Paris (Sèvres) = 48°49'45" N   2°13'14" E.G.
The five figures are: 180 82.

a.3) The 6th figure is used to distinguish the various sites situated in the same square degree.

We suggest the use of letters A to I for the stable sites (Observatories, Institutes...) and the last letters of the alphabet for the provisional sites (airports, railway stations...). In both cases, free letters should be left in view of further sites not yet defined. The following example is given:

Paris (Sèvres, pt. A)	180 82 A
...	...
Paris (Obs., pt. A)	180 82 B
Paris (Obs., pt. C)	180 82 C
Paris (Obs. pil. E, anc. salle)	180 82 E
...	...
Paris-Le Bourget (aérod., hall, près esc.)	180 82 K
Paris-Orly Sud (aérod., 1er étage)	180 82 O

b) Adopted value

The value used as base value is defined in the 7th column by means of a specific numerical code for each site. This parameter does not concern the user - it is only a system for the B.G.I..

So, for Paris (Observ., pt. A):

- figure 0 means the value 980 943.00 mgal
- figure 1 means the value 980 943.15 mgal
- figure 2 means the value 980 943.35 mgal etc..

Col. 53-59 Calibration information (station or base)

This zone will reveal the scale of the gravity network in which the station concerned was observed, and allow us to make the necessary corrections to get a homogeneous system.

In most cases this information will be a reference I.G.S.N. station connected to another reference I.G.S.N. station ("calibration station" defined by the same system as the reference station), the comparison between the two stations will give the scale of the network.

It should be noted that the "calibration station" may be actual or fictious:

- either it may actually have been occupied during the gravity survey (secondary station such as the g value at this point would be sufficiently different from the g value of the reference station; if no special station is indicated, it is possible to choose from among the reoccupied station);

- or its site (and adopted value of g) may not have been actually occupied by the user (previously or afterwards) to determine the constants of the apparatus (calibration) or to check the gravity survey.

This station could be a point of the national calibration line.

e.g.: In France, Toulouse (Obs.) 980 443.10 mgal.

In a few cases, when the gravity network is defined by a reference station and by a calibration base, which is well known but quite independant from the reference station, the calibration line will be indicated in this zone by means of a code which will be defined later.

In the case of measurements at sea, the two stations (reference and calibration) will generally be the reference station of the national network and a harbour station near the station concerned:

e.g.: stn 119 (Gedenkboek (F.A. Vening Meinesz, p. 114):
Washington, Com. Build. 980 118 mgal
Port of Spain 978 177 mgal.

Col. 60 Computation of reductions and anomalies

Theoretical gravity formulae used in the reductions

Many formulae have been defined:

- without terms of longitude:

Helmert 1901 - Bowie 1917 - Heiskanen 1928 - Krassowsky 1938 - Heiskanen 1938 - Heiskanen, Uotila 1957 - International 1930 - IAG System 1967.

- with terms of longitude :

Helmert 1915 - Heiskanen 1924 - Heiskanen 1928 - Niskanen 1945 - Uotila 1957.

We have selected the following formulae which have been used in the past:

0 = International (1930)

$$\gamma o = 978.0490 (1 + 0.005\ 2884 \sin^2 \Phi - 0.000\ 0059 \sin^2 2\Phi)$$

1 = Helmert 1901

$$\gamma o = 978.030 (1 + 0.005\ 302 \sin^2\Phi - 0.000\ 007 \sin^2 2\Phi)$$

2 = Bowie 1917

$$\gamma o = 978.039 (1 + 0.005\ 294 \sin^2\Phi - 0.000\ 007 \sin^2 2\Phi)$$

3 ...

4 ...

5 = Helmert 1915

$$\gamma o = 978.052 (1 + 0.005\ 285 \sin^2\Phi - 0.000\ 0070 \sin^2 2\Phi + 0.000\ 027 \cos^2\Phi \cos^2 (\lambda + 17°))$$

6 = Heiskanen 1924

$$\gamma o = 978.052 (1 + 0.005\ 285 \sin^2\Phi - 0.000\ 0070 \sin^2 2\Phi + 0.000\ 027 \cos^2\Phi \cos^2 (\lambda - 18°))$$

7 IAG System 1967

$$\gamma o = 978.03185 (1 + 0.005\ 278895 \sin^2\Phi + 0.000\ 023462 \sin^4\Phi)$$

The code figures not yet used will be reserved for formulae to be determined.

N.B.: If the user adopts another formula, he must indicate this formula on a separate sheet of paper, and put a blank in this column.

Col. 61-65 Free air anomaly (to 0.1 mgal)

Results are given to 0.1 mgal.

Classical free air anomaly: $(gobs + F.h_s) - \gamma'_o$

h_s= altitude of the station

$$F = 0.308\ 5507 - 0.000\ 000\ 07254\ h_s + 0.000\ 2270 \cos 2\Phi - 0.000\ 000\ 00011\ h_s^s \cos 2\Phi - 0.000\ 0005 \cos^2 2\Phi$$

(HIRVONEN - 1960)

N.B.: This exact coefficient F is seldom used by the authors; in most cases, the approximated coefficient used is the following: F' = 0.3086.

In some cases, this coefficient F' produces large errors:

e.g.: 45° 2,000 m 0.4 mgal
65° 1,000 m 0.3 mgal.

Col. 66-70 Bouguer anomaly (to 0.1 mGal)

The expression of the "complete" Bouguer anomaly is :

Free-air anom. - Infinite plane slab attraction + b + ct

or Free-air anom. - Spherical cap attraction + ct

$$\text{Boug. anom.} = g.\text{obs} + (F - 0.0419d + b)h_s + ct - \gamma_o'$$

h_s = altitude of the station ; d = density

ct = topographic (or terrain) correction

b = Bullard's term (E.C. BULLARD, 1935) *

F = coefficient adopted for the free-air anomaly correction.

This term b is the difference between the effect of the spherical cap (external radius of the zone O_2) and Bouguer's plate. It removes the effect of the plate which is outside zone O_2 and adds the correction caused by the curvature of the Earth.

An approximate relation of this term is given in the following form :

$$b = 2\pi kd.h_s \left(\sin \frac{1°29'58''}{2} - \frac{h_s}{R} + \frac{1}{3}\frac{h_s^2}{R^2} + \ldots\right)$$ (V.VYSKOCIL, 196[illegible])

This term reaches 1.2 mGal, 1.7 mGal, 1.5 mGal respectively for h_s = 1.000 m, 2.000 m, 3.000 m.

Moreover, in many cases, the "complete" Bouguer anomaly defined above is not calculated ; the curvature of the Earth is neglected (with d = 2.67 th simplified coefficient 0.1118 is often used), the terrain correction is not calculated or not expanded to the zone O_2. So, columns71-72 are reserved for this information.

Col. 71-72 Information concerning the Bouguer anomaly

- Horizontal plate without Bullard's term
  - 0 = without topographic (or terrain) correction (ct)
  - 1 = ct computed for a radius of about 5 km (zone H)
  - 2 = ct computed for a radius of about 30 km (zone L)
  - 3 = ct computed for a radius of about 100 km (zone N)
  - 4 = ct computed for a radius of about 167 km (zone O_2)
  - ...
  - 11 = ct computed from about 1 km to 167 km
  - 12 = ct computed from about 2,5 km to 167 km
  - 13 = ct computed from about 5,2 km to 167 km
- Horizontal plate including Bullard's term (or spherical cap)
  - 5 = without ct
  - 6 = ct computed for a radius of about 5 km (zone H)
  - 7 = ct computed for a radius of about 30 km (zone L)
  - 8 = ct computed for a radius of about 100 km (zone N)
  - 9 = ct computed for a radius of about 167 km (zone O_2)
  - ...
  - 21 = ct computed from about 1 km to 167 km
  - 22 = ct computed from about 2,5 km to 167 km
  - 23 = ct computed from about 5,2 km to 167 km

---

* Tables for Bouguer reduction and Bullard's term :

- "Corrections d'altitude diminuées de l'attraction d'une calotte sphérique d'épaisseur h_s et de rayon 166,735 km, en 0,1 mGal" - P. LEJAY. Dans : (Développements modernes de la gravimétrie), Gauthier-Villars, Paris, 1947
- "Bullard's difference in 0.01 mGal for density 2.67 g/cm^3". M. PICK, J. PICHA, V. VYSKOCIL, Trav. Inst. Geophys., Acad. Tch. Sci., 1960, n° 129, Prague, 1961.

Col. 73 Information about isostatic anomaly

0. no information,
1. information exists but is not stored in the data bank,
2. information exists and is included in the data bank.

Col. 74-77 Density for the Bouguer reduction

The density is mentioned to 0.01 (e.g.: 2.67 give 267).

The density mentioned is that used for the plate correction

Where the Bouguer anomalies have been computed in different hypotheses, the Bouguer anomaly computed with the density 2.67 (or about 2.67) will be preferentially punched.

Where various densities have been used for the plate correction, the most important density should be mentioned in the reduction; for instance:

- density of the layers beneath the arbitrary mean level (some German maps...);
- density of the ice ...,

and a minus sign should be added in column 74.

N.B. The density used for topographic correction will not be mentioned: actually in mountainous areas, it has practically the same value as that used for the plate correction; in flat areas, the variation of density is of little importance.

Col. 78 Determination of the altitude (h_s)

Classification of the determination of the previously mentioned altitudes (Col. 20-26).

... no information
0 ... geometrical levelling (bench mark)
1 ... barometrical levelling
2 ... trigonometrical levelling
3 ... data obtained from topographical map
4 ... data directly appreciated from the mean seal level; (the site concerned being very close to the sea)
5 ... data measured by the depression of the horizon (marine)
6 ... nautical sounding
7 ... directly measured depth
8 ... measurements with radar

Col. 79 Type of regional altitude H_m

The parameter given in this column indicates the radius of the chosen zone for the altitude Col. 79-83.

... no information
1 ... radius of approximately 10 km
2 ... radius of approximately 100 km
3 ... radius of approximately 200 km

Col. 80-84 Regional altitude (in metres)

Hm : mean altitude surrounding the observation point in a radius of 10 km approximately.

Col. 85-87 Correction to the altitude of the station

A correction could be added to the above-mentioned altitude (Col. 20-26) when this altitude has been referred to an entirely conventional level such as some levelling in the Antarctica ...

That correction would only be used as an indication for later geodetic computations : the anomalies punched on the card concerned being computed with the previously mentioned altitude (Col. 20-26).

The value will be given in decimeters.

Col. 88-91 Geological information

The codification is not yet defined.

Col. 92-94 Apparatus used for measurements of g

Col. 93-94 0.. Pendulum apparatus constructed before 1932

00 Repsold pend. (used by Borrass, Albrecht, Barraquer, Oppolzer...)
01 Defforges pendulum
02 Sterneck's first apparatus
03 Sterneck's apparatus (with Helmholtz coil)
04 U.S.C. & G.S. Mendenhall apparatus (bronze pendulum)
05 U.S.C. & G.S. Mendenhall apparatus (invar pendulum since 1920)
06 Lenox-Conyngham apparatus
07 Mioni apparatus
08
09 Vening Meinesz tripendulum apparatus (pendulum made of brass, therefore practically non-magnetic).

1.. Recent pendulum apparatus (1930-1960)

10 Askania (4 Invar pend.) without Helmholtz coil
11 Askania (4 bronze pend. or Invar pend. with Helmholtz coil)
12 Cambridge, England (3 Invar pend.) without Helmholtz coil
13 Cambridge, England (3 Invar pend.) with Helmholtz coil
14 U.S.C. & G.S. Mendenhall (4 Invar pend.)
15 Dominion Observatory, Canada (2 bronze pend.)
16 Com. Geod. Ital. (3 molybdenum pend.)
17 Gulf (2 quartz pend.)
18 G.S.I., Japan (3 quartz pend.)
19 PAS, U.R.S.S. (6 quartz pend.) constructed in 1957.

2.. Latest pendulum apparatus (after 1960) and absolute apparatus

20 TsNIIGAIiK apparatus (USSR)
...
25 Absolute apparatus, BIPM (symmetrical free motion)
26 " " USA (free fall)
...
28 " USSR

3.. Gravimeters for continental measurements, in which the variations of g are equilibrated or detected using the following methods:

30 torsion balance (Thyssen, ...)
31 elastic rod (Ising pend. and Holweck-Lejay inverted pend. ...)
32 bifilar system (Schweydar, Berroth, Tomaschek, ...)
33 gas-pressure (Haalck, ...)
34 capacity of a condenser (Lindblad, Boliden, ...)
35 vibrating string (Gilbert, Lozinskaya, ...)
36 ...
37 Cryogenic gravimeter
38 Stabilized laser gravimeter
39 ...

4.. Metal spring gravimeters for continental measurements

40 several seldom used apparatus: Hartley, Truman, Magnolia, Atlas, Mott-Smith, ...
41 ...
42 Askania (Gs 4-9-11-12 ...), Graf

43 Gulf, Hoyt, (Helical spring)
44 North American
45 Western
46 ...
47 Lacoste-Romberg
48 Lacoste-Romberg, model D (microgravimeter)
49

5.. Quartz spring gravimeters for continental measurements

50 Several seldom used apparatus: Frost, ...
51 Norgaard
52 GAE - 3
53 ordinary Worden
54 Worden (additional thermostat)
55 World Wide
56 GAK (3M - 4M - 6M - PT) GRK-2
57 Canadian Gravity Meter, Sharpe
58 GAG-2
59 ...

6.. Gravimeters for underwater measurements (at the bottom of the sea or of a lake)

60 Gulf
61 ...
62 Western
63 North American
64 Lacoste-Romberg
Remote control type
65 vibrating string (WING)
......
69 ordinary Worden (bathyscaphe)

7.. Gravimeters for measurements on the sea surface or at small depth, (submarines...)

See Col. 28 to distinguish the exact observation site.

70 Graf-Askania
71 ...
72 Lacoste-Romberg
73 LaCoste-Romberg (on a platform)
74 GAL and GAL-F (used in submarines) GAL-M
75 AMG (USSR)
76 Tokyo Surface Ship Gravity Meter (TSSG)
77 GSI sea gravity meter
78 GMN, GNU

8.. Gravimeters for aerial measurements

80 airborne Lacoste-Romberg
81 ...
82 airborne Graf-Askania
...
...

Col. 92 A minus sign might indicate that the apparatus has not been used in usual conditions

e.g.: - oscillation of a simple pendulum in Sterneck pendulum apparatus (Connection Uccle - Leopoldville)

- Use of a sea gravimeter for airborne test measurements.

Col. 95-98 Value of the terrain correction (to 0.1 mgal) computed according to the previously mentioned radius. (col. 71- 72).

Col. 99 Gravimetric relief or rate of significance of the Bouguer anomaly

Horizontal gradient of the anomaly for each km computed on the normal direction of the isanomals, at a distance of 5 km on both sides of the observation point.

... no information
0 gradient ≤ 0.01 mgal/km
1 0.01 < gradient ≤ 0.05
2 0.05 < gradient ≤ 0.1
3 0.1 < gradient ≤ 0.5
4 0.5 < gradient ≤ 1.0
5 1.0 < gradient ≤ 2.0
6 2.0 < gradient ≤ 3.0
7 3.0 < gradient ≤ 4.0
8 4.0 < gradient ≤ 5.0
9 gradient higher than 5.0 mgal/km.

Col. 100-101 Type of the isostatic (or other) anomaly mentioned below

0... Pratt-Hayford hypotheses (J.F. HAYFORD & W. BOWIE, 1912 - P. LEJAY, 1948, 1950)

01 = 50 km including indirect effect (Lejay's tables)
02 = 56.9 km
03 = 56.9 km including indirect effect
04 = 80 km including indirect effect (Lejay's tables)
05 = 96 km
06 = 96 km including indirect effect
07 = 113.7 km
08 = 113.7 km including indirect effect (Lejay's tables).

1... Airy hypotheses (equality of masses or pressures) (P. LEJAY, 1948, 1950 - W. HEISKANEN, 1931, 1938)

10 = T = 20 km (Heiskanen's tables, 1931)
11 = T = 20 km including indirect effect: (Heiskanen's tables 1938 or Lejay's)
12 = T = 30 km (Heiskanen's tables, 1931)
13 = T = 30 km including indirect effect: (Heiskanen's tables 1938 or Lejay's)
14 = T = 40 km (Heiskanen's tables, 1931)
15 = T = 40 km including indirect effect: (Heiskanen's tables 1938 or Lejay's
16 = T = 60 km (Heiskanen's tables, 1931)
17 = T = 60 km including indirect effect: (Heiskanen's tables 1938 or Lejay's)

2... Vening Meinesz Regional hypotheses, T = 20 km (F.A. VENING-MEINESZ, 1941)

R = radius of regionality; T = normal thickness of the crust.
20 = R = 0
21 = R = 29.05 km
22 = R = 58.10 km
23 = R = 116.20 km
24 = R = 174.30 km
25 = R = 232.40 km

3... Vening Meinesz Regional hypotheses, T = 30 km

30 = R = 0
31 = R = 29.05 km
32 = R = 58.10 km
33 = R = 116.20 km
34 = R = 174.30 km
35 = R = 232.40 km

4... Vening Meinesz Regional hypotheses, T = 40 km

40 = R = 0
41 = R = 29.05 km
42 = R = 58.10 km
43 = R = 116.20 km
44 = R = 174.30 km
45 = R = 232.40 km
...

