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GRAVITY EXPEDITIONS AT SEA
1934—1939

VOL. III.

THE EXPEDITIONS, THE COMPUTATIONS AND THE RESULTS

BY

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PREFACE.

This report of the gravity expeditions at sea of the Netherlands Geodetic Commission in the years 1934—1939 may well be dedicated to the Netherlands Navy which has made them possible; all these years the Navy has continued to give her full cooperation for this scientific research. In 1934 she undertook the largest voyage of all, the eight months trip of Hr. Ms. K 18 from Holland to Java via Buenos Ayres, Cape Town and Fremantle. The writer wants to avail himself of this opportunity to express his sincere gratitude to the Naval Authorities for this support and to the Captains, the officers, the petty officers and the crews of the submarines for their unfailing assistance during the carrying out of the observations.

CONTENTS.

SUMMARY.

This publication contains a report of the gravity at sea expeditions of the Netherlands Geodetic Commission in the years 1934 to 1939. It gives an account of the expeditions, the observations, the computation of the results and of their mean errors; the last table lists the gravity reduced to sea-level found at the 388 stations that have been occupied during these trips, thirty of which have been observed on land by means of a Holweck-Lejay apparatus. A following publication, Vol IV, will contain the isostatic reduction according to different methods of the gravity results of these and former expeditions at sea; it will include maps giving the location of the stations dealt with in this report and it will investigate different possibilities of interpreting the results.

The first chapter of this report gives a historical summary of the expeditions, the second deals with the expedition of Hr. Ms. K 18 from Holland to Java via Buenos Ayres, Cape Town and Fremantle in W. Australia, the third chapter with the expedition of Hr. Ms. O 16 from Holland to Washington and back to Lisbon, the fourth chapter with the expedition of Hr. Ms. O 12 from Curaçao to Holland, the expedition of Hr. Ms. O 13 to the end of the Channel and the observations made on board of Hr. Ms. O 19 in the North Sea, and the fifth and last chapter with a description of the tables I and II at the end of the report. Table I contains data and figures regarding the observations, the computations and their mean errors. Table II gives the positions of the stations, the sea-depths, the gravity results, their mean errors and the lengths of the waves encountered during submerging.

CHAPTER I.

Historical Summary of the Gravity Expeditions at Sea in the period 1933—1940.

In this second period of the gravity expeditions at sea, organized by the Netherlands Geodetic Commission, the Netherlands Navy has again given her whole-hearted support to this research. No expedition was planned, however great or difficult, without finding an open door for the elaboration and persecution of the plans. Even in the last years, when the political tension was steadily increasing, the authorities have been continually willing to favour the investigations; in many cases, however, the plans had to be given up because of the circumstances. Sincere thanks are due to the Navy for this unfailing support of the research, which forms a unique and honourable page in the Netherlands naval history.

The period began by the greatest expedition of all, the voyage of Hr. Ms. Submarine K 18. The ship left the naval base Den Helder on November 14, 1934, and arrived in Java on July 11, 1935, touching on its way at the harbours of Madeira, St. Vincent, Dakar, Pernambuco, Rio de Janeiro, Montevideo, Buenos Ayres, Mar del Plata, Cape Town, Durban, Mauritius, and Fremantle in W. Australia. Together gravity observations have been made at 226 stations at sea and 30 stations on land. As its main objects we may mention the obtaining of more gravity values in the southern hemisphere, the getting of more figures in the oceans for investigating whether the tendency towards positive anomalies found in some parts is a more general feature of the oceans, the obtaining of more gravity profiles over continental shelves for the study of the mass-distribution in the Earth's crust near the edges of the continents, and many more local problems as e.g. the getting of gravity profiles over the oceanic islands of Madeira, St. Vincent, Tristan da Cunha and Mauritius and over the Romanche Deep and the Walfish Ridge. There is no need to stress the importance of a crossing of the Indian Ocean for the problem of the deviations from equilibrium of the Earth as a whole. If these deviations would correspond to the usual supposition of a flattening of the Earth in the equator plane with its long axis in the Atlantic Ocean, the Indian Ocean ought to coincide with the short axis and so it should have to show negative gravity anomalies. If, on the contrary, the tendency towards positive anomalies in the Atlantic Ocean would be due to systematic gravity excesses in the oceans, we might likewise expect such an excess in the Indian Ocean. So a crossing of the Indian Ocean might give valuable material for a decision about the nature of the yet existing deviations from equilibrium.

For being able to continue the gravity profiles over the continental shelves and over the islands on land, a Holweck-Lejay gravimeter was taken along. This apparatus allows the determination of gravity on land in one or two hours and so the writer could make a few land-observations while staying in the ports. In this way thirty stations have been added to the results obtained at sea. For this possibility the Geodetic Commission is indebted to the "Bataafsche Petroleum My", which has kindly consented to lend one of their Holweck-Lejay apparatus to the expedition.

A further valuable extension of the scientific material was made possible by the Netherlands Navy by providing the ship with an "Atlas" echo-sounding machine. Over practically the whole route soundings have been made. This was important for the South Atlantic where the material of the "Meteor" left gaps that could thus be filled, and especially for the Indian Ocean where only little was known of the bottom configuration. The material obtained in the southern hemisphere has already been incorporated in the new edition of the Bathymetric Charts of the International Oceanographic Bureau of Monaco. In volume IV of this publication detailed profiles will be published which could not well be represented by these small scale maps and which may prove of some interest for the geo-morphologist.

Another contribution which the writer wishes here to acknowledge is the putting at his disposal of an extra chronometer lent by the Hydrographic Service of the French Navy; this gave a valuable improvement of the accuracy of the rate-corrections for the pendulum observations. The writer tenders his thanks for this kind collaboration to the Director of this service, Mr. COT, and to the President of the French National Geodetic Commission, General PERRIER.

The staff of the ship consisted of

Lieutenant-commander D. C. M. HETTERSCHY, Captain,
Lieutenant senior grade M. S. WYTEMA, Executive officer,
Lieutenant senior grade C. TER POORTEN, Navigator,
Lieutenant junior grade A. J. MARCUS,
Lieut. eng. senior grade C. VAN DER LINDEN, in command of the engine-room,
Lieut. eng. senior grade C. B. LEEUWENBURG, second in command of the engine-room.

They have all given their cooperation for the carrying out of the scientific research and the same may be said for the petty-officers and the men of the ship; the writer may mention here the names of sergeant-major torpedoist G. J. VAN WESTEROP for his assistance in keeping the instruments in order and of sergeant wireless-operator C. VERSTRATEN and corporal wireless-operator A. BAUW who together made the soundings and assisted him for the taking of the time-signals. Before continuing this short story of a long expedition the writer wishes to acknowledge his debt towards all those who have assisted so valuably for the obtaining of the scientific results. Moreover, during the many months of hardship of this trip the writer has made good friends on board of the K 18 and he thankfully remembers them when writing these lines many years after. Their faces come back to him out of the shadows of the past while lingering on our joint great adventure.

The whole first part of the trip has been favoured by good weather and calm seas with the exception of a somewhat rough trade-wind sea before touching at St. Vincent. We made a first submerging accompanied by the first gravity station south of the English coast near Brighton and we started the regular series at the end of the Channel, steadily making three observations per twenty-four hours from there to Madeira. At Madeira a well deserved rest after this strenuous programme of submerging awaited us. On one of these days the Govornor of the island, H. Exc, Mr. RIBEIRO PEREIRA, kindly arranged a tour up the mountains giving the writer the opportunity to make observations with the Holweck-Lejay pendulum on the Pico d'Arriero at an elevation of 1530 m and in Monte at an elevation of 590 m. The results have proved valuable for the study of the isostatic equilibrium of the island of Madeira.

After leaving Madeira we continued our programme of three observations per diem till we reached the African coast at a point to the S. S. E. of Gran Canaria; this gave a first gravity profile at about right angles to the African shelf. The series of observations from the Channel to this point, moreover, gave a complete chain of results surrounding this part of the European continent and so, in combination with a similar line of stations nearer to the coast obtained by the O 13 expedition of 1932, it may give valuable information whether strips of abnormal gravity, eventually connected with submarine ridges, strike out from the Iberian Peninsula or from Marocco. As the map of the expedition in the next volume will show, we now followed the African coast for a short while, and then, near Cisneros, we took again an outward course for observing a second coastal gravity profile. The distribution of stations between this profile and the next port of St. Vincent was rendered slightly irregular by the difficulties of diving in the rough sea we encountered here. At St. Vincent the Netherlands Consul, Mr. H. VISGER, Esq, kindly took the writer in his car to a few points where he wished to make Holweck-Lejay observations and so here also the combination of the sea-stations to both sides of the island with the results obtained on land gives a good material for investigating the isostatic equilibrium of the island.

Leaving St. Vincent, our route brought us far out into the Atlantic. This loop was due to the crossing of a Dutch areoplane to the Netherlands West Indies; for providing this plane with the necessary radio-bearings for its position and for giving it indications about the weather, Hr. Ms. K 18 was ordered to be stationed for twenty-four hours at a point in the middle of the ocean. The Navy had consented that the ship, once this duty fulfilled, continued its route for reaching the area of the Mid Atlantic rise and then returned by a different route towards the next port, Dakar. By regularly diving once during the day and once during the night a valuable series of observations was obtained over the whole trip. The soundings over the Mid Atlantic rise showed an irregular topography, suggesting a volcanic landscape. The approach to Dakar provided the writer with a further coastal gravity profile.

The stay in Dakar gave a welcome diversion rendered specially memorable by the passing of New Year's eve in this port. The writer made one Holweck-Lejay observation in the interior, i.e. at Sebikhotane. Leaving Dakar, we followed the coast and near the village of Konakry we struck outwards for our next coastal profile and for our crossing to Pernambuco. During this crossing we received the visit of a most imposing personification of Neptune accompanied by the customary ceremonies for the young sailors which, thanks to the calm sea, could successfully take place on the fore-deck; the victims enjoyed themselves as much as the rest of the crew. The route had been chosen over the Romanche Trough and so we could obtain a continuous line of soundings over this unique feature as well as a gravity profile, both at right angles to its length axis. The trough is accompanied by ridges on both sides; it proves to be flat-bottemed and steep-sided. The depth-profile will be given in volume IV of this publication. A continuous series of gravity observations, once a day and once a night, has been made over the whole route.

In Pernambuco the Netherlands Consul, Mr. F. VAN SOHSTEN Esq., gave his kind assistance to the writer for rendering it easy for him to make Holweck-Lejay observations in a few places in the interior, near the water-basin of Gurjahu and in the village of Victoria; in this way the coastal gravity profile could be continued on land. During the next part of the voyage up to Rio de Janeiro, two more coastal profiles were observed, near Maceio and near the Belmonte River. During his stay in Rio de Janeiro the writer profited of the Brasilian Railway system for making an extensive trip on land, leading to Holweck-Lejay observations in the places Petropolis, Entrerios and Barbacena. He also made observations at the "Observatorio Nacional" in Rio de Janeiro, the base-station of Brasilian gravity work.

Leaving Rio de Janeiro the writer could make a detailed gravity profile towards the S.S.E. in line with the observations made on land. A second profile has been observed returning to the coast near Domingo del Torres. During the stay in Montevideo, Buenos Ayres and Mar del Plata observations were made in these ports and thanks to the great facilities kindly provided to the writer by General de Brigada RODOLFO MARTINEZ PITA, Director General del Instituto Geográfico Militar in Buenos Ayres, he could make series of Holweck-Lejay observations on land. He observed in the gravity base of this Service in Buenos Ayres, in the Observatorio Astronómico in La Plata, where the Director, Dr. AGUILAR gave him every assistance, and in the places Vivoratá and Miramar. With Mar del Plata these two last stations make a profile over the prolongation of the permian mountain range of the Sierra de Tandil which runs up to the coast and breaks off here. For this series of Holweck-Lejay observations the writer had the assistance of Dr. DE BOER assigned to him for this purpose by General PITA.

The crossing of the Atlantic from Mar del Plata to Cape Town was a strenuous undertaking; it took us twenty-six days and during the first half part we three times ran into bad weather. Twice we struck a strong gale lasting a few days and the writer had to interrupt his observations because of the impossibility to dive in these rough seas. He nevertheless could make fifty-two gravity observations during this crossing. About halfway we touched for a few hours at the island of Tristan da Cunha but the time was too short and the landing difficulties too great for allowing Holweck-Lejay observations on the island. He could, however, make a pendulum observation near the island over a depth of 1415 m and this result, combined with those obtained during the end of our preceding and the beginning of our further trip, gives valuable information about the isostatic equilibrium of the island. We likewise could make a sounding profile of the submarine slope; it will be given in the next volume of this publication.

During the second half of the passage the route was chosen to cross the Walfish Ridge and a detailed gravity profile combined with soundings could be made. The ridge proved to be double here; the sounding profile will be represented in volume IV. Near the African continent the route was directed towards a submarine promontory shown by the charts but we could not find it where it was plotted. The new edition of the Monaco Bathymetric Chart for the South Atlantic, which already contains our sounding profiles, has been rectified in this regard.

Because the hull of the ship had to be cleaned after the four months voyage we had behind us, we stayed long in Cape Town. All the members of the expedition will have a memorable recollection of the hospitality and kindness they have found there; it gave them a well-deserved time of rest. The writer remembers especially the kindness shown to him by His Exc. General SMUTS, by the Netherlands Consul, Jhr. W. VAN LENNEP, by Mr. W. WHITTINGDALE, Director of the Trigonometrical Survey, and many others. Mr. WHITTINGDALE arranged a long automobile trip of several days in the interior for making Holweck-Lejay observations; he accompanied him on this trip. Observations have been made in Malmesbury, in Ceres, in Juriesfontein (on the Karroo), in Touws Rivier and in Stellenbosch. Besides, the writer has taken his pendulum apparatus out of the ship and transported it to the Royal Observatory near Cape Town for checking the pendulums. As Dr. BULLARD of Cambridge had made pendulum observations there a few years ago, a check on the pendulums could thus be obtained.

After a stay of three weeks we left Cape Town. The trip to Durban, notwithstanding the winter season, was favoured by good weather and this was remarkable good luck as this part of the ocean has an especially bad reputation in winter time. As the map in the next volume shows, two coastal profiles have been observed during this trip. In Durban Mr. SHORT, President of Surveyors, took the writer in a car into the country, where he could make two Holweck-Lejay observations, one in Alverstone and one on the Karroo past Pieter Maritzburg. Leaving Durban the writer could make a coastal profile more or less in line with these two land-stations. Continuing the regular series of two observations per diem, we shortly afterwards passed near the south cape of Madagascar and the writer thus obtained a valuable profile at right angles to the axis of this island ridge. The next day bad weather overtook us and we had to interrupt the observations till our arrival in Port Louis on the island of Mauritius. As the circumstances rendered it difficult, the writer has made no Holweck-Lejay observations on this island.

During the beginning of the next long trip at sea, the crossing from Mauritius to Fremantle in W. Australia, the writer could continue his normal programme of two observations per diem and a valuable series of fourteen observations in the Indian Ocean could thus be obtained. The sea was rough although we did not meet a strong gale. After eight days, however, technical difficulties arose and we had to stop submerging; the observations had thus to be interrupted. Except an isolated observation at about 91° E.L. no results could be got till we were at a few days distance from Fremantle. There the observations could be taken up again and a profile of five stations running up to the station in the harbour of Fremantle was obtained; it gave the writer much satisfaction that this important part of the crossing could again be observed.

In Fremantle we found a kind reception. The writer has especially to mention in this regard Dr. A. D. ROSS, Professor of Physics at the University of W. Australia, who among other things arranged an extensive automobile trip for the making of Holweck-Lejay observations in the country. We went together as far as Merredin making observations at The Lakes, at York, at Quairading, at Bruce Rock, at Merredin and at Northam. Besides, the writer made a special series of observations in the new Physical Laboratory of Dr. ROSS in Perth. As the reader will find exposed in volume IV of this publication where the discussion of the results is taken up, the results of these observations turned out to be of great importance. They have in themselves justified the taking along of the Holweck apparatus as well as the trouble taken for the observations.

Leaving Fremantle, the last leg of our long voyage commenced. A coastal profile could be observed near the N.W. Cape of the Australian continent and a continuous series of observations was made from there to the neighbourhood of Java, where we could connect it with the gravity profile formerly observed south of Strait Bali. The last observation of the expedition was taken in the roadstead of Banjoewangi, the first port in the Indies arrived at.

A short trip brought us from there to Soerabaya, the end of our long wanderings. A grand reception awaited us there.