5... Regional hypotheses of M. Lehner (Switzerland) (M. LEHNER, 1930)

according to the surface A considered for the altitude and to T, normal thickness of the crust:

50 = A = 8 x 8 km T = 80 km
51 = A = 8 x 8 km T = 100 km
52 = A = 8 x 8 km T = 140 km
53 = A = 64 x 64 km T = 80 km
54 = A = 64 x 64 km T = 100 km
55 = A = 64 x 64 km T = 140 km
56 = A = 128 x 128 km T = 80 km
57 = A = 128 x 128 km T = 100 km
58 = A = 128 x 128 km T = 140 km

6... Combined anomaly or Quasi-Isostatic anomaly

not taking into account the isostasy of the neighbouring masses in a given radius r.

This is a transition between the Bouguer and the Isostatic anomalies: one computes only the topographic influence of the neighbouring masses and the topo-isostatic influence of the remote masses external to the area, of radius r.

60 = Glennie hypothesis "Modified topo anomaly" (E.A. GLENNIE, 1932)
r = 36.5 km
D = 113.7 km (isostatic reduction on the Pratt-Hayfort system)

...

64 = without compensation of the neighbouring continental zones (till 167 km) in the hypothesis of Airy, 30 km.

65 = Vening Meinesz hypothesis "Modified Bouguer anomaly" (F.A. VENING-MEINESZ, 1948)
r = 166.7 km
D = 113.7 km (isostatic correction on the Pratt-Hayford system).

7... Other regional hypotheses: correction of the superficial and/or compensating masses computed in relation with a mean height Hm to be defined according to the authors.

70 = Putnam-Faye hypothesis:

$$g - \gamma o + 0.3086\ h_s - 0.0419\ d\ (h_s - H_m)$$

H_m = mean height of the area for a radius r = 166.7 km (zone O_2)

71 = Same hypothesis (Born), H_m being evaluated for a radius r = 25 km

72 = Putnam hypothesis (1928) = isostatic anomaly (G.R. PUTNAM, 1928);
isostatic correction of the neighbouring masses evaluated in relation with H_m determined from a circle r = 166.7 km (when $h_s > 1\ 000$ m)

73 = Same hypothesis as above with r = 58,8 km (when $h < 1.000$ m)

74 }
75 } "Model Earth" hypothes s (DE GRAAFF HUNTER, GLENNIE):
76 } Complete Bouguer anomaly + 0.0419 d.H
(H = weighted average topographic height)
H evaluation to be precised.

8... Various hypotheses

80 = Helmert hypothesis (compensation for 21 km depth)
81 = Helmert hypothesis (compensation at sea level)
...
88 = Cizancourt hypothesis (H. de CIZANCOURT, 1951)
...

9... Future hypotheses

Col. 102-106 Isostatic anomaly (to 0.1 mgal)

When various isostatic anomalies have been computed, the following preferential order should be adopted:

Airy 30 km (or Vening-Meinesz, T = 30 km, R = 0)
Airy 20 km
Pratt 113.7 km

Col. 107-108	Other type of anomaly (See code Col. 100-101, p.22).
Col. 109-113	Isostatic anomaly Indicated Col. 107-108 (0.1 mGal)
Col. 114-117	Year of observation
Col. 118-121	Year when the information was registered
Col. 122-127	Source of information
Col.122-123	Name of the country Ex. 5 P = Portugal (code IGB)
Col.124-127	Identification of the documents ... number of the publication in the IGB Library or 100 = limited publication (catalogue, list or listing) or 200 = punched cards or 300 = magnetic tape ...
Col. 128-134	Country code See Edition 1973 of Times Atlas
Col. 135-141	Numbering of the station No alphabetical character Original number or IGB sequence number

IV - POSSIBILITIES OFFERED BY THE DATA BANK SYSTEM

These possibilities are of three grades.

IV.1 - Information acquisition and input

Using the magnetic tape or punched cards with the recordings that have been described in paragraph III, we shall create a file for updating purposes in which the data will be arranged in order of importance and the values of the rubrics transformed in their types. The information can then be taken from these files and stored in the bank.

The input of new data will therefore take place via either a file for updating purposes (if a large number of stations are involved) or cards (if it is just a question of a few stations).

IV.2 - Correction of stations

Correction may be made at two levels:

- at the station level;
- at the level of a group of stations.

In both cases, correction may concern:

- the correction of one or several parameters;
- the complete correction of a recording.

These corrections are made by parameter cards for small corrections or a file for updating purposes for large-scale corrections.

This correction system has the advantage of making it possible to try out the desired correction before making it effective.

e.g.: When one particular parameter is to be corrected for one particular group of stations, the correction is made without touching the recordings in the bank. A printed output of the new recordings is made and it is only when the applicant has seen this modification that the go-ahead will be given for the correction which will then be managed automatically.

IV.3 - Information extraction

Using the coordinates of the zones where the user wishes to extract the stations, he will be able to request either all the stations with the value of all the rubrics, or the stations fulfilling only certain precise criteria depending on the value of certain rubrics. All the possibilities are therefore open: in a given geographic zone, at the request of the user, all or part of the current gravimetric stations can be extracted; and, if required, it will also be possible to extract the reference stations corresponding to the current stations observed, or again, the reference stations of the entire zone.

Thus, for a current station, it is possible to obtain:

- its value of observed g;
- the g value for the reference station.

IV.4 - Parameters to be provided by the user

A certain number of parameters will be necessary :

a) the geographical limits of the working zone and the numbers of the corresponding squares of 10°,

b) the origin of the data :

old marine connected to a system other than IGSN 71,
new marine connected to IGSN 71,

old land connected to a system other than IGSN 71,
new land connected to IGSN 71,

c) the list of parameter(s) to be extracted or the choice governing the extraction of the stations.

Within these three types of information, only the maximum and minimum latitude and longitude limits could possibly be given, but in this case, all information concerning the zone, without any distinction will be extracted.

For the correction of station values, it will be necessary to know the access keys.

V - EXAMPLES of OUTPUT

General remarks

We report afterwards (few samples) only some examples of possible output (3 examples).

These examples are given on listing.

However, the data can also be supplied on magnetic tape.

N.B. : When the data concerning a gravimetric station are given on listing, the widest table to be used cannot exceed 130 figures.

The lack of information for a parameter is indicated by the sign $.

For each example of output, it is indicated :

- the question,
- the format of the table in which the data are required,
- the table of the results.

These examples are referring to :

1°) List of land gravimetric stations in a limited zone with special conditions (country and altitude) :

Tables 5 and 5bis.

2°) List of reference stations in Australia in a small region :

Table 6.

3°) List of reference stations in Australia in a larger area :

Tables 7 and 7bis.

CONCLUSION

We hope this code will have the agreement of most of the Observers who are involved in problems of data collection.

We wish that the format be known to all possible users and be used as widely as possible during exchanges between IGB and other Organizations.

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P. LEJAY (1950) - "Tables pour le calcul des corrections isostatiques compte tenu de l'effet indirect" - Ass. Int. Geod., pub. spéciale n°. 4, Paris.

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I.A.G. (1971) - "Geodetic Reference System 1967" - Special Publication N° 3, Paris.

B.G.I. (1963) - "Recording of gravity data on punched cards". Bull. Inf. N° 5, Paris.

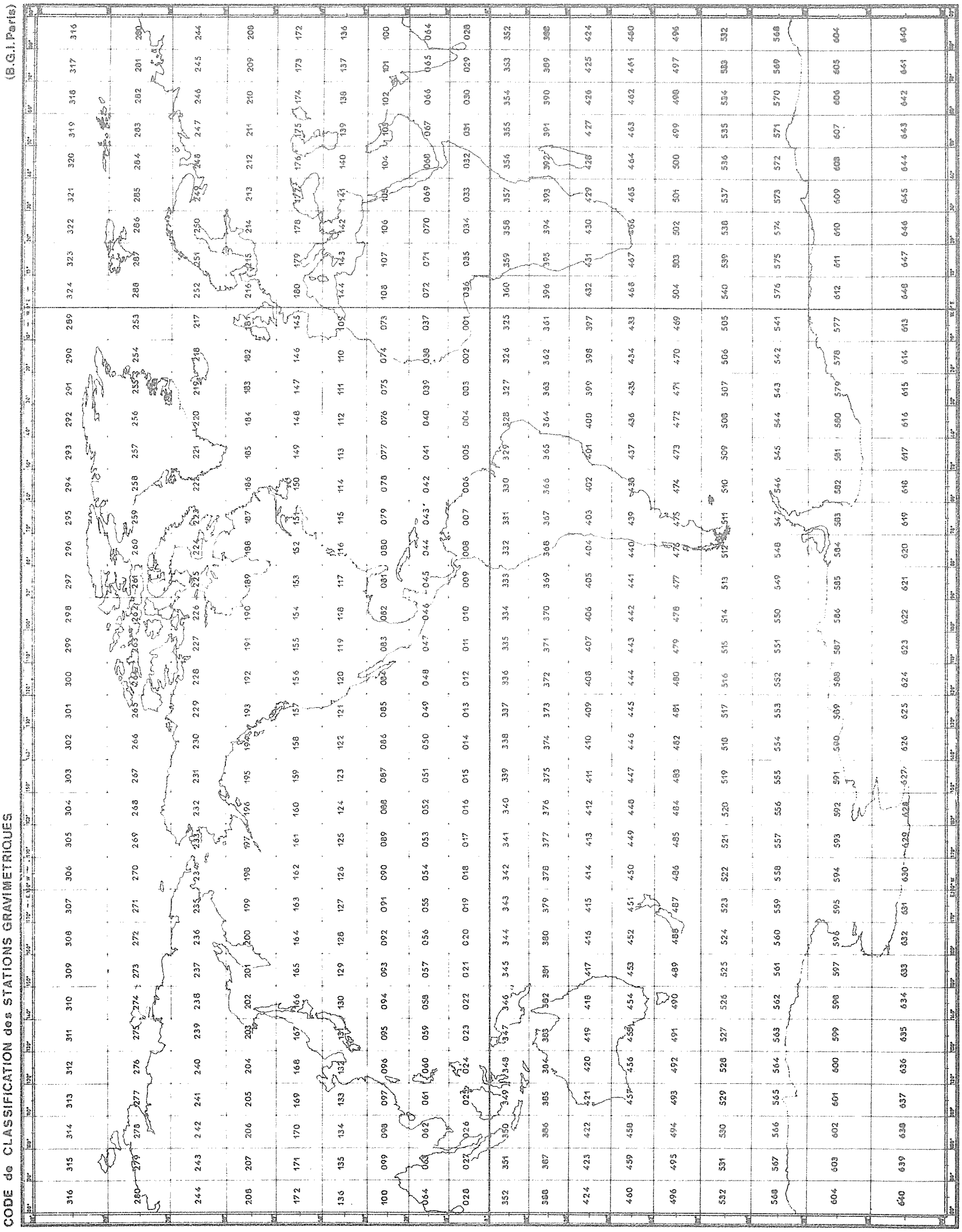


Fig. 1 - Numerotation of the 10° squares for the geographical definition of the station.

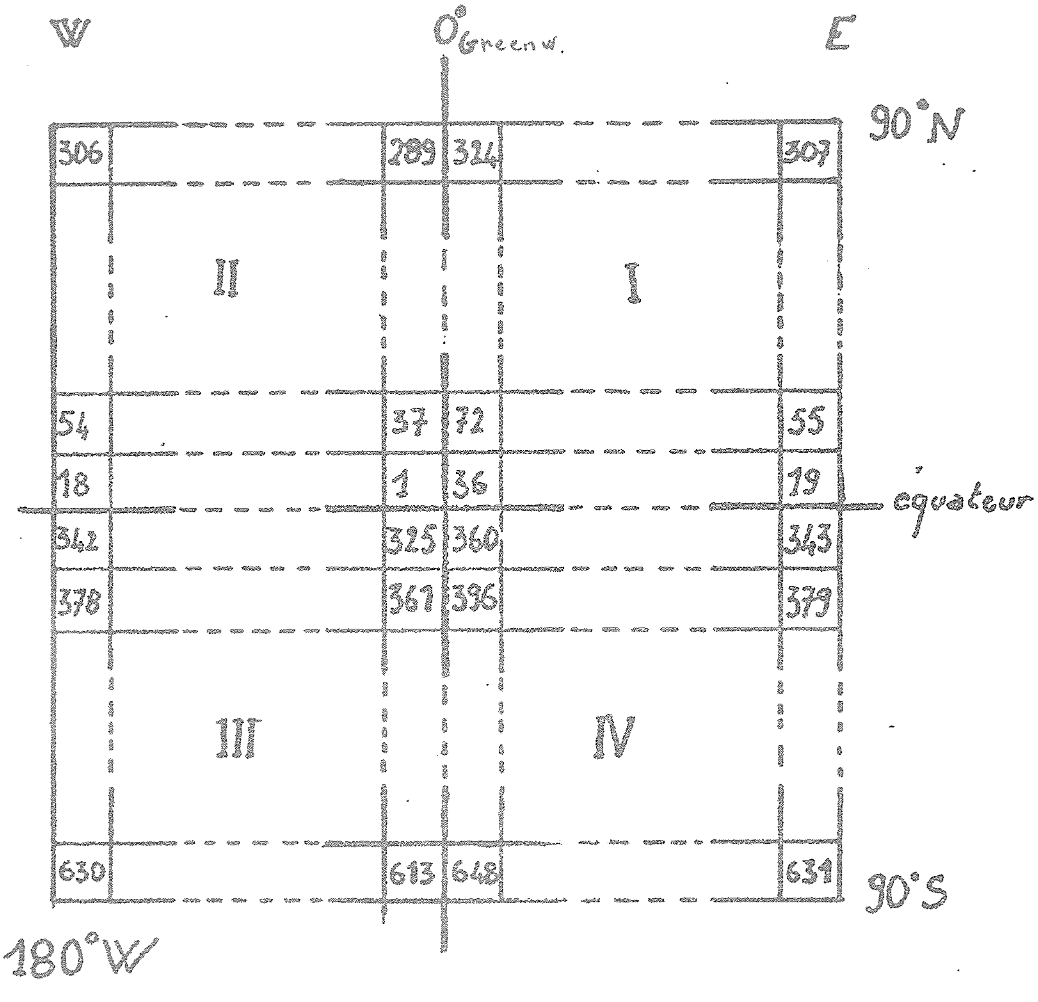
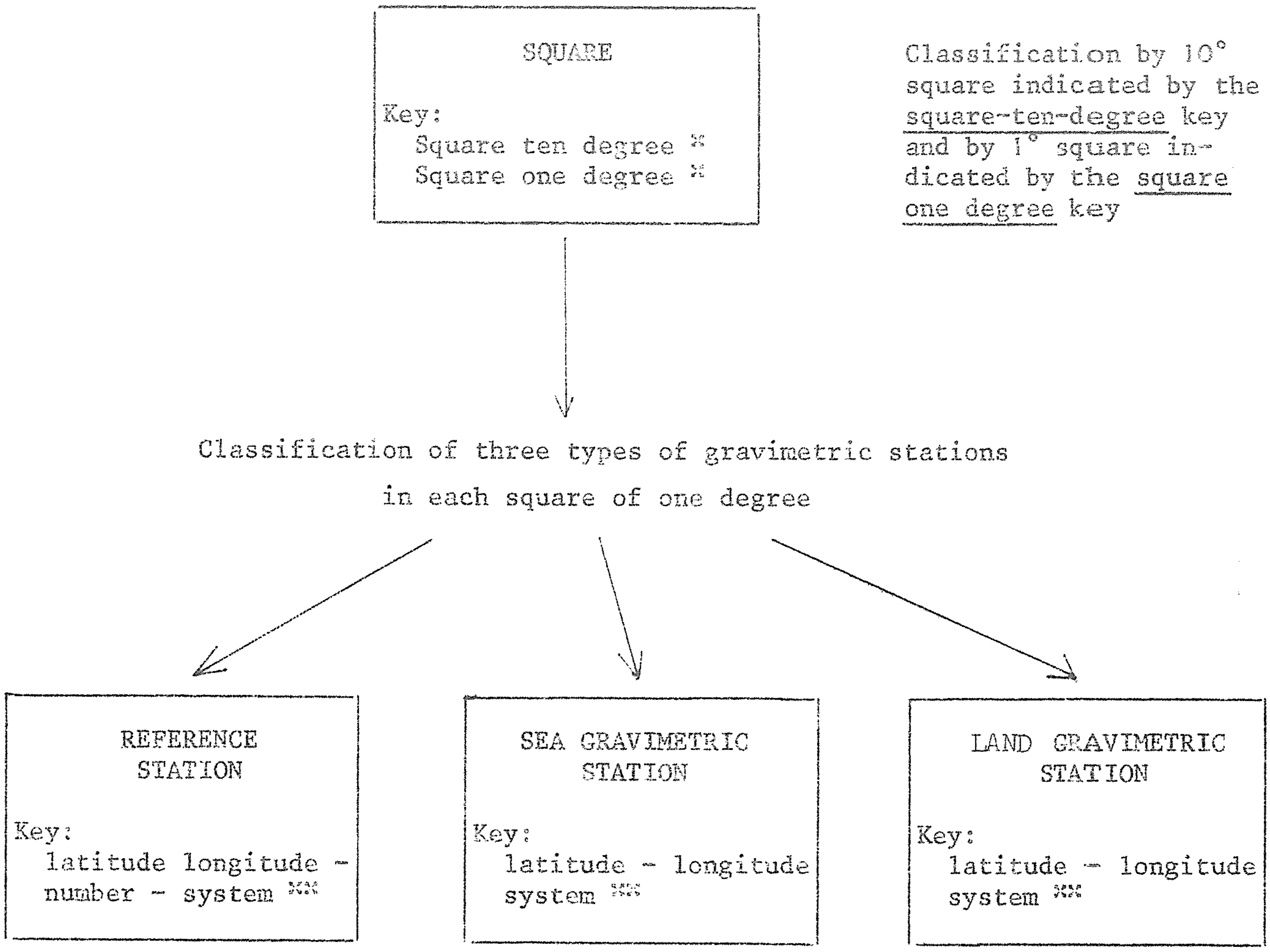


Fig. 2 - Calculation of the number of 10° squares



Classification by 10° square indicated by the <u>square-ten-degree</u> key and by 1° square indicated by the <u>square one degree</u> key

xx Access to any particular station is made by giving the values identifying the key.