We all were glad to arrive after eight months of a strenuous submarine trip and more than 220 times submerging. We were thankful that none of us were missing and we were thankful too that the exorbitant number of dives needed for the obtaining of the great scientific material, had been successfully accomplished. The writer may here express his gratitude to the great many authorities and friends, who in the ports have shown so much kindness to him and his shipmates. In this short summary of the trip he has only touched on the scientific side of the voyage of Hr. Ms. K 18 and he has left aside the navigatorial features; they have previously been the subject of books and publications. The writer should not, however, wish to omit here a sincere and well-merited tribute to the Captain, the Officers and the crew for what they have achieved in this regard during this long expedition.

The next great voyage took place in the first months of 1937. On January 11 Hr Ms. O 16 left the naval base at Den Helder for a trip to Washington and back again. During the outward voyage we touched at the ports of Horta (Azores) and Hamilton (Bermudas) and we returned via Punta Delgada (Azores) to Lisbon. During our stay in Lisbon a message arrived from the Department of the Navy in The Hague interrupting the scientific expedition and directing the ship towards the Spanish waters for convoy duty. The writer returned from Lisbon to Holland by a small ship of the Royal Netherlands Mail. Gravity observations have been made at 89 new stations and, besides, at Horta, Washington, Punta Delgada and Lisbon.

The trip had been planned by the Netherlands Navy and the writer thankfully accepted the opportunity offered to him to accompany the ship for making gravity observations en route. The Navy has been willing to adapt the route to the scientific desiderata and so two important crossings of the Atlantic, for a great part in areas not yet investigated, could be obtained. It gave an opportunity to find out how far the tendency towards positive gravity anomalies in the N. Atlantic Ocean extends westwards; it has given a continental shelf profile at the end of the Channel and two at the east-coast of N. America and it has provided gravity results over the Bermudas, over the Azores and over the area between the Azores and Europe where, together with previously obtained material, a detailed gravity field now is available.

The writer has not taken along a Holweck-Lejay apparatus for the measuring of gravity on land in the neighbourhood of the ports touched at. In the United States gravity is already known in detail thanks to the great work done by the Coast and Geodetic Survey in this field, in the Azores a survey can be better made by a separate expedition to these islands and for the Bermudas it was scarcely worth while; the value obtained in the harbour of Hamilton is well representative as it is situated in the central area of the truncated plateau of which the islands are the parts rising above sea-level.

The ship was provided with a sonic signalling apparatus, which could be used for echo-sounding. At the surface of the sea, however, the echo was too weak to be observed and so sounding was only possible during submerging. For the expedition as it was planned there did not appear reason to make special provisions for creating a possibility for sounding at the sea's surface, for the part of the Atlantic covered by the route the depths are in general well-known.

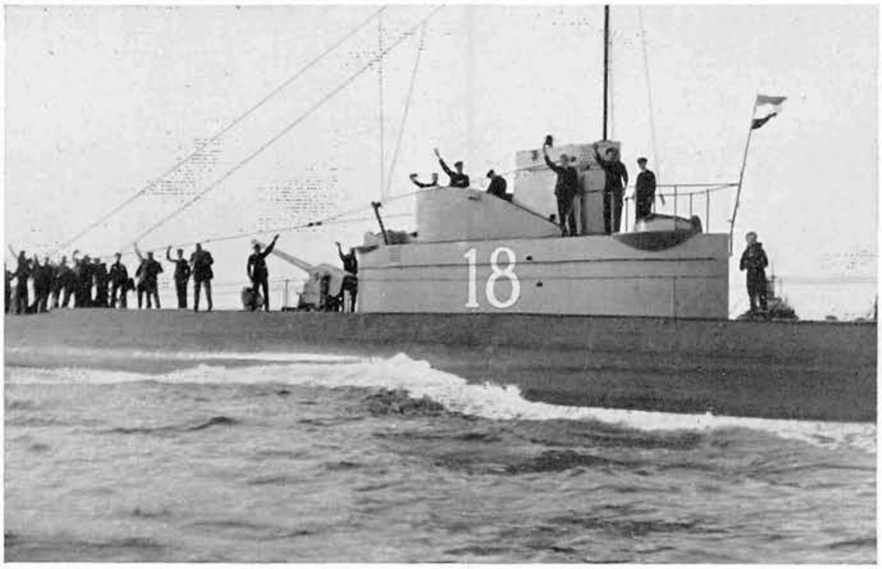

Fig. 1. Hr. Ms. K 18 leaves port.

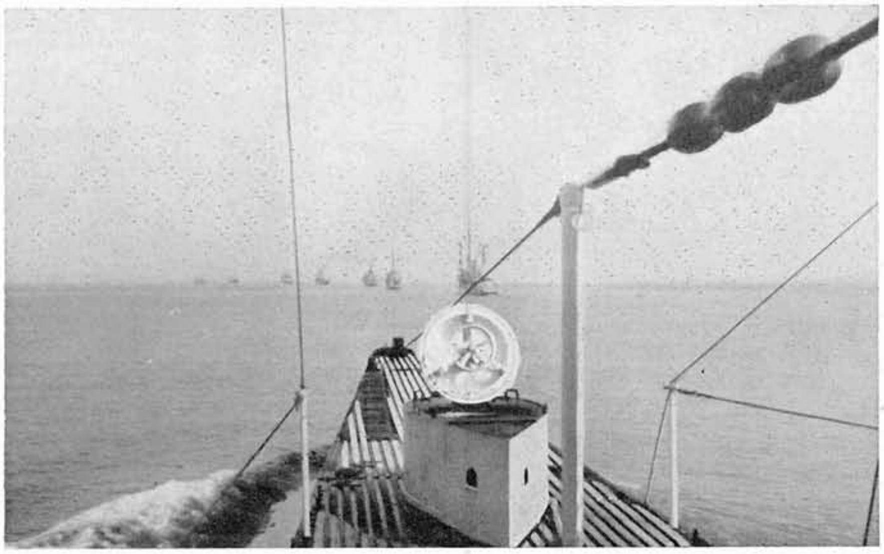

Fig. 2. At the end of its long voyage Hr. Ms. K 18 is welcomed near Surabaya by ships of the Royal Netherlands Navy.

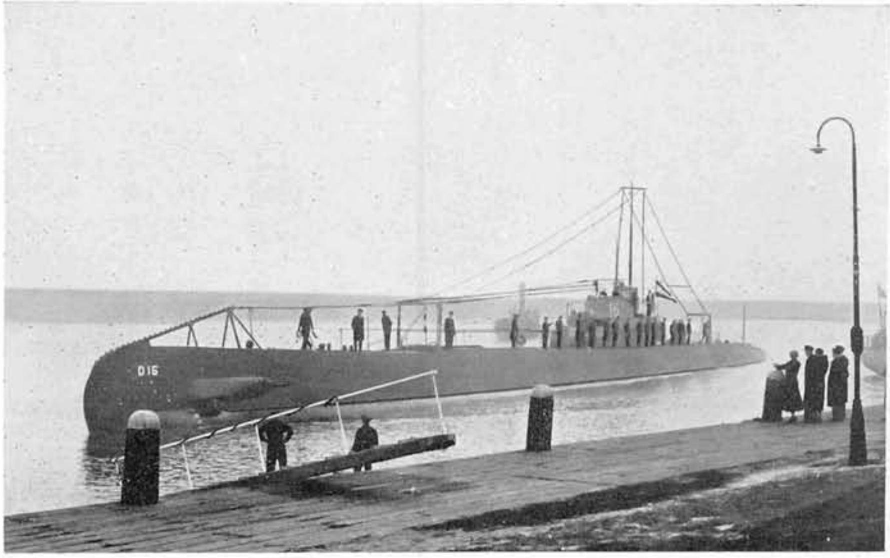

Fig. 3. Hr. Ms. O 16 in the harbour of Den Helder.

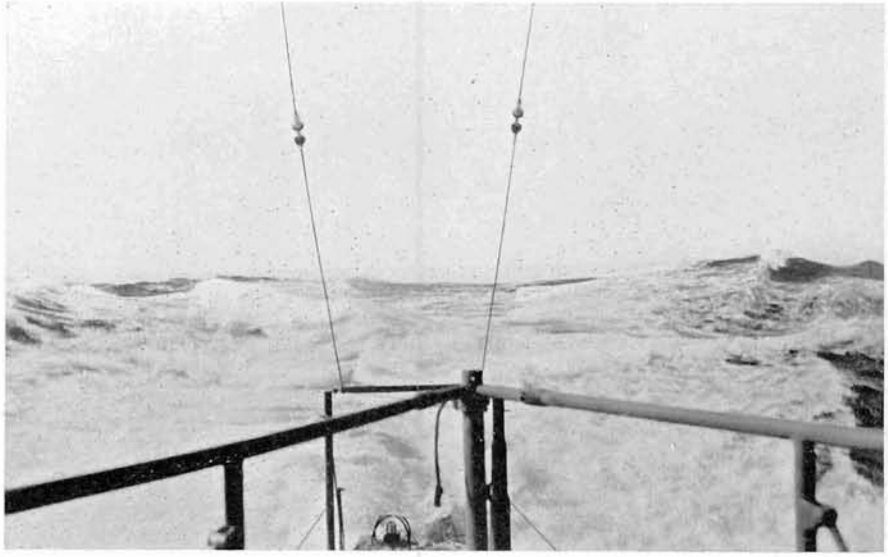

Fig. 4. Rough weather in the Atlantic o/b Hr. Ms. O 16.

For improving the accuracy of the rate-corrections of the pendulum observations a third chronometer besides the two of the Geodetic Commission has been taken along. It belonged to the Astronomical Observatory of Leiden and thanks are due to the Director, Prof. Dr. E. HERTZSPRUNG, for this kind collaboration.

The staff of the ship consisted of

Lieutenant-commander C. J. W. VAN WANING, Captain,
Lieutenant senior grade J. F. VAN DULM, Executive Officer,
Lieutenant senior grade H. A. W. GOOSSENS, Navigator,
Lieutenant senior grade A. H. W. VAN FREYTAG DRABBE,
Lieutenant eng. senior grade K. C. J. LUGTEN, in command of the engine-room,
Lieutenant eng. senior grade A. OHR, second in command of the engine-room.

It is a privilege for the author to find an opportunity here to thank them all for their good comradeship and for their assistance for the scientific work. They have made it a specially pleasant trip for him, although it was a hard and strenuous one because of the exceptionally bad weather we encountered. The Captain saw his way to submerge even in very rough sea and thanks to this the programme of the scientific observations came off satisfactorily notwithstanding the unfavourable circumstances. The writer wants also to mention the good services of Sergeant-Major C. VAN SCHIEVEEN who assisted in keeping the instruments in order and the two telegraphists, Sergeant ZWEISTRA and Corporal MAJOOR, who made the soundings and who arranged the reception of the time-signals.

Nearly the whole voyage has been characterized by bad weather. At the end of the Channel we ran into our first strong gale and this continued practically without interruption for the next days of our trip to Horta, during the five days of our stay there and during the eleven days of our trip from Horta to Hamilton. Once the strength of the wind came up to eleven, Beaufort's scale; this hurricane lasted two days. None of us had ever witnessed weather and sea like this although most of us knew by experience what heavy gale means. Towers of water and spray broke over the ship and the watches on the conning tower had a bad time; they got soaking wet in a few seconds. Waves and wind being against us, the speed came down from eleven knots to five. Diving was of course impossible under these extreme circumstances and so the observations had to be interrupted; this interruption occurred after the observations south of the island of Flores in the route SW of the Azores. During the other hurricanes and gales the submerging went on in the normal way but the movement during submergence was often strong although we dived at sixty meters below the surface; once we rolled even 8° to both sides at that depth. As a consequence the results are not as accurate as usual because the second order correction brings in an amount of uncertainty. A number of times the Captain stayed below for several hours in order to give his crew a little rest and to provide a better opportunity for cooking and for meals than was possible at the surface. In these cases the writer used the opportunity to make a second observation towards the end of the dive. Although the distance of the two observations was only 10 to 20 miles, the writer thought it worth while to make the second observation, in the first place as a check on the accuracy of the observations and in the second place as a check on the reduction for the effect of the topography, which in several cases was decidedly different for the two stations. The map shows the places where these double observations have been made.

The trip up to the Bermudas had been a great strain; the life on board a strongly rolling and pitching submarine is difficult and the nights do not allow much sleep. So our stay of five days in Hamilton was a relief to all of us; we enjoyed a pleasant time on the islands. The next trip to Washington was favoured by good weather and calm seas; we were glad that Cape Hatteras did not come up to its reputation. After a day in Hampton Naval Base where the writer appreciated the friendly visit of his old acquaintance Rear-Admiral FREEMAN, who in 1928 had organized the expedition of the U.S. Submarine S 21, we continued our trip up the Potomac to Washington, where we arrived in the morning of February 15. The nine days spent there will be especially remembered by the writer and his ship-mates; we have been most cordially welcomed. The Captain and the writer enjoyed the great privilege and honour to be received by the President of the United States, Mr. ROOSEVELT, and the Naval Authorities have shown much hospitality. The writer may likewise mention the kindness of the Netherlands Minister, Jhr. VAN HAERSMA DE WITH, of the Consul General Mr. KLEIN MOLENKAMP, and of a great many scientific friends, Dr WILLIAM BOWIE, Major C. L. GARNER, Chief of the Division of Geodesy of the Coast and Geodetic Survey, Dr. FRED. WRIGHT and Dr. HARRY HESS, his ship-mates of the expeditions of the U.S. Submarines S 21 and S 48, Prof. RICHARD M. FIELD, Mr. WALTER D. LAMBERT, Mr. CLARENCE H. SWICK and many others. He profited of his stay in Washington to bring the pendulum apparatus to the base-station of the Coast and Geodetic Survey, where Lieutenant HOSKINSON assisted him in making a series of observations. The time was given by the crystal-controlled time-keeper of the Bell Telephone Laboratories which had been lent for scientific use to the American Geophysical Union and the Coast and Geodetic Survey; it had already been used on board the U.S. Submarine Barracuda during its expedition in the same winter in the West Indies. This time-keeper has a remarkable constancy of rate and is, therefore, ideal for the gravity research by means of pendulum observations.

The first part of the eleven days of our return trip, from Washington to Punta Delgada, was rough again, but wind and waves came from astern and that made it better to bear, although the watch had bad times again. It caused also less loss of speed. After one day in Punta Delgada we continued our voyage to Lisbon and, generally speaking, we had good weather during these four days. During the whole return trip we continuously dived three times a day in the same way as we had done during the outward voyage.

The map in the next volume shows the route and the scientific stations of the expedition. The first part of the outward route had been planned in such a way that the net of stations of former expeditions in the eastern part of the Atlantic and over the Azores was satisfactorily supplemented. Between the Azores and the American continent the outward and the return routes have been well laid apart. The second part of the return voyage gave a valuable east-west profile over the central part of the Azores archipelago and over the deep basin east of it. The last part provided an opportunity to investigate gravity over the "Josephine Bank" to the southwest of Lisbon. Altogether it was a successful expedition.

During the course of the above expedition the writer had received a letter from Mr. B. C. BROWNE, University Demonstrator in Geodesy at Cambridge, about his investigations regarding second order disturbance terms in the gravity determinations at sea of which the effects had been neglected or overlooked by the writer. These terms are caused by the ship's movements and Mr. BROWNE pointed out that in case of strong wave-movements their effect may attain to values of ten milligal and more. After his return the writer received a draft of Mr. BROWNE's well known paper on this subject, "The Measurement of Gravity at Sea", which afterwards appeared in the Geophysical Supplement of the Monthly Notices of the R.A.S., Sept 1937. The writer feels deeply indebted to Mr. BROWNE for this courtesy as well as for the narrow collaboration by correspondence and by personal intercourse which resulted.

After this important discovery by Mr. BROWNE one of the main questions was to develop a method for measuring the horizontal accelerations of the apparatus during the pendulum observations; the magnitude of the greatest disturbance term depends on them. The other term depending on the vertical accelerations does not present difficulties as these accelerations can be derived from the pendulum records. The problem was solved by means of pendulums of very long period, and in the summer of 1937 a first trial apparatus of this kind was constructed in the work-shop of the Meteorological Institute of De Bilt; it was made by the instrument-maker D. VAN LUNTEREN. It was of course important to obtain as soon as possible an opportunity for putting this apparatus and the method to the test and the Netherlands Navy was found willing to provide it; the writer was kindly permitted to accompany a submarine, Hr. Mr. O 12, on its home-bound trip from Curaçao to Holland in November and December 1937. Moreover, if the method proved successful, it would also enable the writer to obtain information about the type of movement brought about by the waves for a submerged submarine. This problem was important for the question whether it would be possible to correct the results of the old pendulum observations at sea for these second order effects. The writer mentioned already that for these observations the vertical accelerations can be determined from the records and, if the ship's movements would prove to correspond to GERSTNER'S or STOKES'S theories about the water-movement or, for shallow sea, to LAPLACE'S, this would allow to derive the horizontal accelerations from the vertical ones. We should thus dispose of the entire material required for the computation of the corrections. As the details of these problems as well as of the slow pendulum apparatus and of the results obtained during this trip have been dealt with at some length in a recent publication of the Netherlands Geodetic Commission [1]), the writer can confine himself here to shortly mentioning that the method proved successful but that the spring suspension of the slow pendulum gave some trouble and that the information regarding the ship's movements, although satisfactory, was not as complete as was hoped for.