Fig. 3 - STRUCTURATION OF THE INFORMATION IN THE DATA BANK

1	2 8	9 16	17	18 25	26	28 34	35	36 43	44	45 48
ref. syst.	latitude	longitude	accur. posit.	date of measure	type observ.	altitude of the station (0.1 m)	accur. hs	observed g (0.01 mGal)	g accur.	standard error

49	50 56	57	58 61	62 64	65 68	69 75	76	77 83	84 89
numb. syst.	ref. station	determ. hs	geol. inf.	appar.	country code	number IGSN71	numb. syst.	number BGI or national	source of information

90 109	110 129	130 132	133 135	136
province location	site of the measure	ext. ties	int. ties	site inform.

Table 1 - Record for reference station

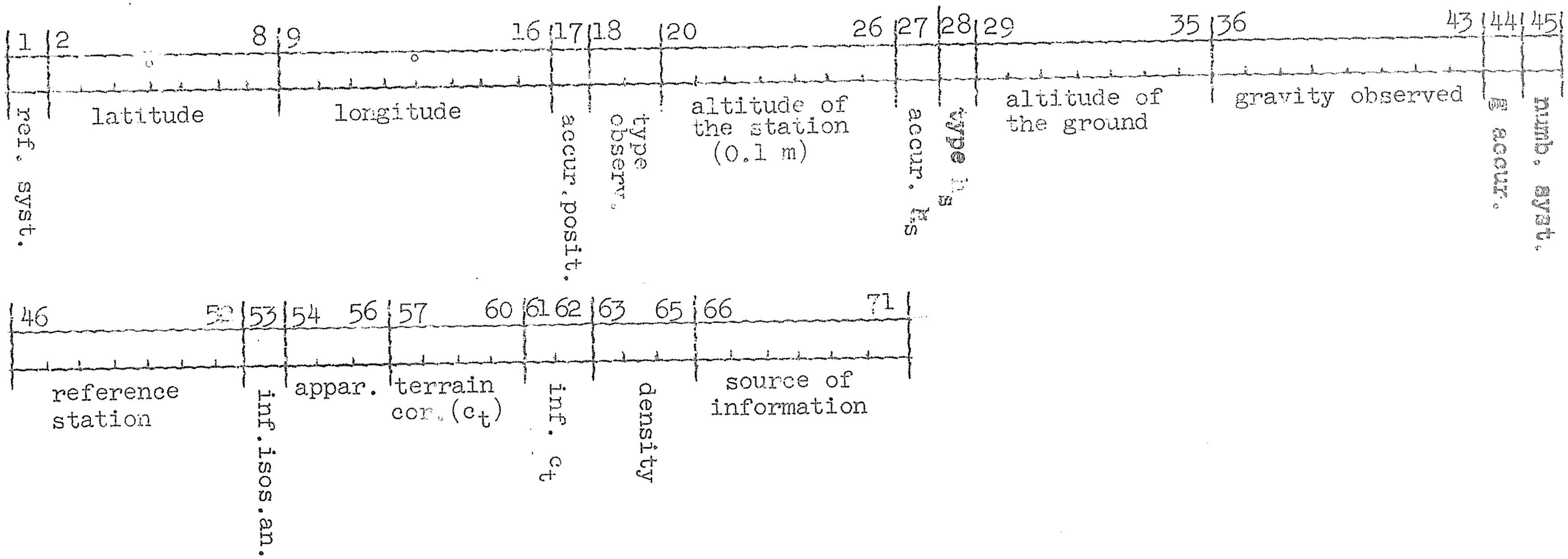
1	2 8	9 16	17	18 21	22	24	26	28	30	33 34	35 41	42	43 44
ref. syst.	latitude °	longitude °	accur. posit.	year	month	day	hour	min.	type of observ.	type of depth	depth (0,1m)	accur. depth	Matthew's zone

45 51	52	53 60	61 68	69	70 76	77 83	84 88	89	90
altitude of the station (0.1m)	inf. on G	gravity G (corrected or compensated)	observed g (0,01 mGal)	numb. syst.	reference station	calibration information	free-air anomaly (0.1 mGal)	accur. free-air an.	syst. posit.

91 99	100 105	107 109	110 113	114 118	119	120 122	123	124 . .	126 128
designation of survey	country code	velocity (0,1kn)	terrain correc. (c_t)	Eötvös correction (0.1 mGal)	cond.appar.	appar.	theor. form.	dist. c_t	density

Tab. 2 - Record for sea gravimetric station

(and eventually for aerial observation)



Tab. 3 - Record for land gravimetric station (select list)

1		ref. syst.
2	8	latitude
9	16	longitude
17		accur. posit.
18		type observ.
20	26	altitude of the station h_s (0.1 m)
27		accur. h_s
28		type h_s
29	35	altitude of the ground
36	43	gravity observed (0.01 mGal)
44		g accur.
45		numb. syst.
46	52	reference station
53	59	calibration information
60		theor. form.
61	65	free-air anomaly (0.1 mGal)
66	70	Bouguer anomaly
71	72	inf. Boug. an.
73		inf. isos. an.
74	77	density
78		determ. h_s
79		type reg. Hm
80	84	regional altitude Hm (m)
85	87	corr. to h_s
88	91	geolog. inf.
92	94	appar.
95	98	terrain correc. (c_t)
99		Bouguer grad.
100		type isos. an. A
102	106	isostatic anomaly A (0.1 mGal)
107		type isos. an. B
109	113	isostatic anomaly B
114	117	year of observ.
118	121	year of recept.
122	127	source of inf.
128	134	country code
135	141	numb. station

Tab. 4 - Record for land gravimetric station (complete list)

Example 1 - LIST OF CONTINENTAL GRAVITY STATIONS IN A LIMITED REGION

For each station the choice of parameters is to be stated by the Users

Question : Select in the ten degree square, n° 109 (30° - 40°N and 0°- 10°W.G.)
only stations of which Country Code is 5^{P} (Portugal)
and $800 \leq H_s \leqslant 1100$ m.

The chosen parameters concerning these stations are listed in the Table 5bis.

```
01005100511BGILFPRET76C9151
020051 C1='SOURCE-LAND' CONT 5P;
030051 C2='ALTI-STAT-LAND' ENTR (800,1100);
040051 POUR 'SQUARE' SELECT ('SQUARE-TEN-DEGREE' EGAL 109
050051 ET 'LAND-STATION' AVEC ('C1' ET 'C2'));
060051 TABL FORTABL1,E,
070051 ('SQUARE-TEN-DEGREE','SQT ',     I(3,2)),
080051 ('SQUARE-ONE-DEGREE','SQO ',    I(3,8)),
090051 ('LAT-LAND','LATI',              I(6,14)),   }   degree and
100051 ('LONG-LAND','LONG',             I(7,23)),   }   1/10.000 degree
110051 ('TYP-OBS-LAND','TYPE',          I(4,33)),
120051 ('ALTI-STAT-LAND','ALTI',        I(5,40)),  ———— decimeter
130051 ('OBS-GRAVITY-LAND',' G  ',      I(8,48)),
140051 ('ACCUR-GRAVITY-LAND',' A-G',    I(4,59)),
150051 ('BOUGUER-LAND','BOUG',          I(5,66)),
160051 ('DENSITY-LAND','DENS',          I(4,74)),
170051 ('YEAR-OBS-LAND','DATE',         I(4,82)),
180051 ('APP-USED-LAND','APPA',         I(6,89)),
190051 ('COND-APP-USED-LAND','C    ',   A(1,98)),
200051 ('SOURCE-LAND','ORIG',           A(6,102));£
```

Table 5 - Example of output : Question.

```
----------------------------------------------------------------------------------------------------------------------------------
     *       *          *            *        *        *              *        *        *        *             *            *   *          *
SQT  *  SGO  *   LATI   *    LONG    *  TYPE  *  ALTI  *       C      *   A-G  *  BOUG  *  CENS  *    DATE     *    APPA    * C *   ORIG   *
     *       *          *            *        *        *              *        *        *        *             *            *   *          *
     *       *          *            *        *        *              *        *        *        *             *            *   *          *
----------------------------------------------------------------------------------------------------------------------------------
109  *    1  * 393597   *   -90297   *      0 *    903 * 98015610     * $$$$   *    514 *    267 *    1946     *         42 * $ * 5P003    *
109  *    2  * 390367   *   -85600   *      0 *    900 * 98009550     * $$$$   *    183 *    267 *    1946     *         42 * $ * 5P003    *
109  *    2  * 390605   *   -81553   *      0 *    825 * 98010840     * $$$$   *    274 *    267 *    1950     *         42 * $ * 5P003    *
109  *    2  * 390935   *   -81493   *      0 *    918 * 98009870     * $$$$   *    166 *    267 *    1950     *         42 * $ * 5P003    *
109  *    2  * 391670   *   -80805   *      0 *    860 * 98008900     * $$$$   *     -3 *    267 *    1949     *         42 * $ * 5P003    *
109  *    2  * 392220   *   -86950   *      0 *   1040 * 98010250     * $$$$   *    111 *    267 *    1946     *         42 * $ * 5P003    *
109  *    2  * 392275   *   -89975   *      0 *   1022 * 98013900     * $$$$   *    484 *    267 *    1952     *         42 * $ * 5P003    *
109  *    2  * 393450   *   -89760   *      0 *   1001 * 98014530     * $$$$   *    437 *    267 *    1946     *         42 * $ * 5P003    *
109  *    2  * 393658   *   -81438   *      0 *    874 * 98012010     * $$$$   *    130 *    267 *    1950     *         42 * $ * 5P003    *
109  *    2  * 394458   *   -82550   *      0 *    834 * 98013290     * $$$$   *    180 *    267 *    1950     *         42 * $ * 5P003    *
109  *    2  * 394467   *   -80825   *      0 *    994 * 98013520     * $$$$   *    232 *    267 *    1948     *         42 * $ * 5P003    *
109  *    2  * 394977   *   -85288   *      0 *    943 * 98014360     * $$$$   *    264 *    267 *    1946     *         42 * $ * 5P003    *
109  *    2  * 395772   *   -84725   *      0 *    844 * 98015270     * $$$$   *    265 *    267 *    1946     *         42 * $ * 5P003    *
109  *    2  * 397775   *   -82430   *      0 *   1031 * 98015550     * $$$$   *    166 *    267 *    1946     *         42 * $ * 5P003    *
109  *    3  * 396460   *   -76758   *      0 *    976 * 98013600     * $$$$   *     76 *    267 *    1946     *         42 * $ * 5P003    *
109  *   11  * 387362   *   -91375   *      0 *    850 * $$$$         * $$$$   * $$$$   *    267 *    1951     *         42 * $ * 5P003    *
109  *   12  * 380475   *   -81422   *      0 *   1032 * 98001920     * $$$$   *    314 *    267 *    1948     *         42 * $ * 5P003    *
109  *   12  * 381752   *   -85650   *      0 *    991 * 98003680     * $$$$   *    375 *    267 *    1949     *         42 * $ * 5P003    *
109  *   12  * 381887   *   -81567   *      0 *    817 * 98006230     * $$$$   *    581 *    267 *    1950     *         42 * $ * 5P003    *
109  *   12  * 382533   *   -82122   *      0 *    898 * 98006820     * $$$$   *    598 *    267 *    1950     *         42 * $ * 5P003    *
109  *   12  * 382927   *   -82538   *      0 *    866 * 98006470     * $$$$   *    523 *    267 *    1949     *         42 * $ * 5P003    *
109  *   12  * 383325   *   -84402   *      0 *    959 * 98004870     * $$$$   *    355 *    267 *    1949     *         42 * $ * 5P003    *
109  *   12  * 385742   *   -88887   *      0 *   1092 * 98005240     * $$$$   *    205 *    267 *    1949     *         42 * $ * 5P003    *
109  *   12  * 386817   *   -86113   *      0 *    972 * 98007670     * $$$$   *    324 *    267 *    1947     *         42 * $ * 5P003    *
109  *   12  * 388703   *   -81533   *      0 *   1082 * 98008250     * $$$$   *    234 *    267 *    1950     *         42 * $ * 5P003    *
109  *   12  * 389443   *   -81418   *      0 *    960 * 98008670     * $$$$   *    185 *    267 *    1949     *         42 * $ * 5P003    *
109  *   22  * 370805   *   -89083   *      0 *    895 * 98001340     * $$$$   *   1103 *    267 *    1947     *         42 * $ * 5P003    *
109  *   22  * 371235   *   -83977   *      0 *    911 * 97996000     * $$$$   *    516 *    267 *    1947     *         42 * $ * 5P003    *
109  *   22  * 373605   *   -87997   *      0 *    991 * 98000550     * $$$$   *    787 *    267 *    1947     *         42 * $ * 5P003    *
109  *   22  * 376313   *   -86358   *      0 *    833 * 98000020     * $$$$   *    463 *    267 *    1947     *         42 * $ * 5P003    *
109  *   22  * 376550   *   -85435   *      0 *    887 * 97999670     * $$$$   *    414 *    267 *    1949     *         42 * $ * 5P003    *
109  *   23  * 376293   *   -76788   *      0 *   1061 * 97999200     * $$$$   *    412 *    267 *    1949     *         42 * $ * 5P003    *
109  *   23  * 379822   *   -76520   *      0 *    829 * 98004010     * $$$$   *    542 *    267 *    1949     *         42 * $ * 5P003    *
```

Table 5bis - Example of output : Answer.

Example II - LIST OF REFERENCE STATIONS IN AUSTRALIA

Question : Select reference stations (IGSN 71) in the ten degree squares between n° 417 and 422 (-20°.. -30°S ; 100°.. 170°E.G.)

LATI. LONG.	degree and 1/10.000 degree
IGSN	System of numbering (see p.13-14)

```
C11C05001C18GILEPRET761001I
021CC5 POUR 'SQUARE' SELECT ('SQUARE-TEN-DEGREE' ENTR (417,422) ET
C31CC5 'LAT-REF' ENTR (-500000,-100000) ET 'LONG-REF' ENTR (1200000,1700000));
C41CC5 TABL REFTABL2;E
```

```
------------------------------------------------------------------------------------------------------------------------
    *      *          *          *          *          *          *                    *                     *
SQT * SQO  *   LATI   *   LONG   *   IGSN   *   GVAL   *   ALTI   *        PROV        *         SITE        * D
    *      *          *          *          *          *          *                    *                     * E
    *      *          *          *          *          *          *                    *                     *
------------------------------------------------------------------------------------------------------------------------
418 *   20 * -211833  * 1491833  * 41819A   * 97372077 *      50  * MACKAY             * AMBULANCE DEPOT     * $
418 *   20 * -211833  * 1491833  * 41819J   * 97871988 *      50  * MACKAY             * APT ENTRANCE STEPS  * $
419 *   10 * -207333  * 1395167  * 41909J   * 97860441 *    3630  * MT.ISA             * APT TERM CONCRETE ST* $
419 *   34 * -238067  * 1338917  * 41933J   * 97863939 *    5370  * ALICE SPRINGS      * APT TERM ENTRANCE   * $
419 *   34 * -238067  * 1338917  * 41933K   * 97863966 *    5460  * ALICE SPRINGS      * OLD TERM MESSBLDG   * $
419 *   34 * -235000  * 1338917  * 41933L   * 97862667 *    5490  * ALICE SPRINGS      * STUART HWY MILE 11N * $
419 *   34 * -232500  * 1338917  * 41933M   * 97867883 *    5490  * ALICE SPRINGS      * STUART HWY MILE 26N * $
```

Table 6 : Example of output : Question and Answer.

Example III - LIST OF REFERENCE STATIONS IN AUSTRALIA

<u>Question</u> : Same example as previously (table 6) but selected stations in several surrounding squares,
n° 381 to 385 ; 417 to 422 ; 455 to 457.

```
011005000018GILEPRET7610011
021005 C1='SQUARE-TEN-DEGREE' ENTR(381,385);
031005 C2='SQUARE-TEN-DEGREE' ENTR(417,422);
041005 C3='SQUARE-TEN-DEGREE' ENTR(455,457);
051005 C4='LAT-REF'          ENTR(-500000,-100000);
061005 C5='LONG-REF'         ENTR(1200000,1700000);
071005 POUR 'SQUARE' SELECT (('C1' OU 'C2' OU 'C3') ET 'C4' ET 'C5');
081005 TABL REFTABL2,E,
091005 ('SQUARE-TEN-DEGREE','SQT ',     I(3,1)),
101005 ('SQUARE-ONE-DEGREE','SQO ',     I(3,7)),
111005 ('LAT-REF','LATI',               I(7,13)),
121005 ('LONG-REF','LONG',              I(7,23)),
131005 ('NUMB-REF','IGSN',              A(7,33)),
141005 ('OBS-GRAVITY-REF','GVAL',       I(8,43)),
151005 ('ALTI-STAT-REF','ALTI',         I(5,54)),
161005 ('PROVINCE-REF','PROV',          A(20,62)),
171005 ('SITE-REF','SITE',              A(20,85)),
181005 ('CODE-DESC-REF','DESC',          I(1,108));&
```

Table 7 - Example of output : Question

```
-------------------------------------------------------------------------------------------------------------------------------
    *      *          *           *          *           *      *                              *                       *
SQT * SQO  *   LATI   *   LONG    *   IGSN   *   GVAL    * ALTI *             PROV             *         SITE          * D
    *      *          *           *          *           *      *                              *                       * E
    *      *          *           *          *           *      *                              *                       *
-------------------------------------------------------------------------------------------------------------------------------
382 *   66 * -169267  * 1457333   * 38265K   * 97846202  *   30 * CAIRNS                       * WHARF                 * $
382 *   66 * -169167  * 1457500   * 38265L   * 97843471  *   30 * CAIRNS                       * RR STATION            * $
382 *   66 * -168833  * 1457500   * 38265A   * 97846624  *   30 * CAIRNS                       * AIRPORT               * $
382 *   97 * -192617  * 1467617   * 38296B   * 97861043  *   50 * TOWNSVILLE                   * RAAF STN BUILDING 73  * $
382 *   97 * -192617  * 1467800   * 38296C   * 97860969  *  200 * TOWNSVILLE                   * HIGH SCHOOL TEST LAB  * $
382 *   97 * -192600  * 1468033   * 38296M   * 97859230  * 2600 * TOWNSVILLE                   * CASTLE HILL           * $
382 *   97 * -192600  * 1468100   * 38296L   * 97861285  *  100 * TOWNSVILLE                   * CENTRAL SCHOOL        * $
382 *   97 * -192583  * 1467633   * 38296A   * 97860974  *   50 * TOWNSVILLE                   * RAAF HANGAR           * $
382 *   97 * -192500  * 1467667   * 38296N   * 97860966  *   60 * TOWNSVILLE                   * CIVILIAN AIRPORT      * $
383 *   21 * -124700  * 1308483   * 38320M   * 97830259  *   30 * DARWIN                       * WHARF HBR MR OFFICE   * $
383 *   21 * -124700  * 1308483   * 38320N   * 97829954  *   50 * DARWIN                       * WHARF BURNS GARAGE    * $
383 *   21 * -124583  * 1308367   * 38320A   * 97829955  *  230 * DARWIN                       * BMR PENDULUM SITE     * $
383 *   21 * -124233  * 1308667   * 38320J   * 97830093  *  310 * DARWIN                       * INTNL APT CUSTOMS     * $
383 *   21 * -124233  * 1308667   * 38320K   * 97830093  *  310 * DARWIN                       * INTNL APT W DOORS     * $
383 *   21 * -124233  * 1308667   * 38320P   * 97830087  *  310 * DARWIN                       * INTNL AIRPORT GATE 2  * $
383 *   21 * -124233  * 1308667   * 38320W   * 97830084  *  310 * DARWIN                       * INTNL AIRPORT DOORS   * $
383 *   21 * -124233  * 1308667   * 38320R   * 97830086  *  310 * DARWIN                       * INTNL APT WAITING RM  * $
383 *   21 * -124233  * 1308700   * 38320L   * 97830061  *  310 * DARWIN                       * ENTRANCE DCA HANGAR   * $
383 *   21 * -124217  * 1308617   * 38320B   * 97830192  *  190 * DARWIN                       * RAAF BASE OFFICERS    * $
418 *   20 * -211833  * 1491333   * 41819A   * 97872077  *   50 * MACKAY                       * AMBULANCE DEPOT       * $
418 *   20 * -211833  * 1491333   * 41819J   * 97871985  *   50 * MACKAY                       * APT ENTRANCE STEPS    * $
419 *   10 * -207333  * 1395167   * 41909J   * 97860441  * 3630 * MT.ISA                       * APT TERM CONCRETE ST  * $
419 *   34 * -238067  * 1338917   * 41933J   * 97863939  * 5370 * ALICE SPRINGS                * APT TERM ENTRANCE     * $
419 *   34 * -238067  * 1338917   * 41933K   * 97863966  * 5460 * ALICE SPRINGS                * OLD TERM MESSBLDG     * $
419 *   34 * -235000  * 1338917   * 41933L   * 97862067  * 5490 * ALICE SPRINGS                * STUART HWY MILE 11N   * $
419 *   34 * -232500  * 1338917   * 41933M   * 97857883  * 5490 * ALICE SPRINGS                * STUART HWY MILE 26N   * $
```

Table 7bis - Example of output : Answer

LISTE des PUBLICATIONS
reçues au
BUREAU GRAVIMETRIQUE INTERNATIONAL
(Décembre 1975 à Avril 1976)

CONCERNANT LES QUESTIONS DE PESANTEUR

LISTE des PUBLICATIONS

* 733 - WAGNER C.A. - "Zonal gravity harmonics from long satellite arcs by a seminumeric method".
J. Geophys. Res., v.78, n°17, p.3271-3280, 1973.

A zonal geopotential is presented to degree 21 from evaluation of mean elements for 21 satellites, including two of low ($<20°$) inclination. Each satellite is represented by an arc of at least one apsidal rotation. The lengths range from 50 to 600 days. Differential correction of the initial elements in all of the arcs, together with radiation pressure and atmospheric drag coefficients, is accomplished simultaneously with the correction for the zonal harmonics. The satellite orbits and their variations are generated by numerical integration of the Lagrange equations for mean elements. Disturbances due to precession and nutation, atmospheric drag, radiation pressure, and lunisolar gravity are added at 1 - to 8-day intervals in the integrated orbits. The results agree well with 1971 and 1972 solutions from other authors using different methods and different satellite and other data sets. These comparisons show the zonal coefficients are now known to better than 0.03×10^{-6} (fully normalized) to at least as high as degree 16.

ACADEMIE des SCIENCES U.R.S.S. - Références bibliographiques :

Géophysique,
734 - N° 4, 248 p, Moscou, 1975. (Texte russe).

Sér. 52, Géodésie et Astronomie,
735 - N° 4, 50 p, Moscou, 1975. (Texte russe).
736 N° 5, 41 p, Moscou, 1975. " "

738 - GEMAEL C. & F. HATSCHBACH - Cartas de redução topo-isostatica para o estado da Bahia".
Bol. Univ. Federal do Parana, Geod. N° 16, 6 p, Curitiba, 1974.

739 - BHATTACHARJI J.C. - "Certain problems in gravimetric deflections of the vertical".
Survey of India, Tech. Paper, N° 17, 158 p, Dehra Dun, 1973.

740 - KAHLE H.G. & M. TALWANI - "Gravimetric Indian Ocean Geoid".
Table 1. 1° x 1° square average free-air gravity anomalies in mGal.
Z. für Geophys., Physica-Verlag, Band 39, S.491-499, Würzburg, 197

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* Les numéros font suite à ceux indiqués dans le Bull. Inf. N° 38, Mai 1976.

741 - MORELLI C. - "Gravity problems with a view to African conditions".
from : African Geod. J., N° 1, 2, p.13-50, 1974.
Presented at the Symposium on Geodesy in Africa, Khartoum, 14-18.1.74
Osser. Geof. Sper., Contr. n°227b, Trieste.

The present status of the World Gravity Net is outlined with reference to the African needs. The gravity problems are discussed as global ones, regional and local ones. The gravity coverage in Africa is presented. The possibilities of dynamic gravimetry are discussed for a rapid filling of the gaps in unknown areas both on land and on the continental shelf.

742 - OBENSON G. - "A 1973 gravimetric geoid of Africa".
Geophys. J. R. Astr. Soc., v. 37, p.271-283, 1974.

Results of a preliminary gravimetric geoid computed on the Geodetic Reference System of 1967 (GRS 67) are given in the form of undulation and deflection maps.

For the computations, 1° x 1° mean free-air gravity anomalies formed the inner zone and 5° equal area values the outer zone around each computation point. Some of the required 1° x 1° means, together with their accuracies, were obtained by statistical prediction methods using an autocovariance function derived from the known 1° x 1° values.

The results confirm the general south-easterly down slope of the geoid undulations. The average computed standard errors are about 3.6m in the undulations and 0".6 in the deflections.

743 - KAHLE H.G. & M. TALWANI - "Gravimetric Indian Ocean geoid".
In memory of Prof. Dr. h.c. K. JUNG.
Z. für Geophys., Physica-Verlag, Band 39, S.167-187, Würzburg, 1973.

The free-air gravity maps of the Indian Ocean (Talwani and Kahle 1973) are used to obtain average free-air gravity values over 1° x 1° squares. These values are then used to compute the gravimetric 1° x 1° geoid over the Indian Ocean. As expected substantially more information is present in the shorter wavelength in this geoid than in the GAPOSCHKIN GAPOSCHKIN and LAMBECK (1970, 1971) geoid obtained primarily from data based on satellite observations. The largest differences between the two geoids are observed over the Madagascar Ridge (+ 23m) and over the deep sea trenches of the Indonesian Island Arc (- 25m). The additional short wavelength information can be associated with physiographic features in the Indian Ocean.

744 - DEFENSE MAPPING AGENCY, AEROSPACE CENTER - "A Bouguer gravity anomaly map of South America".
DMAAC, Tech. Paper N° 73, 21 p, St-Louis, 1973.

The Bouguer anomaly map of South America is a contoured representation of 1° x 1° mean Bouguer gravity anomaly values. Some of these mean anomaly values are computed directly using observed gravity data held by the DoD Gravity Library. Other means are predicted values involving the application of geophysical-gravity correlation techniques. These geophysical prediction methods are discussed in relation to selected geological and tectonic provinces of South America. The map itself was prepared exclusively by automated map compilation techniques.

745 - TSUBOKAWA I., M. YANAGISAWA, C. SUGAWA, K. HOSOYAMA, P. MELCHIOR, B. DUCARME, J. FLICK & M. MOENS - "Results of a comparison of electromagnetic tiltmeter (TEM type) with Quartz pendulums (VM Type) at the European underground laboratory of geodynamics of Walferdange". Obs. Royal Belgique, Comm. Sér. A, N° 31, Sér. Géophys. , N° 125, from : J. Geod. Soc. Japan, v. 20, n°4, p.209-220, 1974.

The results of a comparison between electromagnetic tiltmeters (TEM) and quartz pendulums (VM) at the Laboratory of Geodynamics of Walferdange have been analysed by a global method. The mean result of all instruments fits very well with those obtained in Western Europe, but the EW component of TEM 16 gives a significantly lower value for M_2, than those given by VM pendulums. This may be due to a cavity effect. Diurnal waves for the EW component are in very good agreement between themselves as well as with the Molodensky model 2 introducing the dynamic effects of the Earth's liquid core. The results at Walferdange have a particular importance because instruments working upon basically different principles give the same resonance effects.

746 - IRVING E., J.K. PARK, S.E. HAGGERTY, F. AUMENTO & B. LONCAREVIC - "Magnetism and opaque mineralogy of Basalts from the Mid-Atlantic Ridge at 45°N".
Nature, v. 228, n° 5275, p.974-976, 1970.

The volcanic layer may be only 200 m thick at 45°N and oxidation of titanomagnetite may be responsible for the decrease in amplitude of the magnetic anomalies away from the ridge axis.

747 - LILLESTRAND R.L. & J.R. WEBER - "Plumb line deflection near the North Pole".
J. Geophys. Res., v. 79, N° 23, p.3347-3352, 1974.

In April 1969 the deflection of the plumb line in the vicinity of the Lomonosov ridge near the north pole was determined from a drifting ice station by measuring the displacement between two drift paths, one determined astronomically and the other determined by means of a Transit Satellite receiver. In addition, the fine structure of the drift path relative to the ocean floor was obtained from acoustic measurements. The mean plumb line deflection at 89°40'N 77°W was found to be 9 arc sec. in the direction of 34°E, pointing away from the Lomonosov ridge. Computations were made concerning the perturbation of the gravity vector on the basis of a hypothetical model of the Lomonostov ridge. This model involves a density structure consistent with a continental origin of the ridge and shows that deflection gradients of up to 0.7 arc sec./km and horizontal gravity gradients of up to 3.4 mGal/km can occur. The measured plumb line deflection and gravity observations carried out in the vicinity of the ridge are consistent with the model, but because of the scarcity of observations and the very incomplete bathymetric data, no final conclusions on the origin of the Lomonosov ridge can be made. Continuous plumb line deflection measurements are ideally suited to be carried out from a drifting sea ice station where they will complement the gravity measurements in an area where regional gravity observations are scarce.

748 - MAREES TERRESTRES - Bulletin d'Information N° 71, 1er juin 1975.

a) DITCHKO I.A. & P.S. KORBA - "Sur le ralentissement de la rotation de la terre dû aux marées".
p.4002-4007.

b) GRIDNIEV D.G. - "L'étalonnage des gravimètres "Askania" et la détermination de l'échelle d'enregistrement des marées de la pesanteur par inclinaison".
p.4056-4073.

749 - OJANEN O. - "On the determination of elliptic orbits from the time micrometer observations".(75:3)
Rep. Finnish Geod. Inst., ISBN 951-711-016-2, 15 p, Helsinki, 1975.

750 - KIVINIEMI A. - "Measurements of wave motion in the ice surface".(75:4)
Rep. Finnish Geod. Inst., ISBN 951-017-0, 13 p, Helsinki, 1975.

751 - KAARIAINEN E. - "Land uplift in Finland on the basis of sea level recordings".
Rep. Finnish Geod. Inst., ISBN 951-711-018-9, 15 p, Helsinki, 1975.

CENTRE NATIONAL pour l'EXPLOITATION des OCEANS - Bulletin d'Information

752 - N° 78, 19 p, Paris, Juin 1975.

753 - Rapport annuel 1974, 71 p, Paris, 1975.

754 - N° 79 / 80, 35 p, Paris, Juillet / Août 1975.

755 - FRÖHLICH H. - "Verfahren zur Lösung des Oberflächenintegrales für das Modell der einfachen Schicht in der Satellitengeodäsie".
D.G.K., Reihe C : Dissert., H. N° 207, 47 S, München, 1975.

756 - SCHULTZ P. - "Gleichrichtmomente bei nordweisenden Kreiseln kurzer Nordsuchzeit infolge oszillatorischer Störbewegungen".
D.G.K., Reihe C : Dissert., H. N° 205, 156 S, München, 1975.

757 - RUMMEL R. - "Zur Behandlung von Zufallsfunktionen und folgen in der physikalischen Geodäsie".
D.G.K., Reihe C : Dissert., H. N° 208, 93 S , München, 1975.

758 - SCHWARZ K.P. - "Zonale Kugelfunktionskoeffizienten aus Satellitendaten durch Kollokation".
D.G.K., Reihe C : Dissert., H. N° 209, 58 S, München, 1975.

759 - PREUSSER A. - "Ein System von Unterprogrammen zum Aufstellen und Lösen von grossen Normalgleichungssystemen unterteilt in Submatrizen".
D.G.K., Reihe B : Angew. Geod., H. N° 209, 27 S, München, 1975.

760 - GRAFAREND E. & OFFERMANNS G.-"Eine Lotabweichungskarte Westdeutschlands nach einem geodätisch konsistenten KOLMOGOROV-WIENER Modell".
D.G.K., Reihe A : Theor. Geod., H. N° 82, 60 S, München, 1975.

A vertical deflection map of Western Germany is predicted by the multivariate KOLMOGOROV-WIENER concept out of about 200 astrogeodetic deflections of the Western German first order net stations. It is assumed that the vertical deflection vector is homogeneously and isotropically distributed, its covariance matrix has G.I. TAYLOR - T. KARMAN structure. The model is consistent with the statistics of gravity and height anomalies via the fundamental equations of physical geodesy. The spectrum of auto - and crosscorrelation for a flat Earth model is given. Because of the continuous spectrum a reproducing kernel does not exist. Our model is tested relative to the unvariate KOLMOGOROV-WIENER concept of S. HEITZ.

761 - MINISTERE GEOLOGIQUE de l'U.R.S.S. - "Carte gravimétrique de l'Afrique, 5 feuilles".
Echelle : 1/5.000.000°, isanomales équidistantes de 5, 10, 15, 20 et 40 mGal, 1975.

L'Afrique est divisée en 4 feuilles séparées par l'Equateur et le méridien de Greenwich ; une 5ème feuille comporte un schéma d'emplacement et la bibliographie utilisée.

Deux séries de cartes ont été dressées avec les isanomales de Bouguer sur Terre, par contre en mer l'une des séries comporte les anomalies de Bouguer, l'autre les anomalies à l'air libre.

762 - HAMMER S. - "Approximation in gravity interpretation calculations".
from : Geophys., v.39; N° 2, p.205-222, 1974.

Rigorous calculation of gravity effects of geologic bodies for the interpretation of sub-surface structure from exploration gravity surveys is time-consuming and tedious. Resort to electronic computers is convenient but not always necessary. Simple hand calculations can be instructive and are often adequate and useful. This paper reports the errors involved and ranges of validity of various simplifying approximations for commonly used geometric body shapes :

a) equivalent sphere approximation for an infinitely long horizontal cylinder,
b) circular plate approximation for horizontal slabs of finite width,
c) vertical line element and thin horizontal plate approximations for vertical cylinders of variable radii and heights (dome, salt dome, or plug), and
d) thin-plate approximations for vertical dikes and horizontal fault blocks. ...

763 - MARSH J.G. & S. VINCENT - "Global detailed geoid computation and model analysis".
from : Geophys. Surveys, v. 1., N° 4, p.481-511, 1974.

This paper presents a survey of recent work on the gravimetric geoid. The gravity models considered are those published in the past few years by the Goddard Space Flight Center (GSFC), the Smithsonian Astrophysical Observatory (SAO) and the Ohio State University (OSU). Comparisons and analyses have been carried out through the use of detailed gravimetric geoids which we have computed by combining the above-mentioned models with a set of 26000, 1° x 1° mean free-air gravity anomalies. The accuracy of the detailed gravimetric geoid computed using the most recent Goddard Earth Model (GEM-6) in conjunction with the set 1° x 1° mean free-air gravity anomalies is assessed at 2 m on the continents of North America, Europe and Australia. 2 to 5 m in the North-East Pacific and North Atlantic areas and 5 to 10 m in other areas where surface gravity data are sparse. Rms differences between this detailed geoid and the detailed geoids computed using the other satellite gravity fields in conjunction with same set of surface data range from 3 to 7 m. The maximum differences in all cases occurred in the Southern Hemisphere where surface data and satellite observations are sparse. These differences exhibited wavelengths of approximately 30 to 50 in longitude. Detailed geoidal heights were also computed with models truncated to 12th degree and order as well as 8th degree and order. This truncation resulted in a reduction of the rms differences to a maximum of 5 m. Comparisons have been made with the astrogeodetic data of Rice (United States), Bomford (Europe), and Mather (Australia) and also with geoidal heights from satellite solutions for geocentric station coordinates in North America and the Caribbean.