Besides for the investigation of these problems about the second order corrections of BROWNE, the trip of Hr. Ms. O 12 could also be used for making gravity determinations and the results of these observations will be given in this report.

Towards the end of October the writer left Holland on board of the mailship "Columbia" of the Royal Netherlands Mail and arrived in Curaçao on November 16. As Hr. Ms. O 12 was only due to sail on November 26, there was some time left which he used for experimenting with the new slow pendulum apparatus. The writer wishes thankfully to acknowledge here the assistance given to him in this connection by Mr. VAN NIJMEGEN

[1]) F. A. Vening Meinesz, Theory and Practice of Pendulum Observations at Sea, Part II, second order corrections, terms of Browne, and miscellaneous subjects, Waltman, Delft, 1941.

SCHONEGEVEL, Managing Director of the Oil Refining Plant of the C.P.I.M., who has put the facilities of the workshop of the company at his disposal. The writer took part in a trial trip of the submarine on November 22 and 23 during which three gravity observations could be made. He also profited of the opportunity to make a set of observations in the harbour where the ship was stationed. This station does not quite coincide with the former station at Curaçao occupied in 1926 during the expedition of Hr. Ms. K 13 from Holland via Panama to Java. The new station is located in the Schottegat, i.e. in the bay behind the town of Willemstad, while the former was in the town; the distance is about 1.4 km.

On November 26, 1937, Hr. Ms. O 12 set out on her trip. As the Caribbean is too much enclosed for being subject to long ocean-waves, the writer could not expect much movement of the ship during submergence and so he planned not to start the main experiments with the new slow pendulum apparatus for the measuring of the horizontal accelerations before getting into the Atlantic. This allowed to devote the first part of the voyage exclusively to the gravity determinations and the Captain of the ship, Lieutenant Commander MOORMAN, gave his full collaboration by adapting the route as far as possible to the scientific desiderata; he had done this too during the above mentioned trial trip. The main problem was to get as much evidence as possible about the belt of strong negative anomalies found by HESS, EWING and HOSKINSON during the expedition of the U.S. Submarine "Barracuda" in the winter of 1936—1937. This expedition had been able to trace this belt from near Porto Rico where it had been stated by former gravity expeditions of the U.S. Navy, till Trinidad, and had again found it to the north-east of Curaçao. It would be valuable to supplement these important results by trying to find indications about its course between Trinidad and Curaçao and between Curaçao and the peninsula of Guajira where Dr. HESS supposes it to enter the S. American continent. The writer tried to get further evidence about the last point during the trial trip, and about the first by means of the series of observations during the beginning of our main voyage, but in both cases lack of time prevented getting as far away from Curaçao as he should have wished. However, the results obtained have some value for the problems mentioned; they have indeed confirmed the presence of the belt of negative anomalies at the expected places. The map in the next volume of this publication shows the situation of the seven stations and the profiles thus obtained.

The dives gave a good opportunity for experimenting with the new apparatus and to get it into working order before coming to the Atlantic where the main experiments would begin. The expectation of small ship's movements during submerging in the Caribbean was confirmed. By means of the sonic signalling apparatus of the ship echo-sounding was possible during submerging, but at the surface the sound-emitting units were too near the sea-surface for getting enough sound-energy in the water. So soundings could only be obtained during the observations but not during the intervals between.

The scientific research had the full support of the staff of the ship which consisted of

Lieutenant-commander H. C. W. MOORMAN, Captain,
Lieutenant senior grade J. A. JEEKEL, Executive Officer,
Lieutenant senior grade J. B. KENNEMA, Navigator,
Lieutenant eng. senior grade A. DE VAAL, in command of the engine-room.

The writer wishes to tender them his sincere thanks for their assistance, especially to Captain MOORMAN who has taken much trouble for ensuring the success of the scientific research. As the new slow pendulum apparatus required much care, he allotted the continuous assistance to the writer of a sergeant torpedoist, PLAS, whom the writer wants to thank here for his able instrumental work.

On November 29 Hr. Ms. O 12 arrived in San Juan de Porto Rico where we stayed four days, much enjoyed by all of us. On December 1 st we continued our voyage. The trip to Punta Delgada took us fourteen days and notwithstanding the winter season we had fairly good weather except two days of strong gale shortly before our arrival. As the submarine was a small one, these days gave us some memorable experiences of rolling and pitching, but as it did not last long, we got through it without too much strain. Every day we dived once for a long programme of experiments with the new apparatus, usually taking about three or four hours. Records were made of the main pendulums as well as of the new slow pendulum for different courses of the ship with regard to the direction of propagation of the waves; in most cases this was achieved by slowly describing circles. During the gravity determinations the course was kept straight. On two occasions during the trip this programme was carried out at two different depths successively, at a depth of 20 meters and of 40 meters. This extensive programme of observations made it impossible to make more than one observation daily and so the gravity stations could not be as numerous for this trip as for previous ones. Only once an exception was made; during our passage over the Mid Atlantic rise on December 7 we made two observations in order to get more than one result for this crossing. Together we have occupied twelve gravity stations during this part of the trip and as the route could be arranged so as to cover a part of the Atlantic where no observations had yet been made, this series of stations may be considered as a valuable increase of our gravity material over the Atlantic. A disadvantage during this expedition was that the rates of the chronometers taken along as time-keepers, have been less regular than during former expeditions and this increased the mean error of the results. One station had even to be rejected on this account.

After a well-deserved rest of two days at Punta Delgada, we continued our voyage. During this last trip to Holland of a week, three dives have been made for experimenting with the new apparatus and during two of them gravity observations have been made. On December 24 we arrived in Den Helder, the Netherlands Naval Base, glad to return home before the Christmas days. Besides the main object of this expedition to put the new apparatus for the measuring of the horizontal accelerations to the test, a valuable gravity material of twenty new stations, besides a new determination at Curaçao, had been obtained.

After return the experience gathered during the trip was used for constructing a new slow pendulum apparatus in more final shape. As the above-mentioned publication of the Netherlands Geodetic Commission mentions in detail, the new apparatus is provided with two slow pendulums swinging at right angles to each other for the measuring at the same time of the two components of the horizontal acceleration. It was planned to fit in the space between the pendulum part and the recording part of the old pendulum apparatus; the recording is made by the old recording system and on the same strip of photographic paper. The trouble experienced during the trip with the spring suspension of the slow pendulum was overcome by substituting knife-edges; here again the writer profited by the good advice given to him by Mr. BROWNE. By the kind permission of the Director of the Meteorological Institute at De Bilt, Prof. VAN EVERDINGEN, the apparatus could again be constructed at the work-shop of the Institute, where formerly the pendulum apparatus itself had been made. The construction was executed by the instrumentmaker D. VAN LUNTEREN, to whom the writer feels indebted for the able diligence applied by him to this task.

It was of course desirable to put this new apparatus again to the test and, besides, in connection with the problem of the correction of the old gravity observations at sea more results were wanted about the ship's movements during submerging. The Netherlands Navy was, as ever, found willing to provide the requested opportunity; she has allotted Hr. Ms. O 13 for a trip to the end of the Channel and this enabled the writer to make series of experiments over shallow and deep water. The trip was extended to a point well out in the Atlantic at 47° 9′ Latitude north and 10° 2′ Longitude west and so we could be sure to get ship and water movements in the open ocean. Besides obtaining the desired information as mentioned, the trip gave also seven new gravity stations, of which two in the North Sea, one in the Channel and four near the edge of the continental shelf. Of these last four stations two are located over deep water and two over depths of 125 and 135 meters; they increase our knowledge of gravity over this part of the European shelf.

Hr. Ms. O 13 left Den Helder on May 3, 1938 and returned on May 10. The writer was accompanied by Dr. W. NIEUWENKAMP, who henceforth will undertake the gravity research for the Netherlands Geodetic Commission. The staff of the ship consisted of

Lieutenant-commander G. B. M. VAN ERKEL, Captain.
Lieutenant senior grade J. W. CASPERS, Executive Officer,
Lieutenant senior grade W. J. SNYDER, Navigator,
Lieutenant eng. senior grade A. OHR, in command of the engine-room,
Lieutenant eng. senior grade W. D. J. GESTEL, second in command of the engine-room.

The writer is glad to avail himself of this opportunity to thank them for their helpful assistance given for the scientific research. Captain VAN ERKEL gave his full collaboration for rendering the expedition successful. The weather was propitious; at the end of the Channel we had some rough sea but this provided a welcome opportunity for measuring the water-movements at different depths. At each station we dived for many hours in order to execute the elaborate schedule for the observations and at five of the seven stations this schedule was completed at two depths successively, usually 20 m and 40 m. For each depth a gravity determination was made and afterwards the pendulums as well as the slow pendulums were kept swinging while the ship slowly changed its course till a circle was described. In this way information was obtained about the ship's movements for different courses with regard to the sense of propagation of the waves. The writer hoped that the difference of the results obtained for the gravity observations at two depths would give data about the second order correction, independent of the other measurements, but the chronometer rates were not steady enough for this purpose. For a detailed discussion of the results of the observations the writer may refer to the recent publication of the Commission mentioned above. The new apparatus for the measuring of the horizontal acceleration proved satisfactory and so its shape was adopted as final. The information about the ship's movements was more complete than what was obtained during previous expedition and it confirmed its results. These results lead to the conclusion that for deep water the mean square of the vertical accelerations is equal to the mean square of the horizontal accelerations as GERSTNER'S and STOKES'S theories predict, while for shallow water LAPLACE'S relation holds good. These results allow the computation of the second order correction for the old observations and this has since then been accomplished; they are published in the above-mentioned special publication of the Commission on this subject. However, more data about the ship's movements will be welcome for making sure about the general validity of the above-mentioned conclusions. No doubt they will be forthcoming in the future.

Since the expedition of Hr. Ms. O 13, plans for great expeditions have been elaborated and have even been on the point of being carried out but the political situation has prevented them to come off. An expedition via Cape Town to Java had thus to be given up and likewise an expedition in the Indian Ocean and in the eastern part of the East Indies which also promised valuable results. The main object was to make further gravity research but, besides, further information would be got about the ship's movements during submerging. In the winter of 1938—1939 the Netherlands Geodetic Commission had received the loan of the crystal-controlled time-keeper of the Bell Telephone Laboratories for use during these expeditions and this was an important asset because its rate, as it has already been mentioned, is much more regular than that of the old chronometers. We likewise received the mechanism adapting this time-keeper to the pendulum apparatus as it was constructed by Prof. M. EWING and Mr. B. C. BROWNE. For this generous and valuable support, which may be mentioned as a high-minded instance of international cooperation, the writer wants to express his sincere thanks to the Committee on Geophysical and Geological Study of Ocean Basins of the American Geophysical Union authorizing this loan and especially to its Chairman, Prof. RICHARD M. FIELD.

The expeditions had to be postponed, but for the purpose of getting more data about the ship's movements and the second order correction a slight contribution has been possible. The Geodetic Commission thankfully accepted an offer of the Netherlands Navy to accompany a new submarine, Hr. Ms. O 19, on its trial trip in July 1939 towards the deeper part of the North Sea. Dr. NIEUWENKAMP took charge of the research and could make two sets of observations of ship's movements at depths of 20 and 40 m; at both depths also gravity observations were carried out. Because of the crystal-controlled time-keeper the comparizon of the two values gave a check on the second order corrections, although bad luck brought about a slight uncertainty from other sources. This check as well as the observations of the ship's movements confirmed the results previously obtained. Captain VAN DONGEN gave his collaboration for the successful execution of these investigations.

In the above historical summary of the gravity expeditions of the Netherlands Geodetic Commission since 1933, the writer has found an opportunity to express his gratitude towards the Netherlands Navy and to many who have collaborated for making this research possible or for furthering it. He wants to add a few personal words of thanks to the great many authorities, Netherlands consuls and friends who in the ports where he has been staying have given him so much kindness and hospitality and who thereby have rendered these days so agreeable for him.

CHAPTER II.

Voyage of Hr. Ms. K 18 from Holland to Java via Cape Town and W. Australia. November 14, 1934 — July 11, 1935. Observations, Computations and Results.

The Base Observations before and after the expedition.

During five days before the expedition observations have been made at the base station in the Royal Netherlands Meteorological Institute at De Bilt. Each day the normal programme has been followed of filling up the time between the rythmic time-signals of Rugby (G.B.R.) of 9^h55 G.M.T. and of 17^h55 G.M.T. by three pendulum observations of the usual type of more than two hours, giving equal amplitudes in opposite phase to the two outer pendulums and no amplitude to the middle one, and by one observation of one hour for determining the period of the middle pendulum; as usual for this last observation the outer pendulums got twice, resp. three times the amplitude of the middle pendulum in the same resp. opposite phase to the middle pendulum. The results for the mean period T of the outer pendulums for the five days were

Date	$T_{\text{De Bilt}}$, 1934
3 Aug.	0.5013985.8 sec.
21 Sept.	0.5013984.5 ,,
28 Oct.	0.5013984.7 ,,
29 Oct.	0.5013984.4 ,,
2 Nov.	0.5013986.4 ,,
Mean	0.5013985 sec.

For the mean value of the differences $T_{89} - T_{90}$ and $T_{88} - T_{90}$ of the outer pendulums Nos 88 and 89 and the middle pendulum No 90 for the temperature t° and for the pressure of one atmosphere the writer obtained

$$T_{89} - T_{90} = -10 + 0.16\,t^\circ \quad 10^{-7}\text{ sec},$$
$$T_{88} - T_{90} = +17 - 1.03\,t^\circ \quad 10^{-7}\text{ sec},$$

and for the mean difference of the periods of the outer pendulums for zero temperature and zero pressure

$$T_{88} - T_{89} = 34 \quad 10^{-7}\text{ sec.}$$

Before the departure of the expedition he made a check on the periods at the naval base Den Helder by two half-hour observations in the submarine regularly distributed between the above mentioned two Rugby time-signals; the submarine was located in the outer submarine harbour. He found a value for g_0 of 981.339 which exactly agreed with the value found there formerly.

At the end of the expedition observations have been made in the submarine harbour at Surabaya, where gravity is well-known because of many previous observations; in the list of results in "Gravity Observations at Sea", Vol II, 1923—1932, a mean error of the gravity value for this station is mentioned of 2 mgal. In the second place observations have been made at Bandung, the main base station on Java in the interior of the island.

The observations in Surabaya have been made on board the ship in the same way as all the sea and harbour observations. As, however, four observations of fourty minutes have been made at regular time-intervals between the time-signals, which themselves were twenty-four hours apart, the accuracy of the result is nevertheless satisfactory. In Table I of this publication a mean error of the result has been derived of 2.1 mgal and this figure is probably too large because the writer derived it by assuming the four values to have independent errors, while in reality we may suppose the rate-fluctuations to compensate each other for a great part. The four values obtained for g_0 are

g_0, Surabaya, July 16, 1934,

978.134
978.139
978.143
978.131

978.137

This value, derived by means of $T_{\text{De Bilt}} = 0.5013985$ sec, coincides with the value formerly obtained and mentioned in the above publication.

The observations at the main base station Bandung have been made in good conditions as far as the principal cause of error for base observations is concerned; the Physical Laboratory where the station is located is provided with a crystal controlled time-keeper with a steady rate. The rate was checked by taking the time-signals of Croix d'Hins (F.Y.L.) at 20^h01 G.M.T. The two observation days gave

Date	g, Bandung, 1935
9 Aug.	977.987
10 Aug.	977.985
Mean	977.986

As it has been mentioned on page 86 of "Gravity Expeditions at Sea", Vol I, the value of g in Bandung derived from previous determinations is 977.988, but there is some uncertainty about its validity. The agreement may be considered as satisfactory. By means of the observations at Bandung the writer further obtained

$$T_{88} - T_{89} = 55 \; 10^{-7} \text{ sec},$$
$$T_{89} - T_{90} = -\; 9 + 0.16\, t^\circ \; 10^{-7} \text{ sec},$$
$$T_{88} - T_{90} = +\,42 - 1.03\, t^\circ \; 10^{-7} \text{ sec}.$$

We may conclude that the mean of the periods of the outer pendulums has well remained constant but that probably the pendulums underwent some changes during the expedition. We shall come back to this point when discussing the mean error of the results.

In the middle of the expedition, during our stay in Cape Town, the apparatus has been taken out of the ship and mounted in the Maclean Building of the Royal Observatory. In three successive days the following results based on $T_{\text{De Bilt}} = 0.5013985$ sec have been obtained

Date		g, Cape Town, 1935
16 April,	1 obs.,	979.658
17 April,	3 obs.,	979.660
18 April,	5 obs.,	979.659
Mean value		979.659

As the elevation of the station is 16 meters above sea-level, the value of the gravity g_0 at sea-level is 979.664; this value is mentioned under station-number 658 in Table II.

The value of 979.659 for the Maclean Building of the Royal Observatory does not well agree with the value of 979.650 found there by Dr. BULLARD in April 1934. On the other hand it is in good harmony with some values obtained formerly in the Observatory at Cape Town. Restricting ourself to observations since 1890 we have

	Observer	g
1890	PRESTON	979.659
1894	v. LEIDENTHAL	979.651
1895	GASSENMAYR	979.655
1897	v. REITERDANK	979.642
1898	LOESCH	979.659

From the material then available BORRASS derived a value for Cape Town of 979.657. Although the writer attaches much importance to the high quality work of Dr. BULLARD he should think that in this case there is enough room for uncertainty to refrain from adapting the value of T for the pendulums of this expedition to the result obtained by him. The writer hopes that future observations may settle the question; it may be possible that in that case there will be reason for readjusting the results of this expedition. For the computation of the results we have now adhered to the value

$$T_{\text{De Bilt}} = 0.5013985 \text{ sec.}$$

For the differences of the pendulum periods the observations in the Royal Observatory in Cape Town have given

$$T_{88} - T_{89} = 54 \ 10^{-7} \text{ sec,}$$
$$T_{89} - T_{90} = -13 + 0.16\,t^\circ \ 10^{-7} \text{ sec,}$$
$$T_{88} - T_{90} = +32 - 1.03\,t^\circ \ 10^{-7} \text{ sec.}$$

For the computation of the corrections for deviation from isochronism the differences found in De Bilt have been adopted throughout the whole voyage. The taking into account of the somewhat different figures found in Cape Town and Bandung would not appreciably affect the results. The variability of the differences of the outer pendulums from the middle one has also occurred during previous expeditions; in general it may probably be set down to some slight variability of the middle pendulum, no 90, but in the case of this expedition variations of the outer pendulums must also have played a part.

The observations during the expedition

The observations during the expedition at sea and in the harbours have been made in the usual way by means of the pendulum apparatus for maritime gravity survey as it is represented on page 69 of "Gravity Expeditions at Sea", Vol I, without its later addition for the measuring of the horizontal accelerations. The pendulums were swung for 30 — 35 minutes and the periods of high paper-speed at the beginning and at the end were long enough for being sure to contain at least two coincidences; for this purpose they must obviously be slightly over twice the coincidence-period. For our pendulums six minutes are needed for the latitude of Holland and four and a half minute for the equatorial zone. The thermometer, the hygrometer, the two aneroids and the depth of the ship were read at the beginning, in the middle and at the end of the observation. The sea-depth was determined every quarter of an hour for the whole time of submerging; as the speed during this time was about 4 knots, this corresponds to depth-values at one sea-mile interval. In case of irregular topography the soundings were more frequent. The positions of the stations and the value of the E-W component of the current needed for the Eötvös correction were derived from the data about the ship's position usually provided by Lieutenant Ter Poorten, navigator of the ship. Each position and each current-value was discussed with him and from these discussions resulted the values for the mean errors noted down for these data. In the observation-book short notes were inserted containing the main features and figures of these determinations. The writer wishes here to pay a compliment to Lieutenant Ter Poorten for the excellent position determinations he made; in many cases the error did not exceed one sea-mile.

For station No 536, i.e. observation No 51 of this expedition, two observations have successively been made because the writer was afraid that the irregular sounding-results could be an indication of greater topographic irregularities in the neighbourhood; in that case a strong gravity gradient could be expected and the two observations would show a difference of gravity. This was not the case; both observations gave exactly the same result, viz $g_0 = 978.153$.

At stations No 647 shortly before Cape Town, No 702 in the Indian Ocean and No 721 shortly before arrival in Java, two observations have been made in opposite E-W and W-E courses for determining the amount of the Eötvös correction and finding in that way the speed of the ship during submerging. The results did not give reason to doubt the indications given by the ship's log. Using its data for the computation of the Eötvös correction, the writer found the following pairs of gravity results; they agree inside the degree of accuracy of the observations

No 647A	979.568	No 702A	979.368	No 721A	978.394
No 647B	979.571	No 702B	979.364	No 721B	979.391

So for all the observations the log-indications were used without correction for the computation of the Eötvös correction.

In Funchal, observation No 21, a check was obtained with regard to the value found in 1932. The results are satisfactory, they differ only by one milligal:

$$\text{Funchal, 1932, } g_0 = 979.778,$$
$$\text{Funchal, 1934, } g_0 = 979.779.$$

For improving the accuracy of the rate corrections of the pendulum observations, three chronometers have been taken along. Besides the two NARDIN chronometers, Nos 212 (sidereal time) and 2081 (mean time), of the Netherlands Geodetic Commission, the writer disposed of a mean time chronometer of the French Navy, BROCKING No 1287, which was kindly put at his disposal by the French Hydrographic Service. As it was difficult to make it also register in the pendulum records in the same way as this is done by the others, i.e. by interrupting the light for a short moment every second, a separate recording instrument has been used for making a record of the three chronometers before and after the pendulum observations and the taking of time-signals. The instrument, constructed by BOULITTE in Paris, is in the usual way provided with writing pins moved electro-magnetically by the shutting and breaking of currents of a few milli-ampère in which the chronometer-contacts are inserted; the paper-speed can be so adjusted that the mutual distance of the second-marks is about five centimeters. So the record can easily be read to an accuracy of more than a thousandth of a second and this corresponds to an accuracy of the differences of the daily rates of the chronometers during the time of a pendulum observation of about two hundredths of a second. This is sufficient for our purpose as it gives an accuracy of the seventh decimal place of the second in the rate-corrections of the pendulum-periods.

The rythmic time-signals have been received in the same way as during previous expeditions; the chronometer's break-circuit was put in series with the telephone of the wireless receiving set and the appearing as well as the disappearing of the signals was noted down. Both were used for the determination of the chronometer's correction. The following signals of Croix d'Hins (France) or Monte Grande (Argentine) have been used

Stations Nos 486—571, Croix d'Hins (F.Y.L.) $8^h.01$ and $20^h.01$ G.M.T.,
Stations Nos 572—579, Croix d'Hins (F.Y.L.) $8^h.01$ and Monte Grande (L.Q.C. or L.S.D.) $23^h.45$ G.M.T.,
Stations Nos 580—607, Monte Grande (L.Q.C. or L.S.D.) $23^h.45$ G.M.T.,
Stations Nos 608—644, Monte Grande (L.Q.C. or L.S.D.) $11^h.45$ and $23^h.45$ G.M.T.,
Stations Nos 645—656, Monte Grande (L.Q.C. or L.S.D.) $23^h.45$ G.M.T.,
Station No 657 Croix d'Hins (F.Y.L.) $8^h.01$ G.M.T.,
Stations Nos 659—724, Croix d'Hins (F.Y.L.) $8^h.01$ and $20^h.01$ G.M.T.,
Surabaya (No 168) Croix d'Hins (F.Y.L.) $20^h.01$ G.M.T.

The computations.

The computations have been made according to the normal schedule as mentioned in "Theory and Practice of Pendulum Observations at Sea", part I, 1929, with the exception of two questions which will be dealt with here.

In the first place the writer disposed of three chronometers instead of two, the rate-differences of which have been recorded by a special instrument. From the rate-differences during the pendulum observations as well as the mean rate-differences during the interval between the time-signals, the rates could be derived of one chronometer, Nardin 212, during the pendulum observation according to three assumptions, viz that Nardin 212 had had a regular rate during the whole interval between the time-signals, in the second place that this had been the case for the second chronometer, Nardin 2081, and in the third place that this had been true for the third one, Brocking 1287. Chronometer Nardin 212 had been recorded in the pendulum-record. The computations of the rate-corrections of the pendulum-periods have been first made with the first figure for the rate of this chronometer and afterwards with the two other values. In this way three values were obtained for the mean value T of the reduced pendulum-periods of the two fictitious pendulums. Of these three values of T the mean was taken and this was adopted for the computation of the result for g. In some cases, when the mean rates of one chronometer between the time-signals showed special irregularities, the value of T corresponding to that chronometer was given less weight with regard to the others or it was even entirely omitted. In table I the three values of T with the weights w attached to them are mentioned and in case one has been left out, the space has been left vacant; in case it was the third value it was simply omitted without leaving a blank space.

The three values for T give valuable data for deriving the mean error of the gravity results as far as it is caused by the uncertainty of the rate. This mean error m_v, mentioned in the eleventh column of table I, was found by multiplying the mean error of T, determined in the ordinary way from the three values of T, by the ratio C[1]) of $g - g_{\text{De Bilt}}$ to $T - T_{\text{De Bilt}}$. When only two values of T have been used, the writer has adopted a minimum value of m_v of 1.5 mgal even if the computation would give less, because he could not feel sure that the good agreement of two values was more than accidental. For the first station only one value of T was available because of the failing of the system for comparing the chronometers and so no value of m_v could be deduced. The writer has here adopted the mean value $m_v = 3.4$ mgal of the next four observations.

In the second place the results had to be corrected for the "terms of BROWNE", discovered and published by BROWNE in 1937 [2]). This correction is given by formulas 50, page 26 of "Theory and Practice of Pendulum Observations at Sea", part II, 1941, or, with sufficient accuracy, by formulas 51, ibid., i.e. as BROWNE has given it

$$\frac{\delta g}{g} = - {}^1/_4 \overline{\left(\frac{\ddot{x}}{g}\right)^2} + {}^1/_2 \overline{\left(\frac{\ddot{y}}{g}\right)^2} + {}^1/_2 \overline{\left(\frac{\ddot{z}}{g}\right)^2}$$

where $\ddot{x}$, $\ddot{y}$ and $\ddot{z}$ are successively the vertical component of the acceleration, the horizontal component in the sense of the swinging-plane and the horizontal component at right angles to this plane. The dashes indicate mean values over the time of observation. For its computation we require the vertical and the horizontal components of the accelerations. The first can always be derived from the fluctuations of the chronometer-marks in the pendulum-records brought about by the vertical accelerations. For determining the horizontal accelerations we need a special instrument which since 1937 has been constructed and which can now be added to the pendulum apparatus. For this and the following expeditions no such measurements are available and this is likewise the case for the old expeditions, but, as we

[1]) See e.g. formula 80B of „Theory and Practice of Pendulum Observations at Sea", part. I, 1929.

[2]) B. C. Browne, The measurement of gravity at sea, M.N.R. .A.S. geophys. suppl. Sept. 1937.

have mentioned in the preceding chapter, page 17, and more at large in the above mentioned publication, we nevertheless can solve the problem. For this purpose we have to rely on the validity of GERSTNER'S or STOKES'S theories for the water-movement in waves, which assume the particles to describe circular orbits or, in case of shallow sea, the theory of LAPLACE supposing elliptic orbits, and we have to assume the movements of the apparatus to have the same character. In that case we can derive the mean sum of the squares of the two horizontal components of the acceleration required for the computation of δg from the mean square of the vertical component; it is equal to it or, in case of shallow water, it must be multiplied with the square of the factor N given by table II on page 62 of "Theory and Practice of Pendulum Observations at Sea", part II, 1941.

The results obtained by the expeditions of Hr. Ms. Submarines O 13 and O 19, mentioned on page 66 of that publication, have confirmed these theories for the movement of the apparatus; the mean deviation of the ratio N of the horizontal and vertical axis of the orbits was not more than 0.057, i.e. inside the limits of the errors of observation. The number of these observations, however, is not yet sufficient to draw final conclusions, especially for shallow water where only two results are available. For the correction of the results of this and the following expeditions we shall adopt them to be true; we may hope that in the future further confirmation will be forthcoming. The above formula of the correction now becomes

$$\frac{\delta g}{g} = + {}^1/_4 \overline{\left(\frac{\ddot{x}}{g}\right)^2}$$

and expressing in the amplitude a_{Fo} of the fluctuations of the chronometer-marks in the axis of a pendulum-record of an amplitude a_v (formulas 68B and 69E ibid.)

$$\delta g = {}^1/_2 \frac{T^2}{T_w^2} \left(\frac{a_{Fo}}{a_v}\right)^2 g$$

where T and T_w are the periods of the pendulums and the waves, both taken for a complete phase-revolution and for the pendulums corresponding to the time of a double swing. In case of shallow water the formula has to be provided with a factor $F = 2\,N^2 - 1$ which may be found in the same table II on page 62 of the publication mentioned above, as the ratio N of the vertical and horizontal components of the accelerations.

From the value 0.057 of the mean deviation of the ratio N as derived from the observations, we may deduce (page 68 ibid) a mean error m_δ of the value thus found for δg of

$$m_\delta = 4\,N\,dN\,\delta g' = 4 \times 0.057\,N\,\delta g' = 0.23\,N\,\delta g'$$

where $\delta g'$ indicates the value given by the above formula for δg. For all the observations except those in shallow water the factor N may be omitted and we have, $\delta g'$ and δg being identical in this case,

$$m_\delta = 0.23\,\delta g.$$

The list of values of m_δ thus derived has been included in table I of this publication in the thirteenth column. The way the formula of m_δ has been deduced indicates that it includes as well the effect of the errors involved in the determining of δg as the effect of an eventual deviation of the ratio N of the components of the acceleration from the adopted normal value as predicted by the wave-theories of GERSTNER, STOKES and LAPLACE.

For determining δg we require the amplitude a_{F_0} of the fluctuation of the chronometer-marks and the wave-period T_w. The method used for measuring these quantities has been described on page 31 of "Theory and Practice of Pendulum Observations at Sea", part II, 1941. In the middle half of one of the records of the two fictitious pendulums, i.e. the part of the record comprised between two lines on both sides parallel to the axis of the record and halfway between the axis and the edges, the amplitudes of the fluctuations of the second-marks were measured. Their mean value in mm was divided by the amplitude of the pendulum record at that place in cm and the square of that ratio was taken. This was done for ten different parts of the chronometer-mark curve, chosen at random in the record, and the mean q of these squares was determined. For finding T_w the number of wave-lengths was counted in one minute of the chronometer-mark curve, estimating also fractions when it was not a whole number. This was done for the same ten parts where also the mean amplitudes of the fluctuations had been determined and their mean value N_w computed. Introducing these quantities in the formula for δg and taking into account that the fluctuations had not all been measured in the axis of the record but that they had been found as a mean value over the middle half of it, (page 30 ibid.), we obtain the following simple formula (page 72 ibid.)

$$\delta g = 1.500\, q\, N_w^2 .$$

For shallow water we have to add the above-mentioned factor F. The wave-period T_w follows from

$$T_w = \frac{60}{N_w} .$$

The amplitudes a_F of the fluctuations of the chronometer-marks must of course be measured in a sense at right angles to the axis of the record. This was done by drawing a fine pencil-line about parallel to the chronometer-curve for the part where we want to make the measurements and near to this curve, and by measuring the successive maxima and minima of the distance in the above-mentioned sense between the curve and the line. Indicating this series of maxima and minima by $a, b, c, d, e, f, g,$ ...., the fluctuations are successively $\frac{1}{2}(a+c)-b$, $\frac{1}{2}(c+e)-d$, $\frac{1}{2}(e+g)-f$, etc.

In case the amplitude of the fluctuations did not exceed 0.6 mm, only four parts of the chronometer-curve have been measured. As the correction in this case is only about 5 to 9 milligal, this gives a more than sufficient accuracy. For those records where the amplitude was not more than 0.2 mm the correction has been neglected; it only amounts in this case to a value of 0.5 to 1 milligal.

The above method is accurate if the ship's movements have only one period. In case there are more periods, the correction consists of as many terms of the shape of the above formula for δg as there are periods. We then should have to measure the amplitudes of all the terms present in the fluctuations and for doing so we should have to separate them by harmonic analysis. Such a treatment would be complicated and laborious and it would hardly be justified for the computation of a small correction. We have not done it for the records of the expeditions discussed in this paper nor for those of the previous expeditions but we have kept to the above formula and method for the single harmonic term and we have estimated as well as possible the amplitude and the period of the composite fluctation as if it had been a single periodic one. The writer thinks that the errors thus incurred are negligible for our purpose, but as yet, no special investigation has been made to determine them.