768 - NEW ZEALAND DEPARTMENT of SCIENTIFIC & INDUSTRIAL RESEARCH : Geophysics Division - "Gravity map of New Zealand, sheet 12 : Wellington".
Scale : 1/250.000, Bouguer anomalies, isostatic anomalies, isostatic vertical gradient anomalies.
Wellington, 1974.

The contours on these maps depict the anomaly field on a surface 500 m. above sea level. For an explanation of the method used, see W.I. REILLY (1972), N.Z. Gravity Map Series, N.Z. J. Geol. & Geophys., v.15, p.3-15.

774 - POLSKA AKADEMIA NAUK, KOMITET GEODEZJI -
Geod. i Kartog., t.XXIV, Z.2, 175 p, Warszawa, 1975.

775 - Proceedings of the Institute of Geodesy & Cartography,
t. XXII, Z.1 (50), 106 p, Warszawa, 1975.

776 - MELCHIOR P. - I.U.G.G. Chronicle
N° 98, p.127-190, September 1974.

777 - Studia Geophysica et Geodaetica, t.19, N° 3, Cesk. Akad. Ved., Praha, 1975.

a) MESCHERIKOV G.A. & Yu. P. DEJNEKA - "Utilisation des constantes de Stokes de la Terre pour la construction de modèles mécaniques mondiaux". p.217-225.

Methods of using Stokes's constants of the Earth for constructing its worldwide mechanical models are described. The variance of an approximate distribution of the density of the Earth's interior is obtained on the basis of the parameters of the Earth's gravitational field ; its dynamical flattening, the depths of two discontinuous jumps of the density (at the boundary of the core and at the Mohorovičić surface) and the mean values of the crust's density and the density of the upper mantle. The values of the rigidity, incompressibility, gravity and hydrostatic pressure inside the planet are then found. The periods of free oscillations of the described model are calculated. The results obtained are discussed. Certain possibilities of determining the accuracy of the planet's models - constructed by the described method - are indicated.

b) NEDOMA J. - "The variational formulations of the boundary value problem of gravity potential". p.226-232. The possibility of the variational formulation for the solution of the boundary value problem of the gravity potential is discussed. The method under consideration was derived without any hypothesis about the mass distribution between the Earth's surface and the geoïd. Gravity data on the Earth's surface were used. Special attention will be paid to the disturbing potential in the neighbourhood of the disturbing masses. We confine ourselves to a case in which the total mass of the normal body is equal to the mass of the Earth and, moreover, both bodies revolve round the same axis, passing through an identical centre of gravity, with the same angular velocity ω.

c) BURSA M. - "The scale factor for lengths and the dimensions of the Earth's ellipsoïd based on the GEM 5 and GEM 6 systems". p.291-295.

778 - BRUGGEMANN H., E. GRAFAREND, J. KIEHL & N. SCHARES - "Gravimetrische und magnetische Analyse der Anomalie des Rodderberges bei Bonn". Mitt. Inst. Theor. Geod. Univ. Bonn, N° 24, 52 S, Bonn, 1973.

During the past decade gravimetric measurements have been performed by the Institut für Theoretische Geodäsie (Director : o.Prof.Dr.E.h. H. WOLF) in the Rodderberg region close to Bonn. In addition, magnetic measurements (vertical, horizontal, total intensity, magnetic declination) are presented, here. First attempts for an interpretation of data have been made : Reduction of data (time variational effects, absolute and relative fields, normal field decomposition) and inversion process (dipole densities as the origin of the magnetic field, hybrid analysis of gravimetric and magnetic data by the Baranov method).

779 - RAPP R.H. - "Accuracy of geoïd undulation computations".
from : J. Geophys. Res., v. 78, N° 32, p.7589-7595, 1973.

Geoid undulations have been recently computed using a set of spherical harmonic potential coefficients and 1° x 1° mean free-air anomalies. The latter quantities are used in Stokes's equation out to some spherical radius ψ_0 from the computation points. The possible error sources considered in this paper were :
1) errors caused by the use of Stokes's equation,
2) Earth constant errors,
3) errors in the numerical integration of the Stokes equation,
4) potential coefficient errors with specific estimates made for the Smithsonian Astrophysical Observatory Standard Earth II coefficient set,
5) errors caused by neglecting anomaly information outside ψ_0 ,
6) errors due to the neglect of gravity material in blocks smaller than 1° x 1°,
7) errors due to inaccurate gravity material with specific computations made at four points, and
8) errors due to imperfect knowledge of equatorial gravity.

Considering error sources 4 through 8, typical values of a root mean square undulation error (δN) were : $\psi_0 = 0°$, $\delta N = 6,5$ meters ; $\psi_0 = 5°$, $\delta N = 3,6$ meters ; $\psi_0 = 10°$, $\delta N = 3.0$ meters. For certain ψ_0 values an equatorial gravity error of ± 1 mGal results in the dominant undulation error, indicating that a judicious selection of ψ_0 is necessary when the undulations are being computed.

780 - MATHER R.S. - "On the solution of the geodetic boundary value problem for the definition of sea surface topography".
from : Geophys. J. R. Astr. Soc., v. 39, p.87-109, 1974.

Plans to place three satellites fitted with laser retro-reflectors and altimeters in near-Earth orbit in the next decade, offer a stimulus to activity in physical geodesy. Of prime interest is the definition of the oceanic geoid with sufficient precision to permit the mapping of deviations of the oceans from a level surface, as derived from considerations of the Earth's gravity field. Any such definitions in the next decade may have to be achieved in the absence of a complete representation of the Earth's gravity field by surface measurements of gravity. Another factor to be contended with in this time frame is the absence of a global satellite tracking network with both an adequate station density as well as the resolution for studies of this sea surface topography in four dimensions.

The present development formulates a solution of the geodetic boundary value problem where gravity models used for orbit determination can be related to a finite entity in this solution with a view to minimizing any source of differential error in the final result. The geometry of the solution in Earth space is established. Expressions are developed for obtaining a solution from satellite altimetry. The possibility of obtaining an interim determination from a combination of satellite altimetry in oceanic regions and the available surface gravity data in continental shelf areas is discussed.

The principal problems are those arising from the influence of long wavelength errors in the satellite altimetry and, to a lesser extent, in the surface gravity anomalies. It would appear that meaningful global solutions will only be possible under such circumstances if the altimeter-equipped spacecraft were tracked on a regular basis with a well-distributed network of at least 25 all-weather 10-cm tracking systems in the absence of a reliable gravity field definition. The question of resolution in regional studies is also discussed.

781 - BALMINO G., K. LAMBECK & W.M. KAULA - "A spherical harmonic analysis of the Earth's topography".
J. Geophys. Res., v. 78, N° 2, p.478-481, 1973.

782 - COMFORT G.C. - "Direct mapping of gravity anomalies by using Doppler tracking between a satellite pair".
J. Geophys. Res., v. 78, N° 29, p.6845-6851, 1973.

The on-board measurement of relative velocity between two satellites in the same nominally circular orbit but separated by a small central angle directly measures the difference in kinetic energies between the satellites. The short-period components of this measurement provide a direct mapping of the short-wavelength gravity anomalies along the nominal orbit of the satellite pair, eliminating the requirement of foreing data to an a priori selected model of the potential. This direct mapping of anomalous gravity could serve as basic data for investigators using a posteriori selected gravitational models.

783 - ARTEMYEV M. YE - "Isostasy of the territory of the USSR".
from : Izvestiya, Physics of the Solid Earth, N° 6, p.349-353, 1973.

Isostatic gravity anomalies are obtained for the territory of the USSR. A spectral analysis of the anomaly field showed that the resolution of the anomalies into regional (mantle) and local (lithospheric) components is perhaps quite valid. On the basis of this, a scheme for the horizontal inhomogeneities of the mantle for the territory of the USSR has been constructed and the main features of the isostatic state of the lithosphere are brought out.

784 - ZHAMOIDA A.I. - "Geological cartography in the U.S.S.R. in 1972-1973".
Nat. Com. Geol. USSR, 15 p, Leningrad, 1974.

785 - STANISLAW STASZIC UNIVERSITY of MINING & METALLURGY -
Bull. N° 529, Geod. Bull. 37, Bibliography of publications on the field of geodetical calculations 1973 - 1974, 81 p, Cracow, 1975.

786 - GUSEV N.A. - "Determination of gravity acceleration at Port Moresby (Papua New Guinea) and Hobart (Australia) with OVM pendulum apparatus". B.M.R., Geol. & Geophys., Dept. Minerals & Energy, Record 1975/106, 16 p, 1975.

In late 1974 the Central Research Institute of Geodesy, Aerial Surveying and Cartography of USSR used a set of five OVM pendulums to make two gravity ties. The gravity intervals determined were Moscow (Ledovo) - Port Moresby D = 3349.183 ± 0.055 mGal and Port Moresby D - Hobart B = 2215.655 ± 0.054 mGal on the IGSN 71 System. The gravity interval Port Moresby - Hobart, as determined by pendulums, is the same within experimental error as that determined by GAG-2 gravity meters in 1973. This confirms that the scale on the Australian Calibration Line is known to about 2 parts in 10^5. Using the same set of pendulums the gravity interval Moscow (Ledovo) - Sydney A was determined in 1972 to be 1879.519 ± 0.062 mGal on the IGSN 71 System. The gravity interval Sydney-Hobart of 745.988 mGal derived from the pendulum measurements is within experimental error of the GAG-2 gravity meter result.

822 - WIEBENGA W.A., E.J. POLAK, J.T.G. ANDREW, M. WAINWRIGHT & L. KEVI - "Burdekin Delta Underground Water Investigation, North Queensland 1962-1963".
B.M.R., Geology & Geophys., Rep. 177, 53 p, Canberra, 1975.

A geophysical survey (covering about 250 square miles) was made in the Burdekin Delta, North Queensland, to assist the Irrigation & Water Supply Commission in its investigation of underground water resources in this important sugar-growing area. Gravity, seismic, resistivity, gamma-ray logging and radioactive tracer techniques were used.

Gravity results revealed a fault buried beneath deltaic sediments, and also a remarkable negative anomaly. A hypothetical geological structure that would explain this anomaly has been computed.

823 - ANDERSEN O.B. - "Surface-ship gravity measurements in the North Atlantic ocean 1965 and 1968".
Mémoires de l'Inst. Géod. Danemark, 3ème Série, 41ème T., 47 p, Copenhague, 1975.

The Graf-Askania sea gravimeter Gss 2-14 of the Danish Geodetic Institute mounted on its Anschütz stabilizing platform was employed during a voyage to Greenlandic waters in 1965 on board the inspection ship "Hvidbjørnen" and again during the summer of 1968 on a gravity survey along scattered profiles in the Norwegian Sea of the North Atlantic Ocean on board the inspecting ship "Ingolf".

824 - REILLY W.I. & H.M. BIBBY - "A conformal mapping projection with minimum scale error, Part 2 : Scale and convergence in projection coordinates".
Survey Review, v.XXIII, p.79-87, 1975.

The scale factor and its logarithm, the meridian convergence, and the arc-to-chord correction for a conformal mapping projection are developed as Taylor expansions to the third order in the rectangular projection coordinates.

827 - WOODWARD D.J. & T. HARTHERTON - "Magnetic anomalies over Southern New Zealand".
N.Z. J. Geol. & Geophys., v. 18, N° 1, p.65-82, Wellington, 1975.

Total force magnetic anomalies at a height of 3.05 km over southern New Zealand are presented. Over the Haast Schist Group magnetic relief is low with the exception of a narrow band of positive anomalies of 100 to 300 nT running from the Alpine Fault southwards to Lake Wakatipu. The northern part of his band coïncides with the extent of a lamprophyre dike swarm and with seismic reflections from about 3 km depth ...

Total force anomalies and gravity anomalies are shown over Dunedin Volcano.

828 - ROBINSON R. & W.J. ARABASZ - "Microearthquakes in the North-West Nelson region, New Zealand".
N.Z. J. Geol. & Geophys., v. 18, N° 1, p.83-91, 1975.

Focal depths of microearthquakes indicate that seismicity in the North-west Nelson region is confined to depths less than about 15 km. This result provides a contrast with the Marlborough and Wellington regions where earthquake activity extends through the lower crust and well into the mantle. A composite focal mechanism implies current NW-SE compression in accord with results for shallow earthquakes in other parts of central New Zealand.

BIBLIOGRAPHIE 1976

4 - DAVEY F.J. - "Gravity and magnetic measurements over Aotea seamount Eastern Tasman Sea". (Note).
from : N.Z. J. Geol. & Geophys., v. 16, N° 4, p.1047-54, Wellington, 1973.

Magnetic and gravity measurements over Aotea Seamount, eastern Tasman Sea, have shown that the seamount has a high density and highly magnetised core presumably composed of basaltic rocks.

5 - WATTS A.B. & M. TALWANI - "Gravity anomalies seaward of deep-sea trenches and their tectonic implications".
from : Geophys. J. R. Astr. Soc., v.36, p.57-90, 1974.
Contr. Lamont-Doherty Geol. Obs., N° 2029.

Studies of free-air gravity anomaly referred to the equilibrium figure of the Earth (fl. = 1/299.8) profiles across island arcs show an important belt of positive anomalies seaward of deep-sea trenches. This belt of positive anomalies is called the Outer Gravity High. The Outer Gravity High is well developed seaward of the central and eastern Aleutian, Kuril, Japan, northern Bonin and Philippine Trenches where it correlates with a regional rise in topography of a few hundred metres. The Outer Gravity High can be most satisfactorily explained by a stress system associated with the convergence of lithospheric plates at island arcs. The computed gravity effect of simple models of flexure of an oceanic plate approaching an island arc generally explain both the amplitude and wavelength of the Outer Gravity High. The Outer Gravity High seaward of the central and eastern Aleutian, Kuril, Japan, northern Bonin and Philippine Trenches can be explained by a horizontal compressive stress of the order of a few kilobars acting on the oceanic plate. The Outer Gravity High seaward of the southern Bonin and Mariana Trenches, however, can be explained in the absence of horizontal compressive stresses. These conclusions are consistent with differences in the stress field of island arcs as indicated by the seismicity and regional tectonics of the north-western Pacific. The Outer Gravity High is considered an important part of the regional gravity field of island arcs and the field derived from satellite observations. The close correlation of the Outer Gravity High with regional topography seaward of trenches suggest that the gravity effect of a dense downgoing slab beneath island arcs may be small and confined in lateral extent to the region of the island arc and trench. The prominent positive anomalies in island arc areas derived from satellite observations therefore owe a major part of their existence to causes other than the gravity effect of a dense downgoing slab.

6 - MORGAN J.W. - "Rises, trenches, great faults, and crustal blocks".
from : J. Geophys. Res., v. 73, N° 6, p.79-102, 1968.
Contr. Woods Hole Ocean. Inst., N° 1984.

The transform fault concept is extended to a spherical surface. The Earth's surface is considered to be made of a number of rigid crustal blocks. It is assumed that each block is bounded by rises (where new surface is formed), trenches or young fold mountains (where surface is being destroyed), and great faults, and that there is no stretching, folding, or distortion of any kind within a given block. On a spherical surface the motion of one block (over the mantle) relative to another block may then be described by a rotation of one block relative to the other block. This rotation requires three parameters, two to locate the pole of relative rotation and one to specify the magnitude of the angular velocity. If two adjacent blocks have as common boundaries a number of great faults, all of these faults must lie on "circles of latitude" about the pole of relative rotation. The velocity of one block relative to the other must vary along their common boundary ; this velocity would have a maximum at the "equator" and would vanish at a pole of relative rotation.

The motion of Africa relative to South America is a case for which enough data are available to critically test this hypothesis. The many offsets on the mid-Atlantic ridge appear to be compatible with a pole of relative rotation at 62°N (± 5°), 36°W (± 2°). The velocity pattern predicted by this choice of pole roughly agrees with the spreading velocities determined from magnetic anomalies. The motion of the Pacific block relative to North America is also examined. The strike of faults from the Gulf of California to Alaska and the angles inferred from earthquake mechanism solutions both imply a pole of relative rotation at 53°N (± 3°), 53°W (± 5°). The spreading of the Pacific-Antarctic ridge shows the best agreement with this hypothesis. The Antarctic block is found to be moving relative to the Pacific block about a pole at 71°S (± 2°), 118°E (± 5°) with a maximum spreading rate of 5.7 (± 0.2) cm/yr. An estimate of the motion of the Antarctic block relative to Africa is made by assuming closure of the Africa-America-Pacific-Antarctica-Africa circuit and summing the three angular velocity for the cases above.

7 - DEWEY J.F. & J.M. BIRD - "Mountain belts and the new global tectonics". J. Geophys. Res., v. 75, N° 14, p.257-277, 1970.

Analysis of the sedimentary, volcanic, structural, and metamorphic chronology in mountain belts, and consideration of the implications of the new global tectonics (plate tectonics), strongly indicate that mountain belts are a consequence of plate evolution. ...

8 - KIENLE J. - "Gravity traverses in the Valley of Ten Thousand Smokes, Katmai National Monument, Alaska".
J. Geophys. Res., v. 75, N° 32, p.6641-6649, 1970.