The eighth, ninth and tenth columns of table I of this publication contain the values of q, T_w and δg for all the observations for which they have been measured. For observations in harbours where no fluctuations occurred, a value zero has been entered in the columns for q and δg; for those observations were the fluctuations were below the limit of 0.2 mm, these columns show a blank while in this case a value zero has only been given in the thirteenth column for the negligible value of m_δ.

In the following cases the sea was so shallow that the writer had to add the factor F to the formula for δg and N to that for m_δ. The list below gives these factors and also the factor P tabulated in table I on page 62 of "Theory and Practice of Pendulum Observations at Sea", part II, 1941; this factor was required for deriving the wave-lengths mentioned in the last column of table II of this publication.

number Observ.	sea-depth m	depth apparatus m	T_w sec	F	N	P
29	75	28	10.3	1.23	1.06	1.007
63	60	18	11.1	1.59	1.14	1.038
117	60	28	11.3	2.42	1.31	1.051
171	100	28	14.0	1.47	1.12	1.035
174	80	18	10.0	1.057	1	1
175	90	18	10.6	1.047	1	1
176	80	18	11.4	1.17	1.04	1.014
177	90	18	10.7	1.052	1	1

In cases like observation No 117 where F deviates much from the unity, another source of error makes its appearance, viz the uncertainty of the sea-depth affecting the value of F. As submarines are usually not equipped with a depth-finder for shallow depth, the depth has to be taken from the charts as we have done for this expedition. Errors of the chart and errors of position thus come in. We have not made a special study of this point and it has not been taken into account for the computation of the mean error of the gravity result.

The mean errors of the gravity results.

The contributions to the mean error of the result, brought about by the uncertainty of the rate-correction and of the correction for the "terms of BROWNE" have already been dealt with in the preceding paragraph; their values m_v and m_δ are given by the eleventh and thirteenth columns of table I. The total mean error further includes the error of the Eötvös correction caused by the uncertainty of the data about the E-W speed of the ship, and the error of the pendulum period itself combined with the errors of the corrections for temperature, for air-pressure, for amplitude and for deviation of isochronism and also with the effect of the variability of the pendulums. Together all these errors constitute the total mean error of the result.

The contribution corresponding to the error of the Eötvös correction can be easily deduced from the indications about the mean error m_s of the E-W speed of the ship, made by the writer during the trip and noted down in the observation-book. As the ship was provided with a good-working log and as the check of this log did not give any reason for doubt, the mean error of the E-W speed was practically reduced to the mean error of the E-W component of the current. According to formula 81 B of "Theory and Practice of Pendulum Observations at Sea", Part I, 1929, we have

$$m_e = 7.5 \cos \varphi \, . \, m_s$$

where m_e is expressed in milligal and m_s in sea-miles.

The last part of the total mean error, corresponding to the error of the pendulum-period combined with the effect of the variability of the pendulums and with the errors of the above-mentioned corrections, may be derived from the mean fluctuation m_d [1]) of the difference d of the periods of the two fictitious pendulums; we may in fact assume the mean error of the difference of the mean T of these periods and the value of $T_{\text{De Bilt}}$ at half the value of m_d, and the mean error of the gravity result at this value multiplied bij the ratio C of $g - g_{\text{De Bilt}}$ to $T - T_{\text{De Bilt}}$. For the reasons for adopting this assumption the writer may refer to page 63 e.s. of "Gravity Expeditions at Sea", vol. I, 1932.

We have already mentioned that the pendulums have not remained perfectly stable during this long expedition. For obtaining further insight in the variability we have derived the mean values of the difference d of the fictitious pendulum-periods for successive groups of fifteen observations and the results are given here, accompanied by the mean fluctuation m_d of a single value for each group; the last group includes only ten observations.

Nos of observ.	d 10^{-7} sec	m_d 10^{-7} sec	Nos of observ.	d 10^{-7} sec	m_d 10^{-7} sec
1—15	37	10.2	137—151	53	7.5
16—29	47	7.0	152—165	57	5.7
30—43	57	8.3	166—180	51	6.5
44—57	55	6.4	181—193	56	6.3
58—71	60	8.9	194—207	56	4.8
72—86	63	4.1	208—221	51	6.7
87—100	59	6.7	222—234	49	6.6
101—112	59	6.0	235—240D	54	6.8
113—121	56	6.8			
122—136	54	8.8	Mean value	55	6.9

[1]) The mean fluctuation m_d has in the same way been derived from the deviations of d from its mean value as a mean error is derived from individual errors.

The mean fluctation of the eighteen values of the first column is 5.9 10^{-7} sec. We see that the principal variation of d appears to have occurred in the beginning of the voyage. From the agreement of the mean period T at De Bilt, at the beginning of the expedition, to the value found at the end, at Surabaya and at Bandung, we may probably conclude that the variations of the periods of the two fictitious pendulums have been chiefly in opposite sense. Although the writer is conscious of the uncertainty of this conclusion he considered himself entitled to compute the mean variability of T by taking one third of the value of the mean variability of d instead of half of its value. As we may approximately assume the value of 6.9 10^{-7} sec to represent the mean error of d without including the effect of the variability of the pendulums, and the value of 5.9 10^{-7} sec derived from the first column only, as the mean variability, we obtain the following value for the square of the mean error of the gravity result as far as it is caused by the effects here considered (for C we may introduce the value 0.39)

$$m_p^2 = 0{,}39^2 \left[\left(\frac{6.9}{2} \right)^2 + \left(\frac{5.9}{3} \right)^2 \right] = 2.4 \text{ mgal}^2.$$

We can now combine the different constituting parts of the total mean error of the gravity result and we find

$$m_g = \sqrt{2.4 + m_v^2 + m_e^2 + m_\delta^2} \text{ mgal}.$$

The values obtained have been listed in the last column of table I and likewise in the column behind that of the gravity results in table II. For the observations in the Royal Observatory at Cape Town the uncertainty of the rate may be neglected and the Eötvös correction as well as the "terms of BROWNE" are zero and so the variability of the pendulums combined with a slight error in the determation of the pendulum-periods and of the base value at De Bilt are practically the only remaining causes of error. We have estimated the mean error of this station at 1.4 mgal. We have likewise adopted this figure as a minimum value for the mean error of the gravity result in the harbours even if the normal way of computing this mean error would show a smaller figure. In all the harbours at least two observations have been made and the mean error of the result has been derived from the mean errors of each observation by assuming them to be independent. This assumption is certainly not quite true. We may suppose it to give too high a value for the effect of the rate uncertainty and too low an estimate for the effect of the variability of the pendulums.

It follows from the way m_g has been derived that it is the mean error of the gravity result with regard to the value of gravity at the base-station De Bilt. The writer thought it would not be justified to add a value for the uncertainty of the gravity difference of De Bilt with regard to the international base-station Potsdam because such estimates of mean errors for base-stations are usually illusory; if they are deduced from the extensive series of observations made for comparing those stations we arrive at low figures that nevertheless have often proved untrue when comparizons were repeated. So the values of m_g given in the tables I and II refer to a gravity-system based on De Bilt.

The Holweck-Lejay observations.

In order to supplement the gravity work at sea by work on land during the stay in the ports, the writer has taken along a Holweck-Lejay instrument. This apparatus has been put at his disposal by the "Bataafsche Petroleum My" at The Hague. In all the ports except Mauritius observations have been made, but of course during the few available days no extensive expeditions have been possible. In nearly all cases the writer has to thank kind supporters for his transportation during these expeditions; for their names as well as for other particulars he may refer to the first chapter. In this paragraph a short account will be given of the observations, the results and their mean errors.

The instrument was provided with only one pendulum and so no check could be obtained during the trips. The period of the pendulum was in the ordinary way determined by means of an accurate NARDIN stop-watch with two pointers. Following the schedule given by HOLWECK and LEJAY, the pendulum was started swinging by rythmically pressing the support and then the two pointers were put in motion at the moment of the first passage of the pendulum image through the wire in the field of the telescope. Four more passages in the same sense were then read by means of the second pointer and the figures were memorized and noted down afterwards. After twenty periods had elapsed five passages in the same sense were again read by means of the second pointer and usually this was repeated after another ten periods had gone by. Each observation thus gave five figures for twenty periods and five figures for thirty periods. The temperature-constant being known, the correction for this effect could be easily applied. The observation was repeated when a too large shift of the wire in the field indicated a tilt of the apparatus. At every station at least two observations have been made and usually the number of observations was larger.

Besides the observations at the field stations where gravity was required, a base-station was occupied in all the ports as near as possible to the ship and the gravity reduced to sea-level at this station was adopted to be the same as the value at sea-level derived from the pendulum observations in the ship. This last value thus served as base-value for the net of stations attached to this port and the Holweck-Lejay apparatus was used for the comparizon of the gravity at the stations of the net with that at the base-station. Where the time allowed it Holweck-Lejay observations have been made at the base-station before and after the trip and the measure of agreement of both sets of observations gives a hold on the problem of the mean error of the gravity result at the field-stations. In one case, at St Vincent, the above programme failed because of the large distance between the ship and the shore. As we shall afterwards expose, the results of the observations ashore have in this case been tied up to the Holweck-Lejay results at Den Helder and at Dakar. At Mar del Plata the ship was moored alongside a pier which did not provide a sufficiently stable support for the Holweck-Lejay apparatus and so here also the base-station had to be occupied at some distance from the pendulum-station, but as this distance did not exceed five hundred meters the writer adhered to the usual schedule; the resulting uncertainty in gravity can not be more than one or two milligals.

The computation of the results has been based on the formula as given by HOLWECK and LEJAY

$$g = C - \frac{k}{T^2}. \qquad \text{(I)}$$

The values of the constants C and k were not known beforehand and so they had to be derived from the observations of this trip. As for determining k we need observations at stations where gravity shows large differences, the voyage of Hr. Ms. K 18 presented an especially favorable opportunity for its determination; we changed over from a latitude of more than 50° north to the equatorial zone, then to a latitude of nearly 40° south and afterwards again to stations near the equator. On the other hand the expedition involved a difficult transportation problem for the Holweck-Lejay pendulum which is well-known to be exceedingly sensitive to disturbances. The suspension of the pendulum-box in a larger one to which it was attached by means of eight springs at the corners, no doubt took off all shocks but it must have kept the pendulum dancing for weeks at a time. So we can not be surprised that, as we shall see, the value of C which is a measure for the stability of the pendulum, has shown variations; they remained, however, inside reasonable limits.

We used the three largest gravity differences for deriving k. Indicating the interval of twenty periods by T_{20} and that of thirty periods by T_{30} and introducing two corresponding values k_{20} and k_{30} given by the formulas

$$g = C - \frac{k_{20}}{T^2_{20}} \qquad g = C - \frac{k_{30}}{T^2_{30}} \qquad \text{(II)}$$

we obtained

Intervals	k_{20}	k_{30}	weight
Den Helder — Mean Dakar and Pernambuco	52637	118473	4
Buenos Ayres I — Mean Dakar and Pernambuco	53978	121658	1
Fremantle II — Surabaya	53039	118580	2
Mean Value	52943	118959	

As these values of k_{20} and k_{30} gave slightly different values for the mean of the values for C for all the ports, we have modified them in opposite sense to make this difference disappear and we thus obtained the values used for the computations

$$k_{20} = 52932 \qquad k_{30} = 118984$$

Introducing these values in the formulas II as well as the values for g found at the base-stations in the different ports by means of the pendulum apparatus and the values for T_{20} and T_{30} given by the Holweck-Lejay apparatus, we obtained the following list for C, the first column according to T_{20}, the second according to T_{30} and the third giving the mean of the first two columns; the last column lists the values of g given by the pendulum apparatus and reduced to the same elevation.

Station	$C\ (T_{20})$	$C\ (T_{30})$	C (mean)	g
De Bilt	984.705	984.708	984.706	981.268
Den Helder	984.719	984.723	984.721	981.339
Madeira	984.685	984.687	984.686	979.778
Dakar	984.736	984.735	984.735	978.483
Pernambuco	984.744	984.743	984.743	978.165
Rio de Janeiro I	984.743	984.742	984.743	978.797
Rio de Janeiro II	984.737	984.731	984.734	978.797
Buenos Ayres I	984.762	984.764	984.763	979.705
Buenos Ayres II	984.746	984.749	984.748	979.705
Mar del Plata	984.753	984.757	984.755	980.034
Royal Observ. Cape Town I	984.777	984.773	984.775	979.659
Royal Observ. Cape Town II	984.771	984.771	984.771	979.659
Durban I	984.741	984.742	984.741	979.362
Durban II	984.756	984.754	984.755	979.362
Fremantle I	984.759	984.755	984.757	979.419
Fremantle II	984.753	984.750	984.751	979.419
Surabaya	984.749	984.752	984.751	978.135

Examining these results we get the impression that C has undergone a gradual slow increase caused by a secular change of the spring of the kind HOLWECK and LEJAY make mention of, and besides, irregular changes which usually seem to go back again. The largest deviation is shown by the station at Madeira and this certainly brings along some doubt about the two values found on the island; they have been computed as if the above value of C found in the harbour had been valid for the preceding days also, during which the observations on the island have been made. If this assumption should be wrong, the results of these last observations, stations 469a and b, should have to be increased by about fourty milligal. The uncertainty about the value of C at Madeira has induced us not to use it for the computation of the stations 524a, b and c on St. Vincent where no base-station could be obtained and which we, therefore, had to bring back to the values of C found in other ports; we have derived the results for these stations from the mean of the values of C found at Den Helder and at Dakar. All the other land-stations have been computed by means of the value of C found at the port in their neighbourhood as listed in the above table. For all the stations both formulas II, for T_{20} and T_{30}, have been used and the mean of the results g was adopted. For those ports where two values of C have been obtained, i.e. for Rio de Janeiro, for Buenos Ayres, for Cape Town, for Durban and for Fremantle, the mean of those values have been used, sometimes, if there was reason to do so, giving them different weights in computing the mean value. Their difference may be used for the computation of the mean error of the difference in gravity of the land-station with regard to the base-station at the harbour; we can put this mean error at half its value. Computing these differences slightly more accurately than the above list allows, we found

Port	difference (T_{20}) C (I) — C (II) mgal	difference (T_{30}) C (I) — C (II) mgal	mean error grav. differ. mgal
Rio de Janeiro	6.5	10.9	4.4
Buenos Ayres	15.9	14.6	7.6
Cape Town	5.5	2.6	2.0
Durban	15.1	12.2	6.8
Fremantle	6.2	5.7	3.0
Mean value	9.8	9.2	4.8

For finding the total mean error of the land-stations, the figure of the right column has been combined with the mean error derived for the result of the pendulum observations at the harbour-station, i.e. the root of the sum of the squares was taken. For the land-stations made during the stay in one of the other ports the mean value of 4.8 mgal of the right column has been used; this value was in the same way combined with the mean error of the harbour-station. It has already been mentioned that for the stations on Madeira and on St Vincent there is some room for doubt whether we should not have to increase the figure of the mean error thus obtained.

The results of the gravity determinations for the land-stations, reduced to sea-level by means of the free-air reduction, have been listed in table II of this publication. Behind the column of results g_0 we find the mean errors m_g derived in the way described above. The stations have been numbered by means of the number of the pendulum-station in the neighbouring harbour from where the stations have been occupied, combined with the letters a, b, c, etc. In the first column giving the number of the observations of this expedition, the land-stations have been distinguished by the letters HL (Holweck-Lejay) and they have obtained a separate numbering.

The soundings.

The detailed results of the sonic soundings in areas of special interest made during the expedition of Hr. Ms. K 18 will be dealt with in the next part of this report, volume IV of this publication. The oceanic profiles in general have already been incorporated in the edition of the maps of the southern Atlantic and of the Indian Ocean edited by the International Hydrographic Bureau at Monaco; for the northern Atlantic they will be taken account of in the map accompanying volume IV.

The lengths of the waves.

As the writer thought oceanographers might be interested in the lengths of the waves met with during submerging, they have been derived from the periods T_w of these waves listed in the ninth column of table I. For these computations he has used the formula of

GERSTNER'S wave-theory, i.e. formula 72 C, page 52 of "Theory and Practice of Pendulum Observations at Sea", part II, 1941:

$$\lambda = 1.56\, T^2{}_w \text{ meters.}$$

According to formula 100 and table I both on page 62 ibid, the values thus obtained for the observations in shallow water, listed in the table on page 30, have been divided by the quantity P of that table.

The results of these computations have been tabulated in the last column of table II. The longest waves have been experienced west of Africa where in stations Nos 517 and 518 wave-lengths of 319 meter have been found and west of Australia where stations Nos 716 to 723 show figures of 306 m, 328 m, 360 m, 342 m, 351 m, 308 m, 319 m and 319 m. Short waves do not occur during submerging at depths of several tens of meters because their amplitudes diminish quickly with the depth below the surface.

The tables.

The tables I and II of this publication contain the main particulars about the observations, the computations, the results and the mean errors of the results of this and of the following expeditions. They are preceded by a detailed description of their contents in chapter V to which we may here refer. Table I gives the figures concerning the observations, the computations and the different elements of the mean errors and table II contains the positions of the stations with their mean errors, the gravity results with their mean errors, the free-air anomalies and the lengths of the waves during submerging.

CHAPTER III.

Voyage of Hr. Ms. O 16 from Holland to Washington and back to Lisbon, January 11 — March 12, 1937, Observations, Computations and Results.

The Base Observations before and after the expedition.

During four days before and after the expedition, observations have been made at the base station in the Royal Meteorological Institute at De Bilt; the normal programme was followed as mentioned on page 22 for the base observations of the previous expedition. The results for the mean period T of the outer pendulums, Nos 88 and 89, and for their difference $T_{88} - T_{89}$ were:

Before the Expedition			After the Expedition		
Date 1936/37	$T_{\text{De Bilt}}$ sec	$T_{88} - T_{89}$ 10^{-7} sec	Date 1937	$T_{\text{De Bilt}}$ sec	$T_{88} - T_{89}$ 10^{-7} sec
5 Dec.	0.5013977.6	57.7	17 April	0.5013980.1	56.4
7 Dec.	0.5013973.2	59.5	30 April	0.5013975.6	56.0
11 Dec.	0.5013979.1	56.0	7 May	0.5013976.4	55.8
2 Jan.	0.5013983.5	58.6	13 May	0.5013975.2	57.4
Mean	0.5013978.4	58.0	Mean	0.5013976.8	56.4

For the differences of the periods of the outer and middle pendulums at the temperature t° and pressure of one atmosphere the writer obtained

before the expedition

$$T_{89} - T_{90} = - \ 3 + 0.16\ t^\circ\ 10^{-7} \text{ sec},$$
$$T_{88} - T_{90} = + 47 - 1.03\ t^\circ\ 10^{-7} \text{ sec},$$

after the expedition

$$T_{89} - T_{90} = - \ 5 + 0.16\ t^\circ\ 10^{-7} \text{ sec},$$
$$T_{88} - T_{90} = + 45 - 1.03\ t^\circ\ 10^{-7} \text{ sec}.$$

The results for the mean period T as well as for the differences of the periods before and after the expedition are in good harmony with each other and so this gives confidence in the stability of the pendulums during this trip. For the computation of the results of the expedition has been used

$$T_{\text{De Bilt}} = 0.5013978 \text{ sec},$$

and for the computation of the corrections for deviation from isochronism the figures of $T_{89} - T_{90}$ and $T_{88} - T_{90}$ obtained before the expedition; there was no reason to correct them for the slight difference found after the voyage.

During the stay in Washington the writer made use of the opportunity of checking the pendulums by swinging them at the base station of the Coast and Geodetic Survey (obs. Nos 52 A—E). The apparatus has been taken out of the ship and brought to the new base station in the Department of Commerce where the writer received much support from this Service. He has been assisted by Lieutenant HOSKINSON who made several of the observations and who arranged the use of the crystal controlled time-keeper of the Bell Telephone Laboratories which had been put at our disposal for the observations. For these facilities the writer wishes to express his gratitude to Major GARNER, Chief of the Geodetic Section of the Coast and Geodetic Survey, to Lieutenant HOSKINSON and to many others who assisted him. The results of the five pendulum swings gave a value for g of 980.112, which shows some disparity with regard to the value of 980.118 adopted for this base-station according to the extensive series of observations for the comparizon to Potsdam made by Lieutenant E. J. BROWN and Mr. A. H. MILLER [1]). The differences of the pendulum-periods following from these observations are on the contrary in good harmony with those found in De Bilt and mentioned above; they amounted to

$$T_{88} - T_{89} = \quad 57 \; 10^{-7} \text{ sec,}$$
$$T_{89} - T_{90} = -10 + 0.16 \; t^\circ \; 10^{-7} \text{ sec,}$$
$$T_{88} - T_{90} = +37 - 1.03 \; t^\circ \; 10^{-7} \text{ sec.}$$

It is difficult to see the cause of the disagreement found for the value of g in Washington. The writer has been in doubt whether he should take it into account by changing the value of $T_{\text{De Bilt}}$, used for the computations of this expedition to the mean of the above given value of 0.5013978 and of the value following from the Washington observations by adopting the value of 980.118 for the gravity at that station. He has refrained from doing so because of the good agreement of the difference $T_{88} - T_{89}$ which appears rather to point to some other cause than a change of the pendulum-periods. The satisfactory stability of this difference during the whole trip, which can be noticed in the table on page 43, was an additional reason for this decision. The writer is conscious, however, that there is room for doubt in this matter.

The observations during the expedition and the computations.

The observations and the computations have been made in the usual way and for the programme and the particulars we may refer to the preceding chapter dealing with the expedition of Hr. Ms. K 18. The positions of the stations and the currents have been deduced from the ship's positions as determined by Lieutenant H. A. W. GOOSSENS. Lieut. G. has been remarkably successful in his task; as the sea has often been exceedingly rough, the horizon only visible for short moments, the waves wetting his sextant and the ship's movements very large, the precision he obtained was a noteworthy achievement. Notwithstanding these conditions he succeeded often in obtaining an accuracy of one sea-mile in the ship's position.

[1]) E. J. Brown, A Determination of the relative values of Gravity at Potsdam and Washington, Spec. Publ. No 204 of the U.S. Coast and Geod. Surv, 1936.

On three occasions, where large topographic irregularities were present, the observation has been repeated, viz for stations Nos 77, 80 and 87. The positions of the successive stations not having been exactly the same, they have been separately mentioned in the tables I and II of this report. The observing in case of irregular topography of two stations at short distance gives a check on the amount of uncertainty of the topographic reductions; because of their positions being only a few miles apart, the anomalies after reducing for the effect of the topography ought practically to coincide. At the same time the mean anomaly of the two stations has a smaller mean error because of this uncertainty than would be obtained by a single station.

Applying the reduction for topography for the zones A — O of Hayford to the free-air anomalies of the three pairs of stations, the following anomalies have been obtained; the second figure for each station gives the mean error m_g of the gravity result which is practically the mean error of the free-air anomalies

	anom.	m_g		anom.	m_g		anom.	m_g
No 77A	+ 158	8.5 mgal,	No 80A	+ 164	10.7 mgal,	No 87A	+ 222	4.1 mgal,
No 77B	+ 173	9.5 mgal,	No 80B	+ 164	8.4 mgal,	No 87B	+ 233	4.1 mgal,

We see that the mean errors of the gravity results have been large; this is mainly due to the strong ship's movements bringing about large values for the corrections for the terms of Browne. Because of these great values of m_g it is not easy to say whether the differences of the anomalies for the stations 77 and 87 are caused by these errors only or whether also uncertainties of the reduction for the effect of the topography contribute to them.

As it was known that the log of the ship was trustworthy, no observations have been made for checking the E — W speed of the ship during submerging; its indications have been adopted for the computation of the Eötvös corrections. The mean error of the E — W component of the current had during the voyage been derived from the mean errors of the ship's positions and the resulting figures had been noted in the observation-book.

In Horta and on Punta Delgada, the observations Nos 18 and 81 allowed a check on the values found formerly in these harbours by means of the expeditions of Hr. Ms. K 13 and Hr. Ms. O 13. The results were satisfactory as the following figures show:

Horta, 1926, 980.162,	Punta Delgada, 1932, 980.133,
Horta, 1937, 980.157,	Punta Delgada, 1937, 980.130.

The rates of the time-keepers have been as usual determined by means of rythmic time-signals in the way as shortly described on page 26. During the whole trip the signals of Croix d'Hins (F.Y.L.) have been received and for a few cases the short-wave signals of Paris, T.S.F. (F.Y.B.), both at $8^h.01$ and at $20^h.01$ G.M.T.

During this expedition three chronometers have again been taken along, viz. the two Nardin chronometers of the Netherlands Geodetic Commission, Nos 212 (sidereal time) and 2081 (Mean time), and a chronometer, Ditisheim No 237 (sidereal time), lent by the Director of the Observatory at Leiden Prof. Hertzsprung. The two sidereal time chronometers have been recorded in the pendulum records. By means of the Boulitte recording instrument mentioned on page 26 the positions of all three chronometers have been compared at the time of the time-signals and before and after the pendulum observations. The first value of T for each station, mentioned in the sixth column of table I, has been obtained by measuring in the pendulum-record the chronometer-marks of Nardin No 212 and by correcting the period for the rate of this chronometer according to the assumption that its rate had been regular between the time-signals. The second value has in the same way been found by measuring the chronometer-marks of Ditisheim No 237 and assuming the regularity of rate for this chronometer. The third value is the mean of two values of T; for both the rate of the third chronometer, Nardin No 2081, has been assumed to have been regular between the time-signals, but the first has been obtained by measuring the chronometer-marks of Nardin No 212 and correcting for a rate during the pendulum observation of this last chronometer as derived from the rate of Nardin No 2081 by means of the records before and after the observation of the Boulitte instrument, while the second has been found by measuring the chronometer-marks of Ditisheim No 237 and correcting for a rate deduced in the same way from the rate of Nardin No 2081. If we consider the way these last two values of T have been obtained we see that their difference originates from the deviation in the rate-difference of the chronometers Nardin No 212 and Ditisheim No 237 as derived from their records in the pendulum records and in the second place from the comparison before and after the observation by means of the Boulitte instrument. Three causes cooperate for creating such differences viz. the errors made in measuring the chronometer-marks in the pendulum-records, the errors made in measuring the records of the Boulitte instrument and the fact that the time-interval between the two records on the Boulitte instrument was longer than the interval between the measured chronometer-marks at the beginning and the end of the pendulum-records; the first was usually about an hour while the other was about half an hour and so the two values for the rate-difference refer to somewhat different time-intervals. The differences of the two values of T thus obtained have been larger than was expected; their mean value for one hundred observations of this expedition was 22 10^{-7} sec. This has probably been caused by the rate-irregularities experienced during this expedition; they have been considerably larger than during former expeditions. It seems indicated to attribute this to the fantastic rolling and pitching to which the ship has been subject because of the rough weather encountered. We see clear evidence of these rate-irregularities in the disparities disclosed by the three values of T given for each observation by the sixth column of table I. In some cases, when the irregularity of the rates between the time-signals gave reason to do so, different weights have been attached to these three values or one value has even been left out entirely; the weights have been tabulated in the seventh column.

In the same way as it has been done for the expedition of Hr. Ms. K 18 dealt with in the preceding chapter, the different values of T for each station have been used for deriving the part m_v of the mean error of the gravity result brought about by the uncertainty of the rates of the chronometers. In case only two values of T have been used, no lower value for m_v has been admitted than two milligal; for the expedition of Hr. Ms. K 18 this lower limit had been put at 1.5 milligal but the larger fluctuations of the rates during this expedition made it advisable to raise this figure.

For the determination of the corrections δg for the terms of Browne and of the resulting part m_δ of the total mean error the writer may refer to what has been said in the preceding chapter on page 28 e.s. Because of the exceptional rough sea during this expedition large values of δg have occurred leading also to considerable values of the mean error m_δ. For the stations in the worst circumstances, as e.g. Nos 28, 29, 38, 39, 40 and 78, the writer does not even feel quite sure that the effects of third order terms, i.e. terms proportional to the third power of the accelerations, have still been negligible but probably this has been the case. Besides general considerations a reason for feeling some doubt about this question may be found in slight irregularities of the amplitudes of the fictitious pendulums. Only a special investigation can make sure about it; the writer has not yet attacked this problem.

In two cases, i.e. the observations Nos 1 and 53, the observations have been made over such shallow water that factors F and N corresponding to the wave-theory of LAPLACE [1]) had to be added to the formulas for δg and m_δ. The factor $1/P$ for the wave-length could be neglected for these cases:

Number Observ.	sea-depth m	depth apparatus m	T_w sec	F	N	P
1	45	18	7.0	1.098	1.024	1.00
53	60?	11	7.4	1.007	1.00	1.00

For the second observation the sea-depth was not well-known but as F does not differ much from the unity, this does not bring about a serious uncertainty in δg.

The mean errors of the gravity results.

The mean errors of the gravity results have been derived in the same way as for the expedition of Hr. Ms. K 18 and so we may refer to the preceding chapter for the particulars. For two reasons the mean errors are rather large for this expedition. In the first place the rates of the chronometers have been more irregular than for previous voyages, presumably because of the strong rolling and pitching of the ship. In the second place the corrections for the terms of BROWNE have been large because of the strong ship's accelerations during submerging and their mean errors may be assumed to be proportional to them. As we already mentioned in the preceding paragraph there is even some doubt whether for the worst cases we should not have to increase them because of third order disturbing terms.

The values of the part m_v resulting from the rate-uncertainty, of m_e caused by the Eötvös correction and of m_δ brought about by the terms of BROWNE are listed in table I; the total mean error m_g is found in the last column of this table as well as in the column behind the gravity results g_0 of table II. The last part of this total mean error, constituted by the effects of the mean errors in the determination of the pendulum periods, of the variability of the pendulums and of the not yet mentioned corrections for temperature, for air-pressure,

[1]) „Theory and Practice of Pendulum Observations at Sea", Part II, 1941, § 12, page 62, and page 30 of this report.

for amplitude and for deviation from isochronism has been adopted at the same value as for the preceding expedition; for the square of its value 2.4 mgal² has been added.

As far as the variability of the pendulums was concerned there certainly was no reason for increasing this value; the difference of the periods of the fictitious pendulums has shown smaller fluctuations than during the previous expedition. Deriving the mean of $T_{88} - T_{89}$ for successive groups of fifteen observations we found

Nos of observ.	$T_{88} - T_{89}$ 10^{-7} sec
1 —15	59
16 —28	60
29 —43A	60
43B—57	56
58 —72	52
73 —84	57
85 —93C	62
Mean value	58

The last group includes thirteen observations.

The soundings.

During this expedition no sonic sounding could be made at the sea's surface and so figures could be only obtained during submerging. The main figures have been tabulated in the eighth column of table II.

The lengths of the waves.

For this voyage the lengths of the waves experienced during submerging have again been computed; the results are listed in the last column of table II. For the method of computation, based on GERSTNER'S, STOKES'S and LAPLACE'S wave-theories, we may refer to page 37 of the preceding chapter. Some large figures have been obtained. This may probably be explained by the many successive weeks of stormy weather during this expedition which by far exceeded any previous experience of the writer. It is a well-known fact which the writer has always found confirmed, that the waves in the open ocean gradually become longer when the bad weather continues for a long time. The long swell takes several days to originate. The largest figures have been found for the following stations

Station No	Wavelength	Station No	Wavelength
732	319 m	800	319 m
733	390 m	801	410 m
799	332 m	803	319 m

The tables.

For the explanation of the tables containing the results we may refer to page 49 e.s.

CHAPTER IV.

VOYAGES

of:

Hr. Ms. O 12 from Curaçao to Holland, November 23—Dec. 24, 1937,
Hr. Ms. O 13 to the end of the Channel, May 3—May 10, 1938,
Hr. Ms. O 19 in the North Sea, July 10—July 13, 1939,
Observations, Computations and Results.

The Base Observations.