Three structural sections across the pyroclastic flow of the 1912 Mount Katmai eruption in the Valley of Ten Thousand Smokes were derived from gravity data. Minimum average ash flow thicknesses of 40, 45 and 30 meters were deduced for profiles across the main, the south, and the southeast branches of the valley, respectively. The total volume of the ash flow is estimated to be 3.8 to 4.7 km3.

9 - GIBB R.A. & D.W. HALLIDAY - "Gravity measurements in Northern district of Keewatin and parts of district of Mackenzie and district of Franklin, N.W.T. with maps N° 139 - 148".
Earth Physics Branch, Gravity Map Ser. 139-148, 8 p, Ottawa, 1975.

Ten Bouguer anomaly maps (1:500.000) covering a large part of the Churchill structural province of the Canadian Shield to the north and northwest of Hudson Bay were compiled from a total of 3,698 gravity stations. There is a correlation between positive gravity anomalies and granulite terrains on Boothia and Melville peninsulas. Continuity of a zone of anomalously dense crust from Baker Lake to Southampton Island and perhaps as far east as Coasts Islands is inferred from an easterly alignment of positive gravity anomalies. This zone is expressed at the surface by high grade metamorphic terrains intruded locally by anorthosite and gabbro. In the Ogden Bay region the correlation between gravity anomalies and granulites is not so clear.

Major negative gravity anomalies are related to granitic plutons which lie within a broad regional gravity low extending from north of Baker Lake to Melville Peninsula. Although there is also a general correlation in trend and location between major Aphebian fold belts and this broad regional gravity low there is generally little correlation between individual fold belts and the gravity anomalies.

ACADEMIE des SCIENCES U.R.S.S. - Références bibliographiques :
Sér. 52 - Géodésie et Astronomie.

11 - N° 6, 40 p, Moscou, 1975 (texte russe).
12 - N° 7, 39 p, " " " "
13 - N° 8, 45 p, " " " "
14 - N° 9, 42 p, " " " "
15 - N° 10, 38 p, " " " "
16 - N° 11, 41 p, " " " "
17 - N° 12, 53 p, " " " "

ACADEMIE des SCIENCES U.R.S.S. - Références bibliographiques :
Géophysique.

18 - N° 5, 265 p, Moscou, 1975 (texte russe).
19 - N° 6, 273 p, " " " "
20 - N° 7, 247 p, " " " "
21 - N° 8, 255 p, " " " "
22 - N° 9, 250 p, " " " "
23 - N° 10, 261 p, " " " "
24 - N° 11, 267 p, " " " "

25 - ACADEMIE des SCIENCES U.R.S.S. - Références bibliographiques :
Sér. 52 - Géodésie et Astronomie, Index des auteurs 1974.
93 p, Moscou, 1975 (texte russe).

26 - ACADEMIE des SCIENCES U.R.S.S. - Références bibliographiques :
Géophysique - Index des articles 1973.
270 p, Moscou, 1975 (texte russe).

32 - RUMMEL R. - "Downward continuation of gravity information from satellite to satellite tracking or satellite gradiometry in local areas".
The Ohio State Univ., Dept. Geod. Sci., Rep. N° 221, 50 p, Columbus, 1975.

The derivation of gravity anomalies at the surface of the Earth from satellite to satellite tracking or satellite gradiometry observations is a downward continuation problem. In developing the spectral interrelations in terms of spherical harmonics between different gravity quantities such as the disturbing potential T, gravity anomalies Δg, and $\frac{\partial^2 T}{\partial r^2}$ at the surface and in satellite altitude a discussion of the features of these two methods for the estimation of surface gravity information is possible.

For a local improvement of our knowledge about the gravity field integral formulas in the parameter domain have to be applied instead of a representation by spherical harmonics. The neglected regions will cause a truncation error. The application of the discrete form of the integral equations connecting the satellite observations with surface gravity anomalies is discussed in comparison with the least squares prediction method.

One critical point of downward continuation is the proper choice of the boundary surface. Practical feasibilities are in conflict with theoretical considerations. The properties of different approaches for this question are analyzed.

As a result the considerations indicate the possibility of deriving mean gravity anomalies at the surface of the Earth. By taking into account theoretical restrictions these anomalies are comparable with terrestrial gravity anomalies.

33 - SCHWARZ K.P. - "Formulas and Fortran programs to determine zonal coefficients from satellite observations by collocation". AFCRL-TR-75-0341, The Ohio State Univ., Dept. Geod. Sci. N° 222, Sci. Rep. N° 24, 36 p, 1975.

Following a proposal by MORITZ and SCHWARZ the collocation method is applied to determine zonal coefficients from satellite observations. The perturbation equations are specialized from KAULA's more general formulas and are supplemented by a recurrence relation for the inclination function. The computational formulas for the collocation procedure are summarized and a method is given to determine the optimal number of coefficients by an eigenvalue analysis of the error covariance matrix.

Two programs have been developed. The first one computes the coefficients of the perturbation equation, the second one determines the collocation solution and performs the accuracy analysis.

34 - HAJELA D.P. - "Equal area blocks for the representation of the global mean gravity anomaly field". The Ohio State Univ., Dept. Geod. Sci., Rep. N° 224, 41 p, Columbus, 1975.

A practical scheme of approximately equal area blocks in various sizes is considered for the representation of the global mean gravity anomaly field. It is assumed that the starting data is mean anomalies over 1° x 1° equiangular blocks, instead of point anomalies. This leads to the constraint that the latitudinal and longitudinal limits of all blocks should be in integer degrees, so that the calculation of proportional anomalies over fractional 1° x 1° blocks is avoided. Similarly, a second condition is imposed that the external limits of smaller size blocks should match exactly with the limits of a large size block, e.g. a 5° equal area block should encompass a whole number of 1° equal area blocks. This necessitates the subdivision of a larger block into component blocks of smaller size.

It is found that different block limits result when we consider a 10°, 15°, or 30° equal area block and its subdivisions. It is proposed that the largest block should be taken as a 10° equal area block, and 5°, 2°.5, 2° and 1° equal area blocks should be obtained by the subdivision of 10° blocks. This will allow the representation of the global gravity field by anomalies in blocks of different sizes with matching boundaries. The block limits of 10° equal area blocks, and the component 5° and 1° blocks are given. The areas have been tabulated on unit sphere, as well as on unit ellipsoïd, with semi-major axis as unity.

35 - MORITZ H. - "Combination of aerial gravimetry and gradiometry". AFCRL-TR-75-0378, The Ohio State Univ., Dept. Geod. Sci., Rep. N° 223, Sci. Rep. N° 25, 71 p, 1975.

This report considers the use of a combined accelerometer and gradiometer system for measuring first and second order gradients of the Earth's gravitational potential. In this way it is possible to rigorously separate genuine gravitational effects from inertial disturbances, in both 1st and 2nd order gradients. The theory is developed at length. Accuracy studies comprise the error propagation along a flight profile as well as the error of interpolation between the profiles. By means of least-squares collocation it is investigated how the additional use of second order gradients improves the interpolation of gravity. Numerical estimates are given.

36 - RAPP R.H. & S.I. AGAJELU - "Comparison of upward continued anomalies computed by the Poisson integral and by collocation". AFCRL-TR-75-0401, The Ohio State Univ., Dept. Geod. Sci., N°227, Sci. Rep. N° 26, 12 p, 1975.

The computation of gravity anomalies at four altitudes, 6.096 km, 7.010 km, 9.144 km and 10.670 km, was carried out through the use of the standard Poisson integral, and through the use of the method of least collocation as implemented through a Fortran computer program written by TSCHERNING. In the comparison of the results we found (approximately) mean differences on the order of 0.5 mGal, root mean square differences on the order of 0.7 mGal, and percentage differences on the order of 10 %. Specific values depended on how the collocation procedure was implemented and the heights involved.

The computer time needed for the collocation procedure was greater than that needed for the Poisson integral. In cases when an integral formula can be obtained for a desired quantity, the collocation process would take longer computationally. However there are many types of computations that can only be done using least squares collocation.

37 - UOTILA U.A. - "External gravity potential of the Earth, gravimetric quantities and geodetic parameters affected by gravity". AFCRL-TR-75-0431, The Ohio State Univ., Dept. Geod. Sci. N° 229, Final Rep., January 1, 1972 to June 30, 1975

This is a final report on research done under Air Force Contract N° F.19628-72-C-0120. The research reported in twenty-six scientific reports, numerous scientific papers, internal memorandums, and dissertations have been summarized and evaluated, keeping in mind the objectives of the contract. Subject matter include such items as the use of gravity gradient measurements, the convergence problems in physical geodesy, least-squares collocation theory and applications, combination of satellite and gravimetry data, inversion of large symmetric matrices, covariance functions, anomaly degree variances, mass distribution in the Earth's interior, role of altimeter data in the determination of mean gravity anomalies, refinement of modeling techniques for the determination of geopotential coefficients and computational techniques in gravimetry. Suggestions for further studies are made

38 - KAULA W.M., M.E. PARMENTER, N. BURKHARD & D.D. JACKSON - "Application of inversion theory to new satellite systems for determination of the gravity field".
AFCRL-TR-75-0450, Univ. California, Dept. Geophys. & Space Physics, Sci. Rep. , N° 1, 1975.

Influence coefficients for gravity field and sea level effects on altimetry and satellite-to-satellite range rate are developed and used in orbital simulations. Inversion theory is extended to variables over two dimensional continuum and applied to gravity anomalies.

39 - MUELLER I.I. - "Proceedings of the Geodesy/Solid Earth and Ocean Physics (GEOP) research conferences 1972-1974.
The Ohio State Univ., Dept. Geod. Sci., Rep. N° 231, 181 p, 1975.

List of the various items :
GEOP 1 - Solid Earth and ocean tides
GEOP 2 - The rotation of the Earth and polar motion
GEOP 3 - Vertical crustal motions and their causes
GEOP 4 - The geoid and ocean surface
GEOP 5 - Planetary dynamics and geodesy
GEOP 6 - Earthquake mechanism and displacement field close to fault zones
GEOP 7 - Coastal problems related to water level
GEOP 8 - Lunar dynamics and selenodesy.

a)HENDERSHOTT M.C. - "Ocean tides proceedings" (GEOP 1).
p.7-17.

Tidal dissipation, continental shelf and marginal sea tides, baroclinic tides,
Tidal admittance, tidal Q and tidal resonance,
Earth tides and ocean tides,
Global numerical models of ocean tides,
Closing remarks.

b)American Geophysical Union - HARRISON J.C., M.C. HENDERSHOTT, J.T. KUO, I.I. MUELLER & B.D. ZETLER - "Solid-earth and ocean tides". (GEOP 1).
p.19-23.

First session - Second session - Third session - The superconducting gravimeter.

c)ROCHESTER M.G. - The arth's rotation proceedings". (GEOP 2).
p.27-39.

Reference frames - Time - Dynamics of changes in earth's rotation - Precession - Nutation - "Secular" decrease in obliquity - Chandler wobble - Seasonal wobbles - Secular motion of the pole - Long period wobbles - Nearly diurnal free wobble, Short-period changes in length of day - Irregular fluctuations in axial spin rate - Secular acceleration of Earth's rotation - Conclusion.

d)KAULA W.M., K. LAMBECK, Wm. MARKOWITZ, I.I. MUELLER & D.E. SMYLIE - "The rotation of the Earth and polar motion". (GEOP 2).
p.41-47.

First session - Second session - Third session - Fourth session.

e) MENARD H.W. - "Epeirogeny and plate tectonics". (GEOP 3).
p.51-62.
External loading and unloading - Bending at subduction zones - Density changes - Mantle motion - Epeirogeny and drift - Oceanic epeirogeny - Conclusion.

f) American Geophysical Union - ISACKS B., I.I. MUELLER, R.I. WALCOTT & M. TALWANI - "Vertical crustal motions and their causes". (GEOP 3).
p.63-66.
First session - Second session - Third session - Fourth session.

g) RAPP R.H. - "The geoid definition and determination". (GEOP 4).
p.69-77.
The geoïd : definition - Theoretical refinements - Gravity data requirements for a precise geoid - Mean sea level and the geoid - Satellite altimetry - Closing remarks.

h) American Geophysical Union - CHOVITZ B., I.A. MUELLER, R.H. RAPP, W. STURGES & G. WEIFFENBACH - "The geoid and ocean surface". (GEOP 4).
First session - Second session - Third session - Fourth session.

i) ANDERSON J.D. - "Geodetic and dynamical properties of planets". (GEOP 5).
p.85-93.
Gravity fields - Shape and topography - Planetary rotations - Planetary interiors.

j) American Geophysical Union - COUNSELMAN C.C. III, W.B. HUBBARD, I.I. MUELLER, S.J. PEALE & R.H. TOLSON - "Planetary dynamics and geodesy". (GEOP 5).
First session - Second session - Third session - Fourth session.

k) BRUNE J.N. - "Current status of understanding quasi-permanent fields associated with earthquakes". (GEOP 6).
p.103-110.
Excerpts from the Reid report - Modern tectonic models - Modern data - Modern problems.

l) American Geophysical Union - ALLEN C.R., J. BERGER, I.I. MUELLER, J.C. SAVAGE & J. WEERTMAN - "Earthquake mechanism and displacement fields close to faults zones". (GEOP 6).
p.111-115.
First session - Second session - Third session - Fourth session.

m) WALCOTT R.I. - "Recent and late quaternary changes in water level". (GEOP 7).
p.117-127.
Changes of water level - Deformation and movements of the Earth's surface - Fluctuations in Holocene, sea level - Conclusions.

n) American Geophysical Union - G.C. DOHLER, P. GALE, I.I. MUELLER, R.B. PERRY & J.F. POLAND - "Seventh GEOP research conference report".
p.129-135.
First session - Second session - Third session - Fourth session.

o) KAULA W.M. - "The gravity and shape of the moon" (GEOP 8).
p.139-146.
Gravity - Dynamics - Geometry - Tectonic implications - Conclusions.

p) American Geophysical Union - DOYLE F.J., D.H. ECKHARDT, J.W. HEAD, W.M. KAULA, I.I. MUELLER & W.L. SJOGREN - "Lunar dynamics and selenodesy".
p.147-154.
First session - Second session - Third session - Fourth session Summary session.

40 - Bollettino di Geofisica teorica ed applicata, v. XVII, N° 65, 84 p, Osser. Geof. Sper., Trieste, Marzo 1975.

a) ELTER P., G. GIGLIA, M. TONGIORGI & L. TREVISAN - "Tensional and compressionnal areas in the recent (Tortonian to present) evolution of the Northern Apennines".
p.3-18.

This paper is an attempt to focalize the relations between surface geology and gravity anomalies, seismicity and depth of the Moho in the Northern Apennines.

In this orogenic belt a striking contrast exists between the internal (western) and external (eastern) areas. The former has been submitted to strong tensional deformation which began in Upper Miocene and is still active. In the same time interval, the crust of the eastern area has undergone compressive deformation.

The limit between the two areas significantly coïncides with the passage from positive to negative gravity anomalies. In the two cross-sections which have been examined in detail, the depth of the Moho varies from a minimum of 20 up to 46 km. The light crust is thinned in the internal Tyrrhenian slope which is presently undergoing tensional deformation, and thickened in correspondence with the external margin of the belt where compressionis presumably still active.

After a short summary of the tectonic and paleogeographic evolution of the belt, a hypothesis, based on the existence of a convective cell in the Southern Tyrrhenian Sea and conterclockwise rotation of the peninsula is advanced to explain the coexistence of tensional and compressional movements in adjacent areas of the same belt.

b) MORELLI C., C. GANTAR & M. PISANI - "Bathymetry, gravity (and magnetism) in the Strait of Sicily and in the Ionian Sea".
p.39-58.

14 gephysical cruises in the Mediterranean with CNR's Ships "BANNOCK" and "MARSILI" interested the Strait of Sicily and the Ionian Sea from 1965 to 1972. Results are presented in form of the following maps, scale 1:750.000 ; Bathymetry, Free-Air Gravity Anomalies, Bouguer anomalies.

Bathymetry is giving the details for the continental bridge between Sicily and Africa, delimited by a steep N.S. faults system to the East, foundred in the central part ("intermediate basin") with 3 main grabens (Pantelleria - 1317 m ; Malta - 1721 m ; Linosa - 1529 m) and interested by a distension fault system oriented mainly NW-SE. Two sills (western : - 410 m ; eastern - 510 m) regulate the intermediate water flow between Western and Eastern Mediterranean.

Free-air anomalies are in general positive, so confirming the general tendency of the area to sink. They are negative in correspondence of the grabens in the Strait of Sicily, and strongly negative in correspondence of the Hellenic trench, of the Calabrian Rise and of the Malta Rise.

The Bouguer anomalies are mainly positive in the central area of the Sicily Strait in correspondence to magmatic intrusions through distension faults revealed by magnetic anomalies and by reflection seismics. They are also strongly positive in the centre of the Ionian sea, whereas negative anomalies corresponding to great thickness of sediments exist in front to Calabria, in the Taranto Gulf and in front of Greece.

The magnetic field is mainly regular, in correspondence with the thick sedimentary layers. But magnetic anomalies of magmatic origin are aligned :
N.S in correspondence with the eastern meridian faults systems seen from bathymetry, and its submerged continuation towards Africa ;
NW.SE connected with the central area faults systems, most of them in correspondence with the volcanic islands and submerged volcanos.
Other ones are spread near the African coast.

The geological synthesis and correlations between Sicily and Tunisia by Castany and Burrolet agree well with the above mentioned geophysical results. But these confirm that also the Ionian area is the continuation of the African block, more deeply foundred than the Strait of Sicily area probably owing to a more advanced oceanization of the Lower Crust.

c) RIUSCETTI M. & R. SCHICK - "Earthquakes and tectonics in Southern Italy". p.59-78.