Before and after the expeditions base observations have been made at the base station in the Royal Meteorological Institute at De Bilt. Each observation day the normal programme has been followed as described on page 22 for the base observations of the expedition of Hr. Ms. K 18. After the few days trip o/b Hr. Ms O 19 no new base observations were considered to be necessary. The results of the base observations for the mean T of the periods of the two outer pendulums, Nos 88 and 89, and for the differences of the periods of the three pendulums are

Date	$T_{\text{De Bilt}}$ sec	$T_{88} - T_{89}$ 10^{-7} sec	$T_{89} - T_{90}$ 10^{-7} sec	$T_{88} - T_{90}$ 10^{-7} sec
4 Oct., 1937	0.5013974.0	58.9		
21 Oct., 1937	0.5013975.5	58.3		
24 Oct., 1937	0.5013984.4	57.0		
Mean	0.5013976	58.1	$-7 + 0.16\,t^\circ$	$+45 - 1.03\,t^\circ$
Expedition of Hr. Ms. O 12,				
8 Feb., 1938	0.5013985.9	55.8		
12 Feb., 1938	0.5013976.7	54.9		
19 Feb., 1938	0.5013975.1	51.3		
Mean	0.5013976	54.0	$+9 + 0.16\,t^\circ$	$+57 - 1.03\,t^\circ$

Date	$T_{\text{De Bilt}}$ sec	$T_{88} - T_{89}$ 10^{-7} sec	$T_{89} - T_{90}$ 10^{-7} sec	$T_{88} - T_{90}$ 10^{-7} sec
Expedition of Hr. Ms. O 13,				
19 May, 1938	0.5013973.5	52.7		
21 May, 1938	0.5013969.9	51.4		
22 May, 1938	0.5013974.6	53.3		
Mean	0.5013973	52.5	$-2 + 0.16\,t^\circ$	$+43 - 1.03\,t^\circ$
11 Febr., 1939	0.5013977.4	57.5		
4 March, 1939	0.5013985.3	57.1		
6 March, 1939	0.5013981.2	58.4		
8 March, 1939	0.5013976.0	54.8		
Mean	0.5013980	57.0	$-2 + 0.16\,t^\circ$	$+48 - 1.03\,t^\circ$
Expedition of Hr. Ms. O 19.				

As usual the difference $T_{88} - T_{89}$ has regard to the reduced pendulum periods, while the above formulas for $T_{89} - T_{90}$ and $T_{88} - T_{90}$ give the differences at a temperature t° and for an air-pressure of one atmosphere.

Because of the imperfect reception of one of the time-signals the rate during the observation day of October 24, 1937, has been somewhat uncertain and so the writer has not given full weight to the result of that day when deriving the mean period T for October 1937.

The results obtained for T shown by the above list as well as those for $T_{88} - T_{89}$ are in good harmony. For the computations of the observations of the expeditions we have assumed

expedition of Hr. Ms. O 12, $T_{\text{De Bilt}} = 0.5013976$,
expedition of Hr. Ms. O 13, $T_{\text{De Bilt}} = 0.5013974$,
expedition of Hr. Ms. O 19, $T_{\text{De Bilt}} = 0.5013980$.

Three of the four values for the differences $T_{89} - T_{90}$ and $T_{88} - T_{90}$ also agree well but the second pair of values shows a disparity. This appears to point to a variability of the middle pendulum, No 90. The writer has already mentioned in chapter II that this is not an uncommon occurrence and that we need not be too anxious about it as the error brought about in the result for T is negligible.

Some doubt, however, on the stability of the main pendulums, Nos 88 and 89, is caused by the deviations shown by the differences $T_{88} - T_{89}$ during the trips. The following values have been obtained for the mean values of this difference for the first thirteen observations of the expedition of Hr. Ms. O 12, for the remaining twelve observations of this voyage, for the eight observations of the trip of Hr. Ms. O 13 and for the two observations of Hr. Ms. O 19:

	Nos of observ.	$T_{88} - T_{89}$ 10^{-7} sec
Hr. Ms. O 12	1—12	72
Hr. Ms. O 12	13—22	64
Hr. Ms. O 13	1— 7	56
Hr. Ms. O 19	1— 2	77

The observations during the expedition and the computations.

As it has been mentioned in the historical summary in the first chapter, the main purpose of the expeditions dealt with here has been the testing of the new apparatus for the measuring of the horizontal components of the accelerations and the obtaining of evidence about the character of the ship's movements, both problems being connected with the second order corrections. As this side of the research has been treated of in "Theory and Practice of Pendulum Observations at Sea", part II, 1941, the writer may refer to that report for the particulars of these investigations. Here we shall only deal with the gravity observations made during these voyages. They have been executed in the ordinary way as mentioned in chapter II for the expedition of Hr. Ms. K 18; we shall not repeat these details and we shall only touch here on some special points regarding these expeditions.

As the log of the ship was known to be reliable, also during submergence, no double observations have been made during these trips for the determining of the E-W speed of the ship. In the stations Nos 835, 836, 839, 840 and 844 two observations have been made at different depths in connection with the above-mentioned research. The first observation at station 839 had, however, to be omitted from the results because the correction for the tilt of the swinging-plane of the pendulums was large and very uncertain. For each double observation the mean of the two gravity results has been adopted and this figure has been entered in table II.

The first station of the expedition of Hr. Ms. O 12, Curaçao II, station No 816, gives a check with regard to the old station Curaçao I, station No 71; the stations do not exactly coincide but their distance is only 1.4 km and so the gravity anomalies ought not to differ more than one or two milligal. The agreement is satisfactory but the difference is three milligals larger when we subtract the effect of the topography

	Station No	free-air anomaly	free-air anom.— —topog. (zones A-O)
Curaçao I	71	+ 160	+ 163 mgal
Curaçao II	816	+ 163	+ 169 mgal

The rates of the time-keepers have as usual been determined by means of rythmic time-signals; they have been received as indicated on page 26. For the first half of the expedition of Hr. Ms. 0 12 up to observation No 20 the short-wave signals of Paris T.S.F., (F.Y.B.) at $8^h.01$ and at $20^h.01$ G.M.T. have been used and for the second half and also for the next expeditions, the long-wave signals of Croix d'Hins (F.Y.L.) at the same hours.

For the expeditions of Hr. Ms. 0 12 and 0 13 the time has been given by the two chronometers of the Netherlands Geodetic Commission, Nardin Nos 212 (sidereal time) and 2081 (mean time). Their rates have not been satisfactory and the result is a loss of accuracy for the observations of these trips. Observation No 11 of the first expedition had even to be left away entirely because of the great uncertainty of the rates. For observations Nos 7 and 8 the resulting mean error is likewise large but they still may be worth while mentioning because they are situated in the area where a strip of strong negative anomalies is present and so with regard to these great anomalies the inaccuracy is of minor importance. The observations on board of Hr. Ms. 0 19 have been better favoured; the crystal controlled time-keeper of the Bell Telephone Laboratories was then available and so the rate-uncertainty for station No. 844, observed during that trip, was negligible.

The corrections δg for the terms of BROWNE have been determined in the same way as during previous expeditions and we may refer to page 29 where the method of measuring and computing has been described. As it has been mentioned there, we derived the mean square of the vertical accelerations from the fluctuations of the chronometer-marks in the pendulum records and adopting GERSTNER'S or STOKES'S theories about the water-movement, we assumed the mean square of the horizontal accelerations to be equal to it; for shallow water we had to add a factor given by table II on page 62 of "Theory and Practice of Pendulum Observations at Sea", part II, 1941. In this way we obtained the figures for the means of the squares of the vertical and horizontal accelerations required for computing the formula for δg given on page 27 of this publication.

For the last two expeditions, however, the new apparatus for the measuring of the horizontal accelerations has been functioning well and so in these cases we should have been able to derive their mean squares directly from the records of this apparatus in stead of deducing them from the vertical accelerations. This would have made us independent from assumptions about the water and ship's movements. As, however, the determining of the wave-accelerations by means of those records is somewhat complicated by the presence of other periodic terms in these curves than those connected with the waves, we have chosen another line. We have only used those parts of the records where the other periodic terms have been small and where thus the horizontal accelerations could easily be determined, and we compared the results to the vertical accelerations for the same parts as derived from the fluctuations of the chronometer-marks in the pendulum-records. In all cases [1]) the theories of GERSTNER or STOKES have been found confirmed — in case of shallow water that of LAPLACE — and that made it possible to keep to the usual way of determining δg by only measuring the vertical accelerations as mentioned above and described on page 29 of this paper.

The last modification of the new apparatus, the introduction of a damping of the slow pendulums used for the determining of the horizontal accelerations, eliminates one of the most disturbing periodic terms of its records and so in the future a direct measuring of the horizontal accelerations over the whole time of the pendulum observation will presumably be feasible. Future experience will have to be awaited before it is possible to decide whether it will still be advisable in that case to adhere to the above method [2]).

For three observations, 0 13, Nos 1 and 7, and 0 19, No 1A, the water was so shallow that we had to apply the factors F, N and $1/P$ to the formulas for δg, m_δ and the wave-length [3])

Number Observ.	sea-depth *m*	depth apparatus *m*	T_w sec	F	N	P
O 13, 1	42	18	8.5	1.59	1.14	1.020
O 13, 7	40	18	10.0	2.60	1.34	1.083
O 19, 1A	90	18	10.0	1.025	1.00	1.00

[1]) „Theory and Practice of Pendulum Observations at Sea", Part II, 1941, § 12, page 63 e.s.
[2]) Ibid. page 38 and 39.
[3]) See page 30 of this report and page 62 of „Theory and Practice of Pendulum Observations at Sea", part II, 1941.

The mean errors of the gravity results.

For the computation of the mean errors we may refer to the corresponding paragraph on page 30 e.s. of the second chapter; they have been determined in the same way as for the expedition of Hr. Ms. K 18. The last columns of table I give the values of the part m_v caused by the uncertainty of the rate, the part m_e brought about by the Eötvös effect because of the error in the E-W component of the sea-current and the part m_δ due to the corrections for the terms of BROWNE. The last column gives the total mean error m_g found by means of the formula on page 32, which combines the effects of m_v, m_e and m_δ with the effect of the mean error in the pendulum periods, of the variability of the pendulums and of the corrections for temperature, for air-pressure, for amplitude and for deviation from isochronism. The square of this last part of the mean error has again been estimated at 2.4; there was no reason to change this figure derived from the numerous observations of the expedition of Hr. Ms. K 18.

Some of the values of the mean errors for the expedition of Hr. Ms. O 12 are large. This is caused by the great values of m_v brought about by the irregular rates of the chronometers during parts of this trip. For the expedition of Hr. Ms. O 13 the rates have been more satisfactory and this is reflected in the smaller values for m_v and for the total mean error m_g. For the observations made on board of Hr. Ms. O 19, m_v has been negligible because of the perfectly regular rate of the crystal controlled time-keeper used during this trip. For the expedition of Hr. Ms. O 12 a minimum value for m_v has been adopted of 2.5 milligal and for that of Hr. Ms. O 13, of 1.5 milligal.

CHAPTER V.

The Tables.

The following tables I and II contain the main particulars about the observations and the results of the expeditions discussed in this publication. This paragraph gives a short summary of their contents.

Table I.

The first columns of both tables contain the numbers of the observations of the expedition; the observations with the Holweck-Lejay apparatus during the expedition of Hr. Ms. K 18 have been separately numbered and distinguished by the prefix HL.

The second columns of both tables give the numbers of the stations that have been occupied. The list begins by No 487 and thus is a sequel to that given in "Gravity Expeditions at Sea", Vol II, 1934, pages 89 e.s. Stations observed for the second time, as e.g. the harbour of Funchal, No 469, have not received a new number although the locality has not always been exactly the same; the difference may be derived from the latitude and longitude indicated in table II. In case the distance exceeded five hundred meters a new number has been introduced as e.g. No 816 (Curaçao II) besides No 71 (Curaçao I), or an accent as e.g. No 591′ besides No 591 (Rio de Janeiro). The Holweck-Lejay stations occupied during the expedition of Hr. Ms. K 18 have been designated by the number of the neighbouring harbour-station supplemented by the letters *a*, *b*, *c* etc. In notes to table II their names are given and some indications about the localities where the observations have been made.

It will be noticed that observation No 11 is missing in the list of stations of the expedition of Hr. Ms. O 12. This observation has been omitted because of the great irregularity of the chronometer-rates which brought about a too large mean error for the gravity result. For the observations Nos 7 and 8 of this trip the mean errors resulting from the same cause were also large, but as much greater differences occur in the anomaly field of this area, they have nevertheless some value.

The third column of table I gives the depth of submergence in meters of the pendulum apparatus; this figure is the depth of the meta-centre of the ship.

The fourth column shows the change of temperature of the thermometer of the pendulum apparatus between the beginning and the end of the observation, i.e. over a time-interval of about half an hour. This figure may give the reader an idea of the stability of the temperature and may thus provide a measure for the possible errors in the temperature corrections of the pendulum-periods.

The fifth column gives the difference of the reduced periods of the two fictitious pendulums, i.e. $T_{88} - T_{89}$, in 10^{-7} sec.

The sixth column lists the mean period T of the two fictitious pendulums, i.e. $\frac{1}{2}(T_{88} + T_{89})$, for different assumptions about the chronometer rates, viz in the first place that chronometer Nardin 212 had had a regular rate between the time-signals, in the second place that this had been the case for chronometer Nardin 2081, and thirdly that this had been true for the third chronometer; for the expedition of Hr. Ms. K 18 this was chronometer Brocking 1287, for that of Hr. Ms. O 16 it was Ditisheim 237 and for the last expeditions no third chronometer has been taken along. For the expedition of Hr. Ms. O 19 (station No 844) the crystal-controlled time-keeper of the Bell Telephone Laboratories had been taken along and the extreme regularity of its rate did not make it necessary to mention more than one value of T, viz that obtained by assuming the rate of this time-keeper to have been regular.

If in the parts of the table referring to the expeditions of Hr. Ms. K 18 and O 16 one value of T had been left out because of the rate of the corresponding chronometer not having been reliable for that day, this place in the table has been left vacant unless it was the third chronometer; in this last case the third value was simply left away. In other cases different weights have been given to the values of T and these weights w have been tabulated in the seventh column of the table.

The eighth column lists the values of q required for the computation of the correction δg for the terms of BROWNE. As it has been explained on page 29 q is the mean ratio of the square of the fluctuation-amplitude of the chronometer-marks in the pendulum-record in *mm* divided by the square of the pendulum-amplitude in cm. The ninth column gives the periods T_w of the waves experienced during the submerging of the ship; it follows from the mean number N_w of the fluctuations of the chronometer-marks per minute. The tenth column contains the values of the correction δg derived by means of the formula on page 29. For the observations over shallow water tabulated on pages 30, 42 and 47 this formula had to be multiplied by the factor F of those tables. In case the column shows a blank space, the accelerations have been so small that the correction does not exceed one milligal.

The last four columns of table I give figures about the mean errors, all expressed in milligals. The eleventh column contains the values of the mean error m_v in the gravity result brought about by the uncertainty of the rates of the time-keepers. Determining the mean error of the mean value of T from the three or two values from which it has been derived, eventually taking into account the difference of weight attached to them, and multiplying this figure by 0.39 we found m_v. In case the mean error of T has been derived from only two values of T, no smaller values of m_v have been adopted than the following figures

expedition of Hr. Ms. K 18, m_v (min.) = 1.5 mgal,
expedition of Hr. Ms. O 16, m_v (min.) = 2 mgal,
expedition of Hr. Ms. O 12, m_v (min.) = 2.5 mgal,
expedition of Hr. Ms. O 13, m_v (min.) = 1.5 mgal.

For the first station of the list only one value of T was available and so no mean error could be derived; the writer has in this case taken the mean value of the mean errors m_v of the next four observations.

The twelfth column lists the mean errors resulting from the uncertainty of the E-W speed of the ship required for the computation of the Eötvös correction. Their value may be derived from the mean error m_s of the E-W speed noted in the observation-book; the formula is

$$m_e = 7.5 \cos \varphi \,.\, m_s.$$

As the logs of the ships have proved trustworthy, m_s has practically only been caused by the uncertainty of the E-W component of the sea-current.

The thirteenth column gives the mean error of the correction δg for the BROWNE terms, put at (see page 28)

$$m_\delta = 0.23\, \delta g$$

which in case of shallow water had to be multiplied by the factor N as given in the tables on pages 30, 42 and 47.

The last column tabulates the total mean error m_g of the gravity result, derived from the formula

$$m_g = \sqrt{2.4 + m_v^2 + m_e^2 + m_\delta^2}.$$

According to the discussion on page 32 the quantity 2.4 represents the effect of the mean error of the pendulum period itself, of the corrections for temperature, for air-pressure, for amplitude and for deviation from isochronism, and the effect of the variability of the pendulums. It has been derived from the differences $T_{88} - T_{89}$ obtained during the voyage of Hr. Ms. K 18 and there was no reason to adopt other figures for the other trips.

Table II.

As it has already been mentioned, the first two columns give the numbers of the observations and of the stations; they are identical to the corresponding columns of table I except that the Holweck-Lejay stations have been provided with notes giving their names and some particulars about the localities of the observations.