Focal parameters of 19 shallow and 8 deep-focus earthquakes in Southern Italy, within the years 1905-73, have been calculated. ...

Six earthquakes have their epicenters aligned along the Còmiso-Messina-S.Eufemia line. Three of them show a dip-slip motion along a fault plane parallel to the strike of the Còmiso line. The relative displacement for the two greatest ones is in the sense of an Eastern upward movement. The rest of the studied shallow shocks have a predominantly strike-slip mechanism with left-lateral motion. Only the "Malta earthquake" of MAR 21, 1971 has a right-lateral movement.

The recalculated hypocenters never fall in the depth interval from 40 to 200 km. Fault Plane Solutions of 3 deep-focus earthquakes have been studied. They show a nearly identical N-S direction for a vertical fault plane with dip-slip motion. While the total picture given by seismology seems to confirm the existence of a fault plane along the line Còmiso-Messina-S. Eufemia, it both disagrees with the described prevalent strike-slip motion along it and does not support the hypothesis of a slab sinking North-Westward from the Ionian to the Tyrrhenian sea.

42 - MELCHIOR P. - Marées terrestres, Bulletin d'Information
N° 72, p.4085-4185, Obs. Royal Belgique, 15 Oct. 1975.

43 - HOLUB K., V. TOBYÁŠ & K. DIVIŠ - "Seismic noise at the International gravity point in Prague-Ruzyně (Czechoslovakia)".
Cesk. Akad. Ved, Studia Geophys. & Geod., t. 19, v. 4, p.383-387, Praha, 1975.

The vertical component of ground displacement was measured at the Prague-Ruzyně International Gravity Point in the frequency range of 1 - 300 Hz. The permanent noise, the vibrations caused by the observers during gravimetric observations and by the wind, as well as those due to normal operations at the airport, display maximum peak-to-peak amplitudes of 0.06 µm in the frequency range of 1-50 Hz ; with a CG-2 gravimeter this is not detrimental to the accuracy of the observations. The taxiing of turbo-jet and jet aircraft and engine tests of aircraft generate vibrations in frequency ranges of 75 - 90 and 190 - 270 Hz. Their amplitudes, according to the results of laboratory tests published for various types of gravity meters (CG-2, GAK-PT, GVP-3, KVG), are of magnitudes which generate errors in tenths of mGal.

44 - VYSKOCIL P. & A. KOPECKY - "Neotectonics and recent crustal movements in the Bohemian Massif".
Dedicated to the 20th Anniversary of the Res. Inst. Geod., Topog. & Cartog. in Prague, 179 p, 1974.

Historical evolution and modern methods of studying neotectonic and recent movements. Neotectonic map of the Bohemian Massif and its stages of development. Neotectonic classification of the Bohemian Massif. History, available data and results of the investigation of the Earth's crust recent movements by geodetic methods. Participation of Czechoslovak geodesists in the construction of the synoptic map showing recent vertical movements in Eastern Europe. The map of Quaternary tectonics and recent movements in the Bohemian Massif ; comparison and interpretation based on geological and geomorphological data. Geophysical interpretation of the map showing recent vertical crustal movements on the territory of Bohemian Massif.

CENTRE NATIONAL pour l'EXPLOITATION des OCEANS - Bulletin d'Information,

45 - N° 81, 21 p, Paris, Sept. 1975
46 - N° 82, 20 p, Paris, Oct. 1975.
47 - N° 83, 17 p, Paris, Nov. 1975.

48 - COOKE R.J.S. - "Australian calibration line gravity survey 1971".
B.M.R., Geol. & Geophys., Dept. Minerals & Energy, Record 1975/103, 10 p, Canberra, 1975.

14 stations of the Australian Calibration Line (ACL) spanning about 2775 mGal were re-occupied in April 1971 with 4 LaCoste & Romberg gravity meters. Of these meters G20 behaved well and appeared to have regained approximately the scale correction factor (SCF) derived for it in 1969 relative to the mean Australian milligal ; the value is now about 1.000170 compared with 0.999830 found on the ACL traverse in 1970. G101 behaved erratically again as it did on the two earlier calibration line surveys, preventing any estimation of its SCF.

G132 behaved very well and exhibited the same SCF (0.999905) as it had shown on the 1969 and 1970 surveys. G252, a new meter, which had not previously been used on a calibration line, behaved fairly well, but occasional tares prevented the derived SCF of 0.999935 being regarded as firmly established.

During this survey, an accurate tie was made between the BMR pendulum station in Sydney (5099.9905) and the reference point for the CSIRO absolute determination of gravity at Sydney.

50 - HOWARD D.W. - "Deep-seated igneous intrusions in Co-Kerry".
Proc. Royal Irish Acad., v. 75, Section B, N° 7, p.173-183, Dublin, 1975.

Gravity and magnetic surveys have been carried out over a 1,500 km2 area of mid and west Co. Kerry. The gravity interpretation favours the existence of an acidic intrusion under the southern part of the area. This intrusion together with the great accumulation of sedimentary rocks within "the Munster Basin" are considered to be responsible for the large gravity "low in the South".

The magnetic survey delineates a belt of positive anomalies running across the centre of the area. These have amplitudes up to 300 nT. The belt is interpreted as being caused by basic igneous intrusives all at a similar depth of 1,6 km.

From a correlation between the gravity and magnetic anomalies a basic igneous intrusive is postulated to lie under an area around Slea Head on the western extremity of the Dingle peninsula.

51 - RECQ M. - "Contributions à l'étude de la zone de transition entre la structure continentale et la structure océanique de la croûte terrestre entre Toulon et Gênes".
Thèse Univ. Paris VI, Dr. es Sci., 167 p, Paris, 1974.

Le principal objet de ce travail consiste en l'étude de la zone de transition entre la structure continentale et la structure océanique (ou supposée telle) de la croûte terrestre en Provence, plus particulièrement entre le massif des Maures et Menton, par la réalisation de profils sismiques de réfraction sur terre et en mer le long des marges continentales

En novembre 1971, le domaine d'investigation a été étendu jusqu'à Gênes par l'exécution de nouveaux profils terrestres entre San Remo et Gênes-Pegli et en mer par des profils parallèles à la côte effectués à l'aide de bouées au large d'Imperia en 1973. Les résultats de ces dernières expériences seront publiés ultérieurement.

52 - SLETTENE R.L. - "A Bouguer gravity anomaly map of Africa".
DMAAC, Tech. paper N° 73-3, DoD, 12 p, St-Louis, 1973.

Mean values obtained from the observations and correlation methods and computed in the New Reference Systems (Geodetic constantes 1967 - IGSN 71).

53 - OLCZAK T. - "L'ellipsoïde terrestre et quelques constantes physiques". Inst. Geofiz. UW, Acta Geophys. Polonica, v. XVIII, N° 3-4, p.299-323, Warszawa, 1970. (Texte polonais).

La valeur de la constante géocentrique de la gravitation $km_{\oplus}$ ainsi que la valeur de rapport de la masse de la Lune à celle de la Terre μ, déterminées récemment au cours d'une série d'expériences cosmiques ("Ranger 6 - 9", "Luna 10", "Lunar Orbiter", "Mariner 2"...) parallèlement avec les valeurs des coefficients harmoniques du géopotentiel déduites de perturbations de satellites artificiels de la Terre, permettent d'augmenter très sensiblement la précision de plusieurs constantes physiques se rapportant à l'ellipsoïde terrestre.

Utilisant les données publiées jusqu'à présent et admettant $km_{\oplus} = 398601{,}15.10^{9}$ m^{3-2}, $\mu = 1 : 81{,}30215$ et $J_2 = 1082{,}65.10^{-6}$, on est conduit avec la valeur de la pesanteur équatorielle $g_a = 9{,}78031$ ms^{-2}, estimée de mesures faites en surface, aux valeurs suivantes du rayon équatorial et de l'aplatissement de l'ellipsoïde terrestre a = 6378145 m et = 1 : 298,254, ainsi qu'à la gravité à sa surface.

$$g = 9{,}78031 \frac{1 + 0{,}001931714 \sin^2 \psi}{\sqrt{1 - 0{,}006694542 \sin^2 \psi}}$$

Ensuite, en se basant sur les mêmes données on a trouvé pour l'aplatissement dynamique H la valeur 1 : 305,478 et pour les moments d'inertie équatoriale A et polaire C les valeurs $801{,}39.10^{35}$ kg m^2 et $804{,}02.10^{35}$ kg m^2 respectivement.

L'étude de quelques formules pour la pesanteur normale montre, que les anciennes formules donnent avec les valeurs du rayon équatorial, actuellement acceptées, une valeur trop faible de la constante $km_{\oplus}$ (exemples : formule de Helmert, 1901, et formule "internationale") ; les formules modernes (exemples : formule de Zhongolovitch, 1952 et celles de Uotila, 1957 ; Kaula, 1958 ; Grushinskij, 1960) conduisent à des valeurs satisfaisantes de la dite constante.

54 - SIBUET J.C. - "Contribution de la gravimétrie à l'étude de la Bretagne et du plateau continental adjacent". from : C.R. sommaire des Séances de la Soc. Géol. de France, Fasc. 3, séance du 24.4.72, p.124-129, 1972.

L'interprétation de détail des levés gravimétriques nécessite une bonne connaissance de la géologie superficielle, au moins en des points particuliers comme les affleurements du socle. Or, nous disposons maintenant d'une esquisse géologique et d'une estimation de l'épaisseur des séries sédimentaires du plateau continental au large de la Bretagne. Il est donc possible de tenter une interprétation de la nouvelle carte des anomalies gravimétriques de cette région, en s'appuyant sur les données géologiques terrestres et marines.

55 - FAIRHEAD J.D. & R.W. GIRDLER - "The seismicity of the Red Sea, Gulf of Aden and Afar triangle".
from : Phil. Trans. Roy. Soc. London, v. 267 A, p.49-74, 1970.

The seismicity of the Red Sea, Gulf of Aden and Afar triangle has been studied for the period January 1953 through December 1968. Epicentres have been relocated using the method of Joint Epicentral Determination (Douglas 1967) and some fault plane solutions have been attempted. Magnitude-frequency studies indicate that with the present distribution of teleseismic stations, earthquakes with body wave magnitude $m_b \geqslant 4.8$ are well determined in this region.

The study confirms that there is surprisingly little major earthquake activity in the northern part of the Red Sea. Between 19.5 and 21.0°N, there is a concentration of epicentres and some of these might be associated with an active NNE transform fault. In the southern part of the Red Sea, most of the epicentres are associated with the deep, axial trough, although some are associated with the western margin, especially in the neighbourhood of the Gulf of Zula (15° N).

Earthquake activity is confined to the centre of the Gulf of Aden with concentrations of epicentres occurring on or near to NNE transform faults. The seismically active zone continues westwards through the Gulf of Tadjoura and across the Afar depression to the western boundary scarp. There are no teleseismically recorded epicentres between latitudes 12.2 and 14.2°N.

In general, most of the seismic activity occurs along the centres of the Red Sea and Gulf of Aden and this supports sea-floor spreading mechanism for their origin. The number of plates involved is discussed.

56 - SANCHO J., J. LETOUZEY, B. BIJU-DUVAL, P. COURRIER, L. MONTADERT & E. WINNOCK - "New data on the structure of the Eastern Mediterranean Basin from seismic reflection".
Earth & Planetary Sci. Letters N° 18, p.189-204, 1973.

Several seismic reflection profiles have been made in the Eastern Mediterranean, namely between Cyrenaica and Crete through the Mediterranean Ridge and the deeps south of the Aegean Arc, in the abyssal plain and at the foot of the Messina Cone, on the Apulian Plateau and its margins. Good penetration was obtained with Flexotir in spite of the existence of strong diffracting horizons.

The main finding is the existence of sedimentary series several thousand meters thick, probably mainly of Tertiary age, in the Ionian Sea as well as on the Ridge. These basins have a smooth structure, shaped by intense vertical faulting of Plio-Quaternary age. These results, placed in their regional geological context and compared with the geophysical data suggest that, in contrast to earlier ideas, the Mediterranean Ridge is not made of highly tectonised sediments due to underthrusting of the Mediterranean basin under the Aegean area.

57 - MUELLER I.I. - Bulletin Géodésique de l'Association Internationale de Géodésie. N° 117, paris, 1er Septembre 1975.

a) ZIELINSKI J.B. - "Solution of the downward continuation problem by collocation".
p.267-278.

The modern satellite techniques enable to measure the gravity acceleration in space. The downward continuation of these measurements to the Earth's surface is by the closed theory practically impossible. Using the method of collocation we can estimate the values of Δg in the limited region underneath the observation with a little loss of accuracy. Results of some numerical tests for elevation of 300 km are presented.

b) RAPP R.H. - "Comparison of the potential coefficient models of the Standard Earth (II and III) and the GEM 5 and GEM 6".
p.279-287.

The results given in this paper can be used in the evaluation and comparison of the geopotential models studied. The various modes of comparison considered seems to suggest that the gravitational model of the SE 3 is less accurate than the GEM 6 model. Additional types of comparisons are needed to investigate this further. For example, various potential coefficient sets could be used in satellite orbit determination and prediction. The magnitude of the residuals is then a criteria on the suitability of a coefficient set. A limited test with a 7 day orbit using laser data indicated the best orbit fit was obtained by the coefficients of the SE 2 (RAPP, 1974).

c) ARUR M.G. & K.I. MUELLER - "Does mean sea level slope up or down towards North ?".
Comments on the article of the same title by I. FISCHER (1975)".
p.289-297.

Geodesists and oceanographers have disagreed on the direction and magnitude of the North-South sea level slopes along the East and West Coasts of the United States.

There was some room to doubt the validity of the comparison between the results of the geodesists and the oceanographers since they use different methods and different reference surfaces for the determination of these slopes (FISCHER, 1975).

An attempt has now been made to compare the results of the oceanographers and geodesists by reducing them to the same terms.

d) MOURAD A.G. - Symposium on applications of marine geodesy.
Batelle Columbus Laboratories, Columbus, Ohio USA, June 3 - 5, 1974.
p.299-304.

e) TORGE W. - "Geodäsie".
Ed. Walter de Gruyter, Berlin, New-York, 268 p, 101 fig.
C.R. par M. LOUIS, P.305.

Ce petit livre, écrit en langue allemande, traite la géodésie de façon fort complète en un minimum de pages. Il ne s'agit pas en effet d'un résumé, mais d'un ouvrage fort bien articulé où cependant les longs développements mathématiques ont été exclus.

58 - COMITE NATIONAL FRANCAIS de GEODESIE & GEOPHYSIQUE - Rapport National sur les travaux français exécutés de 1971 à 1974.
Etabli à l'occasion de la XVIème A.G. de l'UGGI, Publié par le Secrétaire Général adjoint G.M. WEILL, 277 p, 1975.

a) BOLLO R. & A. GERARD - "Carte gravimétrique détaillée de la France, état d'avancement".
p.17-19.

b) LEVALLOIS J.J. - "Travaux sur le géoïde".
p.22-25.

c) CORON S. - "Activité du Bureau Gravimétrique International, Paris".
p.43-45.

d) SAKUMA A. - "La mesure absolue de la pesanteur".
p.46-47.

59 - COMITE NATIONAL FRANCAIS de GEODESIE & GEOPHYSIQUE - Compte-rendus, année 1973, publiés par le Secrétaire Général A. COUZY.
55 p, 1975.

60 - MASSON SMITH D.J. & E.M. ANDREW - "Gravity and magnetic measurements in the Lesser Antilles".
Overseas Geol. Surveys, Geophys. Div., 85 p, London, 1965.
(Preliminary report and illustrations).

In January and February 1963, gravity and magnetic surveys of most of the islands in the Lesser Antilles were made at the request of the Seismic Research Unit, University of the West Indies. In 1962 a gravity survey of Barbados was made as part of a water supply investigation and the results are included here.

In the tables results are given for 1072 stations distributed over 11 islands :
coordinates, elevation, observed gravity, free-air anomaly, terrain correction, Bouguer and isostatic anomalies.

61 - ANDREW E.M., D. MASSON SMITH & G.R. ROBSON - "Gravity anomalies in the Lesser Antilles".
Inst. Geol. Sci., Geophys. Paper N° 5, 21 p, London, 1970.

A belt of large positive gravity anomaly follows the volcanic island arc of the Lesser Antilles and is flanked to the east by an equally pronounced belt of negative anomaly. Isostatic anomaly changes exceeding 300 mGal have been observed. The islands are composed mainly of volcanic rock and occupy a very small part of the area so that the source of the gravity anomalies is not evident from geological observation. The belt of positive anomaly appears to be due to a zone 100 km wide of material of lower crustal density emplaced in the upper crust. The large anomaly gradients and curvatures rule out the possibility that an appreciable part of the anomaly originates in the lower crust or mantle. The belt of negative anomaly may in part be due to considerable thicknesses of recent sediments on the sea floor, but may also arise from isostatic compensation for the crustal load implied by the belt of positive anomaly.

Remark : "Errors in the isostatic anomalies".

The Airy-Heiskanen isostatic anomalies published in this paper are everywhere about 50 mGal too positive when compared with the results of more recent investigators. The error appears to have arisen from a defect in the computer program used to calculate the isostatic correction. The effect of this error is to invalidate the interpretation given in the paper of the isostatic anomalies in terms of the regional geological structure. A reduction in the level of anomaly reduced the thickness and extent of the high density material in the upper crust which was postulated as the cause of the belt of positive anomaly over the islands : the flanking belt of negative anomaly to the west becomes more pronounced and requires a greater thickness of unconsolidated marine sediments beneath.

62 - SOLLOGUB V.B., D. PROSEN & H. MILITZER - "Die Struktur der Erdkruste Mittel - und Südosteuropas nach Angaben der Tiefenseismik".
Nat. Kom. für Geod. & Geophys. der Deutschen Demokratischen Republik bei der Deutschen Akad. der Wissens. zu Berlin,
Geod.Geophys. Veröff., R.III, H.27, 186 p, Berlin, 1972.

Results of deep seismic soundings conducted during recent years in south-eastern and central Europe are reviewed. The present volume is the first generalization of the explosion seismology data on crustal structure of the territory in question.

The data of the international profiles are discussed and an attempt is made of comparison between deep-seated and near-surface horizons. It is hoped that the book may be of value for wide circles of geophysicists and geologists.

63 - KAUTZLEBEN H. - "Aufgaben und Ergebnisse der Forschungsarbeiten im Zentralinstitut für Physik der Erde der Akademie der Wissenschaften der DDR".
Akad. Wissens. DDR, Zentralinst. Physik Erde, Veröff. N° 29,
173 S, Potsdam, 1974.

The Central Earth Physics Institute was formed in 1969 by the union of four institutions, independent until this time, for geodesy, geodynamics, geomagnetism and geotectonics. The scientific field extends, on the one hand, from contributions concerning geodesy and investigations on seismology as well as geophysical solid state physics to selected problems of physics and chemistry of the Moon and planets and, on the other hand, from contributions relating to structure and dynamics of the lithosphere, especially the Earth's crust, to structural geological and geotectonical investigations. At a growing extent the investigations are stamped by the objectives of the Geodynamics Project and are determined by the requirements of the socialist society with regard to scientific advance and selected scientific service. This paper gives a review on the most important developments and results obtained in the past decade.

a) FROLICH F. - "Neue Aspekte zum Geodynamics Project aus hochdruck-fest Körperphysikalischer und planetarer Sicht".
S. 21-33.
Several new aspects affecting the internationally co-ordinated Geodynamics Programme have been opened by including in geophysical research work
1) experimental high-pressure and high-temperature physics and their possibilities for testing materials under the extreme conditions of the Earth's interior,
2) theoretical solid-state physics and its higher approximations and,
3) planetary physics regarding the limits of the comparability. On the other hand, the tendency to an integrating, interdisciplinary research in the field of geosciences contributes to this too. Thus e.g. the effects of pressure-involved regularities as well as processes released by the evolution of the Earth-Moon system and aspects in connection with changes of the atmospheres of the "terrestrial" group of planets belong to that. These points will be discussed in the following paper.

b) HURTIG E. & H. WIRTH - "Uber Beziehungen zwischen geothermischen und gravimetrischen Anomalien".
S. 57-69.
Easy evaluations of steady-conduction temperature distribution in the upper crust down to the crust - mantle boundary in 30 km depth have been made, showing that horizontal variations of temperature up to 200°C over distances of 50 to 100 km may appear. The gravimetric effect produced by the thermal expansion of the rock material is estimated to be 10 mGal of magnitude. In areas such as the northern part of Central Europe, this is a considerable share of the entire gravity anomaly. In addition, density variations may occur if the isotherms in the underground are crossing boundaries of stable state of certain minerals.

c) SCHWAB G. & H.J. TESCHKE - "Mobilisierung und Kratonisierung von Senkungsstrukturen. Ein Beitrag zur Mächtigkeitsanalyse des Deckgebirges in Europa".
S. 71-84.
The authors proceed from a schematic map of the base and thicknesses, respectively, of the unfolded cover of Europe to outline the character and development of the main sedimentary basins. The succession of thicknesses of individual depressions is represented in tectonograms. Two types of depressions are distinguished, with the development of the epeirogenic ones taking place in several stages, each period beginning with high rates of growth, and ending after a long-lasting stage of differentiation with a tectonic cratonization. With respect to time, the stages of consolidation of the depressions correspond to the main tectogeneses. Over against this, the dictyogenetic depressions, which are connected with zones of tectonic mobility, are activated during these times.

d) SCHNEIDEN M.M. - "Geodätische und gravimetrische Forschungen in der Antarktis".
S. 161-173.

Scientists from the GDR have participated in Soviet Antarctic expeditions since 1959. They have wintered at Mirny, Molodoshnaya and Vostok stations successfully continuing the German tradition in Antarctic research, which began at the end of the 19th century. Geodetic problems form an essential part of the research programmes. Detailed investigations of the mechanism of movement and of the mass balance have been made by several expeditionary groups in coastal areas of the Antarctic inland ice. The absolute displacement of its surface has been quantitatively determined for the first time in central Antarctica by scientists from the GDR, using repeated astro-geodetic measurements. The gravity bases Mirny, Molodoshnaya and Vostok have been connected to the Potsdam system. At Molodoshnaya and Vostok load-induced and tidal gravity variations have been continously recorded.

65 - KAUTZLEBEN H. & E. BUSCHMANN -"2nd International Symposium Geodesy and Physics of the Earth". Potsdam, May 7th - 11th, 1973.
Akad. Wissens. der DDR, Zentralinst. für Physik der Erde,
Proc. Part 1 - Veröff. N° 30, teil 1, 233 p.
Proc. Part 2 - Veröff. N° 30, teil 2, p.234-556.
Potsdam, 1974.

Part 1 : General Subject
Dynamics of the Entire Earth
Part II: Recent Earth Crust Movements
Figure of the Earth and Gravity Field
Special Problems of Geodesy and Geophysics

Many contributions, especially :

Teil 1

a) MELCHIOR P. - "Geodynamics, a meeting point for astronomy, geodesy and geophysics".
p.15-37.

b) TENGSTROM E. - "New methods for studying the dynamics of the entire Earth".
p.39-46.

c) KAUTZLEBEN H. - "Problems and consequences of modern hypotheses on the global tectonics for Geodesy and Gravimetry".
p.47-64.

d) PARIYSKIY N.N. - "Earth rotation and gravity variations".
p.67-73.

e) SCHNEIDER M.M. & D. SIMON - "Results of the Earth-tide observations at the Antarctic station Vostok, 1969".
p.183-193.

In 1969, the tidal variations of gravity and tilt were measured at the Soviet intercontinental Antarctic station Vostok using a gravimeter GS 11 and a horizontal pendulum. The obtained mean value of the gravimeter factors of the diurnal tides is 1.20. The fluctuations of air pressure are proved to produce fictitious gravity changes according to a conversion coefficient of 6 ... 8 µGal/mbar. An instrumental effect is made probable. The tilt measurements show a diminishing factor almost equal to unity. A considerable thermal component must be assumed in the tilt of the snow surface.

Teil 2

f) THURM H. & P. BANKWITZ - "Situation and trend of the investigation of recent Earth crust movements".
p.245-254.

The disadvantages of the method hitherto applied to the determination of recent vertical crustal movements from first-order relevelling networks are discussed. These disadvantages may be reduced by taking into account relevellings of minor accuracy, gradients of vertical crustal movements and absolute gravity measurements. In the Elbe Valley Zone a function of horizontal dislocation was determined from the results of retriangulations. With the help of the differentials of this function the parameters of horizontal strain are derived, which give a complete picture of the horizontal deformation of the Earth's crust in this area.

g) GRIGORYEV A.S. - "Theoretical determinations of the day surface movement velocities and of the state of stresses in the Earth's crust for certain mechanisms of its deformation".
p.255-264.

h) GZOVSKIY M.V., A.S. GRIGORYEV, O.I. GUSHCHENKO ...
"Problems in the interpretation of recent movements by the methods of tectonophysics".
p.265-285.

The aim of tectonophysical interpretation of recent movements of the surface is to locate the areas of high shear stresses τ_{max} for enabling earthquake risk to be estimated more accurately. A total scheme of complex investigation of a part of the crust, including geological, geodetic and tectonophysical field observations as well as modelling and theoretical calculations, is taken into consideration. The basic types of mechanisms of the crust's deformation are dealt with, and those of movements differing in the character of connection with concentration τ_{max} at depth and with seismicity - pleistoseismic, hyposeismic, cryptoseismic, teleseismic are singled out. A division of the territory of the USSR into regions of different recent tectonic activity and of various values of stresses τ_{max} is considered. On the example of the study of one of the regions, the use of tectonophysical methods for analysing recent tectonic activity is shown to be promising.

i) GROSSE S. & C. ELSTNER - "On the determination of small gravity differences".
p.303-310.

The arrangement of a special profile for high precision gravity measurements on the territory of the G.D.R. is described. The main purpose of the yearly repeated observations of gravity differences is, for the first years, the detection of gravity variations caused by local sources. The results of the measurements effectuated from 1970 until 1972 are discussed with respect to possible hydrological disturbances. Effects of soil moisture and ground water table variations are estimated. The comparison of calculated hydrological effects with the observational data shows the importance of exact data reduction with respect to these effects in order to detect further causes of long-time gravity variations.

j) BEETZ H. & R. BREIN - "High precision gravity measurements along special lines".
p.311-314.

For measurements in the field some methods proved in the Earth tides section are used. At each station short registrations are performed. During the measurement of a gravity difference the measuring screw was not turned. The difference was compensated by an electromagnetic device. All the results of one test loop are shown. The "inner accuracy" of one measurement on a station (duration 15 minutes) is about 1 μGal. A favourable point in the results lies in that the drift is mostly linear within this accuracy. The disproportionately great differences obtained in repeated measurements cannot yet be explained.

k) BIRO P. - "The influence of secular changes of the Earth's gravity field on the elevation of bench-marks".
p.315-322.

For the purpose of the study of recent Earth crust movements the changes of elevation resp. that of differences of elevations are determined by repeated levellings and gravity measurements. These measurements result in changes of the situation of the Earth's surface and the level surface relative to each other. In the case of a time-change of the gravity field of the Earth, the level surface will be displaced, and their displacement will be followed by a certain deformation of the elastic Earth's material. Under the supposition of only elastic deformations the real (absolute) vertical Earth crust movements can be calculated from the results of measurements, but in general it seems not to be possible. Therefore, it must be known that in a gravity field with time-changes vertical Earth crust movements determined as usual by repeated levellings are only displacements relative to the level surface and can significantly differ from the real vertical movements of the Earth's surface.

l) LIEBERT J. - "Geodetic-astronomical observations in the Antarctic". p.323-326.

During the 8th (1963) and 17th Soviet Antarctic Expedition 1972, the geographical coordinates were determined at Vostok and Mirny stations. The purpose of the measurements was to define the direction and rate of movement of the innercontinental station of Vostok. The observations were carried out with a transit instrument. The mean error of the amount of the velocity vector is minor to 1m/year. Reobservations made at the astronomical point of the coastal station of Mirny (lying on rock) are showing a significant alteration of geographical latitude.

m) VYSKOCIL P. - "Recent crustal movements in the Bohemian massif". p.331-345.

The present paper deals with the essential results of geodetic measurements performed on the territory of the Bohemian Massif. The new map of recent crustal movements in C.S.R. is submitted and their interpretation will be tried. The crustal movements along the International Seismic Profiles number VI and VII are interpreted. Recent crustal movements in connection with the deep faults and the MOHO discontinuity are dealt with. Finally, the map of recent crustal movements on the boundary between the Carpathians and the Bohemian Massif is interpreted in detail, based on geological and geophysical data.

n) BARTA G. - "Possibilities to apply the satellite geodesy in investigating the Earth's interior structure". p.351-356.

Magnetic and gravitational evidences concerning the asymmetry of the internal structure of the Earth and its temporal variations are given in brief and further possibilities of the study are discussed. An even more accurate approximation of the geoidal figure can be obtained if the axes of the approximating rotation-symmetrical forms will be located outside the plane of the equator. Such an investigation of static and dynamic phenomena can provide a better understanding for some features of the material of the core. Further seismological investigations are needed for a precise location of the position of the inner core. The study of the mass movements of the core may result in a better knowledge of the tectonical processes of the Earth's surface.

o) MORITZ H. - "Geodetical and geophysical reference models". p.357-361.

At the XIVth General Assembly of the IUGG in 1967, a new reference system for the Earth's figure and external gravity field, the Geodetic Reference System 1967, was introduced. At the XVth General Assembly, an IUGG Committee on Standard Earth Model was established, with the charge to elaborate a corresponding reference model for the Earth's interior, giving the distributions of density, pressure, gravity ...

The paper describes problems which arise in defining such a Standard Earth Model and in joining it to the Geodetic Reference System 1967. Such problems are caused by the difficulty in determining reliable internal distributions and representing them mathematically, and by the fact that the equipotential ellipsoïd is not a figure of equilibrium.

p) KHAN M.A. - "Plumes in the Mantle".
p.365-379.

Free-air and isostatic gravity anomalies for the purposes of geophysical interpretation are presented. Evidence for the existence of hotspots in the mantle is reviewed. The proposed locations of these hotspots are not always associated with positive gravity anomalies. Theoretical analysis based on simplified flow models for the plumes indicates that unless the frictional viscosities are several orders of magnitude smaller than the present estimates of mantle viscosity or alternately, the vertical flows are reduced by about two orders of magnitude, the plume flow will generate implausibly high temperatures.

q) YEREMEYEV V.F. & M.I. YURKINA - "On the determination of secular variation in the Earth's gravity field and of secular polar motion".
p.415-422.

r) ZIDAROV D. - "Application of the solution of the inverse gravimetric and magnetic problem for studying the Earth's figure, structure and evolution".
p.423-427.

It is shown that by far more extensive information about the Earth's figure, structure and evolution is obtained by the data of the Earth's gravity and magnetic fields if the latter are represented, instead of harmonic polynomials, by the fields of natural sources such as point masses, homogeneous ellipsoïdal dipoles, electrical point contours etc. The application of these methods has permitted to trace the change of an average magnetic dipole position, whose field represents the palaeomagnetic data about different geological epochs by identifying the motion of this Earth magnet with the motion of the Earth's core centre. It is established that the Earth's core has been apart from the Earth's centre, directed towards the Pacific Ocean, and has gradually approached towards it, by which it has caused the continents displacement and the apparent change of the Earth's axis of rotation.

s) GROTEN E. & R. REINHARD - "Use of terrestrial gravity data in combination with satellite results for determining geoïd heights in Central Europe".
p.441-454.

By applying a truncated form of STOKES's integral formula the contribution of surface gravity within the neighbourhood of the station to geoïd heights is evaluated. The contribution of the distant zones is evaluated by transforming MOLODENSKIY's modified spherical harmonic formula where results of satellite and combination solutions are applied. So a novel method for combining satellite and surface data is given ; results are discussed.

t) KAMELA C. - "On the modification of RUDZKI's method".
p.455-457.

In flat areas, the difference between RUDZKI's gravity anomaly and FAYE's free-air anomaly changes linearly, even between quite distant points. Therefore, the joint point with known anomalies of FAYE and RUDZKI should be chosen in a number suitable to transform, in the simplest way, the FAYE anomalies into the RUDZKI anomalies for all the other points. As it is now possible to measure the vertical gradient with considerable accuracy, we may obtain corrected maps of FAYE's anomalies presenting good quality and thereby easily produce exact maps of RUDZKI's anomalies, which may be used in higher geodesy and exploratory geophysics.

u) SOMMER M. - "Gradients of the deflections of the plumb-line and their influence on astronomical determinations of position and azimuth".
p.503-505.

Astronomical measurements of latitude, longitude and azimuth are the basic elements for the orientation of astronomic-geodetic networks on the reference ellipsoïd. The status of an error-free element of measurement is particularly given to the so-called LAPLACE azimuths, although especially in that case an unfavourable synthesis of the errors from the measurements of latitude and azimuth will occur if it is not possible to measure both elements in the centre of the station. The reason for these errors is the divergence of the directions of the plumb-line from those in the centre of the station. As could be demonstrated significantly with the adi of special investigations on gravimetric deflections of the plumb-line, that divergence can amount to some 0.1 seconds of arc. The consideration of these changes of deflection of the plumb-line is discussed on the example of the astronomic-geodetic network of the G.D.R.

v) SCHWAHN W. - "Some remarks on the simulation of the empirical autocovariance functions of gravity".
p.513-523.

Autocovariance functions (ACF) of density, gravity and vertical deflections are coupled. Theoretical computations on the base of pure stochastic density models do not show the oscillations around the zero line which are often observed to be significant in practical cases. Another statistical model is proposed, instead. For a distinct depth the distance between a causing body (in our examples a point mass) and the next causing body in the x_1 - y_1 plane is characterized by their mean distance, $\bar{x}$, and their variances, $\sigma_{\bar{x}}$ and $\sigma_{\bar{y}}$.
By integral transforms one gets the ACF of a point mass (ACFP) in this depth. The resulting normalized ACF_s of the proposed models show that :

1. for $\bar{x} >$ (depth/sampling interval) the values for the first 5-7 lags are equal to those of the normalized ACFP ;
2. assuming $\sigma_{\bar{y}}$ = const.,
   a) for $(\bar{x}/\sigma_{\bar{x}} < 1$ periods will occur, but they differ from each other and therefore no estimate of $\bar{x}$ can be got,
   b) for $(\bar{x}/\sigma_{\bar{x}}) > 1$ there exist persistent periods in terms of $\bar{x}$
   The amplitudes at greater lags are nearly constant.

A short geological discussion shows the connection with the problems of the Geodynamics Project.

w) WIRTH H. - "Possibilities of a dynamical interpretation of geophysical potential fields".
p.525-529.

For the development of source models of the global anomalous fields only fundamental perceptions of physics and geology should be used. As a result of the discussion a new model for gravimetric and geomagnetic sources is proposed, derived from stochastic processes, corresponding to the physical phenomena of diffusion and BROWN's motion. This model shows, in its time dependency, relations to temperature and viscosity in the Earth's interior.