The third column tabulates the dates at which the observations have been made. The next columns give the latitudes and longitudes, each accompanied by a column of the mean errors of these positions in sea-miles (one sea-mile = 1852 m). For neighbouring stations the relative position is more accurate than it would follow from these figures. For the harbour-stations these mean errors apply to the relative position with regard to the land as measured on the map; they do not include eventual uncertainties of the position of the land itself. For the Holweck-Lejay stations no mean error has been given; their positions have been derived from maps, if possible topographic maps, and no study has been made of the accuracy of these maps.

The eighth column lists the sea-depths in meters. The elevations of the Holweck-Lejay stations have been indicated by a negative sign.

The ninth column tabulates the gravity results g_0 of the observation, reduced to sea-level by means of the free-air reduction. For the sea-stations this reduction to sea-level has as usual also involved the adding of twice the attraction of the sea-water above the ship computed by means of the Bouguer formula; the value of g_0 for those stations, therefore, is the attraction that would have been observed if the observation had been made at the surface of the sea. The values of g_0 are based on a value of g at De Bilt of 981.268.

The tenth column gives the mean errors in milligal of the gravity results as mentioned in the last column of table I. The next column lists the values for normal gravity as given by the formula of Cassinis (international formula)

$$\gamma_o = 987.049 \ (1 + 0.0052884 \ sin^2 \varphi - 0.0000059 \ sin^2 2 \varphi).$$

The twelfth column contains the free-air anomalies, i.e. the differences of the values of the ninth and the eleventh columns.

The last column shows a list of the length of the waves experienced during submergence. As mentioned on page 36 e.s. these wave-lengths have been derived from the wave-periods T_w by means of the formula

$$\lambda = 1.56 \ T^2_w \text{ meters,}$$

in case of shallow water divided by the factor P of table I of page 62 of "Theory and Practice of Pendulum Observations at Sea", part II, 1941. The longest wave met with during these expeditions has been encountered in station 801 in the Atlantic; its length was 410 meters, corresponding to a period of 16.2 sec. Short waves will not be found in this list as these waves disappear too quickly when submerging in deeper water for being perceptible at depths of several tens of meters.

TABLE I.
Voyage of Hr. Ms. K 18.

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
1	487	10	+ 0.18	51	0.5014268				0	3.4	2.0	0	4.0
2	488	23	+ 0.17	34	0.5014717 729 748 0.5014723	1 1 0	0.045	8.0	3.7	2.3	1.0	0.9	3.1
3	489	23	— 0.02	20	0.5014935 961 964 0.5014953	1 1 1	0.111	8.8	7.7	3.6	1.0	1.8	4.4
4	490	28	+ 0.07	27	0.5015090 113 122 0.5015108	1 1 1	0.108	9.5	6.4	3.7	1.0	1.5	4.4
5	491	28	0	35	0.5015425 461 444 0.5015443	1 1 1	0.160	10.7	7.6	4.0	1.6	1.7	4.9
6	492	28	0	36	0.5015455 456 467 0.5015459	1 1 1	0.073	9.5	4.4	1.5	1.6	1.0	2.9
7	493	28	+ 0.09	27	0.5015435 431 429 0.5015432	1 1 1	0.125	11.5	5.1	0.7	1.6	1.2	2.6
8	494	28	+ 0.08	42	0.5015662 669 661 0.5015664	1 1 1	0.256	12.2	9.2	1.0	1.6	2.1	3.2
9	495	28	— 0.03	34	0.5016067 099 089 0.5016082	2 1 2	0.428	11.5	17.4	3.6	1.1	4.0	5.7
10	496	28	+ 0.14	53	0.5016168 183 171 0.5016174	1 1 1	0.432	12.2	15.6	1.8	1.1	3.6	4.4
11	497	28	0	36	0.5016362 347 340 0.5016350	1 1 1	0.677	12.8	22.4	2.5	1.1	5.2	6.1
12	498	28	0	45	0.5016416 421 417 0.5016418	1 1 1	0.365	12.0	13.7	0.6	0.6	3.2	3.6

No. Voy. K 18	No. stat.	Depth Subm.	Change Temp.	d	T(chron. 212) T(chron 2081) T(chron.1287)	w	q	T_w	δg	m_x	m_e	m_δ	m_g
		m	°	10^{-7} sec									
13	499	28	+ 0.13	37	0.5016700 677 673 0.5016683	1 1 1	0.239	11.5	9.7	3.3	0.6	2.2	4.3
14	500	28	+ 0.06	23	0.5016916 903 909 0.5016909	1 1 1	0.504	13.0	16.0	1.5	0.6	3.7	4.3
15	501	28	0	51	0.5017219 202 211 0.5017211	1 1 1	0.270	12.5	9.3	1.9	0.6	2.1	3.3
16	502	28	+ 0.12	46	0.5017324 333 320 0.5017326	1 1 1	0.292	12.2	10.5	1.5	0.6	2.4	3.3
17	503	28	— 0.02	47	0.5017639 633 619 0.5017630	1 1 1	0.190	13.0	6.0	2.3	0.6	1.4	3.2
18	504	28	— 0.03	37	0.5017752 743 730 0.5017742	1 1 1	0.229	13.0	7.3	2.5	0.6	1.7	3.4
19	505	28	+ 0.13	38	0.5017981 982 989 0.5017984	1 1 1	0.142	12.0	5.3	1.0	0.6	1.2	2.3
20	506	28	+ 0.02	49	0.5018187 192 195 0.5018191	1 1 1	0.090	10.9	4.1	0.9	1.2	0.9	1.8
21A	469	2	+ 0.13	41	0.5017785 807 795 0.5017796	1 1 1	0		0	2.5	0	0	2.5
21B	469	2	+ 0.08	55	0.5017797 771 791 0.5017786	1 1 1	0		0	3.1	0	0	
22	507	23	+ 0.06	40	0.5018564 563 574 0.5018567	1 1 1	0.136	11.1	6.0	1.4	1.3	1.4	2.8
23	508	23	— 0.01	38	0.5018753 774 774 0.5018767	1 1 1	0.120	10.7	5.6	2.7	1.3	1.3	3.6

No. Voy. K 18	No stat.	Depth Subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron 1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
24	509	23	+ 0.16	56	0.5018949	1	0.065	10.2	3.4	1.3	1.3	0.8	2.5
					940	1							
					938	1							
					0.5018942								
25	510	28	+ 0.05	57	0.5019182	1	0.128	11.5	5.2	3.1	1.3	1.2	3.9
					203	1							
					208	1							
					0.5019198								
26	511	23	— 0.10	45	0.5019126	1	0.058	12.2	2.1	4.0	0.7	0.5	4.4
					161	1							
					149	1							
					0.5019145								
27	512	23	— 0.01	45	0.5019576	1	0.161	13.0	5.1	2.1	1.3	1.2	3.1
					557	1							
					567	1							
					0.5019567								
28	513	28	— 0.05	53	0.5019706	1	0.080	13.3	2.4	2.4	1.3	0.6	3.2
					715	1							
					694	1							
					0.5019705								
29	514	28	+ 0.07	54	0.5019823	1	0.138	10.3	8.6	2.7	1.4	1.7	3.8
					800	1							
					817	1							
					0.5019813								
30	515	28	+ 0.09	52	0.5019913	1	0.215	10.2	11.2	1.0	1.4	2.6	3.5
					904	1							
					909	1							
					0.5019909								
31	516	28	— 0.11	53	0.5019757	1	0.186	10.7	8.8	0.9	1.4	2.0	3.0
					763	1							
					755	1							
					0.5019758								
32	517	28	+ 0.10	43	0.5019924	1	1.153	14.3	30.5	0.3	1.4	7.0	7.3
					924	1							
					926	1							
					0.5019925								
33	518	28	+ 0.18	60	0.5019952	1	0.847	14.3	22.4	2.0	1.4	5.2	5.9
					961	1							
					943	1							
					0.5019952								
34	519	28	+ 0.13	56	0.5020289	1	0.586	12.8	19.4	1.5	1.4	4.5	5.2
					285	1							
					298	1							
					0.5020291								
35	520	28	+ 0.11	48	0.5020620	1	0.421	14.0	11.7	2.5	1.4	2.7	4.2
					613	1							
					598	1							
					0.5020610								

No. Voy. K 18	No. stat.	Depth Subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
36	521	28	+ 0.15	62	0.5020712 718 708 0.5020713	1 1 1	0.345	13.6	10.0	1.1	1.4	2.3	3.3
37	522	28	— 0.01	63	0.5020771 768 765 0.5020768	1 1 1	0.400	13.0	12.7	0.7	1.4	2.9	3.6
38	523	28	+ 0.02	47	0.5020932 936 936 0.5020935	1 1 1	0.189	11.3	8.0	0.5	1.4	1.8	2.8
39A	524	2	+ 0.15	75	0.5020427 428 393 0.5020416	1 1 1	0.105	7.6	9.9	4.5	0	2.3	2.4
39B	524	2	— 0.01	61	0.5020457 444 443 0.5020448	1 1 1	0.068	7.5	6.5	1.8	0	1.5	
40	525	28	+ 0.14	51	0.5021109 116 105 0.5021110	1 1 1	0.178	12.5	6.2	1.3	1.4	1.4	2.8
41	526	28	— 0.08	65	0.5021156 139 146 0.5021147	1 1 1	0.125	11.8	4.9	1.9	1.4	1.1	3.0
42	527	28	+ 0.11	62	0.5021262 276 267 0.5021268	1 1 1	0.093	11.3	3.9	1.6	1.4	0.9	2.8
43	528	28	— 0.06	58	0.5021368 387 372 0.5021376	1 1 1	0.077	11.8	3.0	2.3	1.5	0.7	3.2
44	529	28	+ 0.02	43	0.5021478 486 0.5021482	1 1	0.068	10.7	3.2	1.6	1.5	0.7	2.8
45	530	28	0	53	0.5021570 567 0.5021568	1 1	0.238	13.3	7.2	1.5	1.5	1.7	3.1
46	531	28	— 0.06	53	0.5021710 703 719 0.5021711	1 1 1	0.277	13.0	8.8	1.8	0.7	2.0	3.2

No. Voy. K 18	No. stat.	Depth Subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron 1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
47	532	28	— 0.05	51	0.5021857 840 836 0.5021844	1 1 1	0.230	13.0	7.3	2.5	0.7	1.7	3.5
48	533	28	— 0.01	65	0.5021943 965 947 0.5021952	1 1 1	0.196	13.0	6.2	2.6	1.5	1.4	3.7
49	534	28	0	56	0.5021962 991 0.5021972	2 1	0.138	10.0	7.5	5.3	1.5	1.7	6.0
50	535	28	— 0.01	52	0.5021934 939 922 0.5021932	1 1 1	0.065	9.8	3.6	2.0	1.5	0.8	3.0
51A	536	28	+ 0.10	53	0.5021996 007 984 0.5021996	1 1 1	0.102	10.3	5.1	2.6	3.0	1.2	3.2 (51A and 51B bracketed)
51B	536	28	+ 0.10	54	0.5021990 001 978 0.5021990	1 1 1	0.102	8.7	7.3	2.6	3.0	1.7	
52	537	28	0	50	0.5022023 018 033 0.5022025	1 1 1	0.090	9.7	5.2	1.7	1.5	1.2	3.0
53	538	28	+ 0.08	63	0.5021959 969 972 0.5021967	1 1 1	0.072	9.1	4.7	1.5	1.5	1.1	2.8
54	539	28	— 0.03	63	0.5021886 . . . 897 0.5021892	1 1	0.122	10.9	5.5	1.7	1.5	1.3	3.0
55	540	28	+ 0.06	49	0.5021792 781 761 0.5021778	1 1 1	0.161	10.9	7.3	3.5	1.5	1.7	4.4
56	541	28	— 0.01	52	0.5021698 728 714 0.5021713	1 1 1	0.140	12.2	5.0	3.3	1.5	1.2	4.1
57	542	28	+ 0.08	65	0.5021689 662 665 0.5021672	1 1 1	0.098	10.0	5.3	3.3	1.5	1.2	4.1

No. Voy. K 18	No. stat.	Depth Subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
58	543	28	— 0.02	56	0.5021556 . . . 571 0.5021563	1 1	0.098	12.0	3.7	2.9	1.5	0.8	3.7
59	544	28	— 0.03	53	0.5021525 551 560 0.5021545	1 1 1	0.169	12.5	5.8	4.0	1.5	1.3	4.7
60	545	28	+ 0.02	71	0.5021450 465 455 0.5021457	1 1 1	0.287	13.0	9.1	1.7	1.5	2.1	3.4
61	546	28	— 0.02	47	0.5021356 348 333 0.5021346	1 1 1	0.764	13.6	22.2	2.6	1.5	5.1	6.1
62A	547	2	+ 0.01	56	0.5021123 135 125 0.5021128	1 1 1	0		0	1.4	0	0	1.7
62B	547	2	+ 0.13	72	0.5021105 086 089 0.5021093	1 1 1	0		0	2.3	0	0	
63	548	18	+ 0.11	72	0.5021473 468 485 0.5021475	1 1 1	0.082	11.1	5.7	1.9	1.5	0.9	3.0
64	549	18	+ 0.07	55	0.5021677 689 692 0.5021686	1 1 1	0.200	10.9	8.1	1.8	2.2	1.9	3.7
65	550	18	— 0.02	49	0.5021754 751 751 0.5021752	1 1 1	0.168	11.5	6.8	0.4	2.2	1.6	3.2
66	551	18	+ 0.07	48	0.5021742 754 737 0.5021744	1 1 1	0.090	12.5	3.9	1.9	2.2	0.9	3.4
67	552	18	+ 0.05	66	0.5021758 752 770 0.5021760	1 1 1	0.090	11.1	4.1	2.0	1.5	0.9	3.1
68	553	18	— 0.07	65	0.5021959 975 951 0.5021962	1 1 1	0.128	11.5	5.2	2.7	1.5	1.2	3.6

No. Voy. K 18	No. stat.	Depth Subm.	Change Temp.	d	T(chron. 212) T(chron 2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
69	554	18	+ 0.01	65	0.5021962 973 963 0.5021966	1 1 1	0.307	12.5	10.6	1.3	1.5	2.4	3.5
70	555	18	+ 0.02	55	0.5022002 004 009 0.5022005	1 1 1	0.144	11.1	6.3	0.8	1.5	1.5	2.7
71	556	28	— 0.09	67	0.5022072 060 073 0.5022068	1 1 1	0.058	11.5	2.4	1.6	1.5	0.5	2.7
72	557	28	— 0.01	63	0.5022123 100 121 0.5022115	1 1 1	0.189	11.8	7.4	2.9	1.5	1.7	4.0
73	558	28	+ 0.02	73	0.5022161 171 159 0.5022164	1 1 1	0.095	11.8	3.7	1.5	0.7	0.9	2.4
74	559	28	— 0.07	62	0.5022170 183 169 0.5022174	1 1 1	0.137	9.8	7.6	1.8	1.5	1.8	3.3
75	560	28	0	64	0.5022239 246 237 0.5022241	1 1 1	0.117	10.7	5.5	1.1	1.5	1.3	2.7
76	561	28	0	59	0.5022170 178 178 0.5022175	1 1 1	0.102	10.5	5.0	1.0	2.2	1.1	3.1
77	562	28	— 0.08	60	0.5021999 030 018 0.5022016	1 1 1	0.068	10.0	3.7	3.5	1.5	0.9	4.2
78	563	28	— 0.10	61	0.5022589 618 595 0.5022601	1 1 1	0.112	10.2	5.8	3.5	1.5	1.3	4.3
79	564	28	+ 0.01	61	0.5022123 117 138 0.5022126	1 1 1	0.090	10.3	4.5	2.4	1.5	1.0	3.4
80	565	28	— 0.01	63	0.5022153 167 165 0.5022162	1 1 1	0.070	9.4	4.3	1.7	1.5	1.0	2.9

No. Voy. K 18	No. stat.	Depth Subm.	Change Temp.	d	T(chron. 212) T(chron 2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10—7 sec									
81	566	28	— 0.09	61	0.5022211 192 199 0.5022201	1 1 1	0.062	8.7	4.4	2.2	2.2	1.0	3.6
82	567	28	+ 0.05	65	0.5022191 214 206 0.5022204	1 1 1	0.062	9.2	3.9	2.6	2.2	0.9	3.8
83	568	28	+ 0.01	54	0.5022095 113 107 0.5022105	1 1 1	0.072	9.7	4.1	2.1	1.5	1.0	3.2
84	569	28	— 0.09	63	0.5022122 136 126 0.5022128	1 1 1	0.060	9.7	3.5	1.6	1.5	0.8	2.8
85	570	28	— 0.05	64	0.5022058 060 067 0.5022062	1 1 1	0.115	10.9	5.2	1.1	1.5	1.2	2.7
86	571	28	— 0.04	66	0.5022. . . 110 119 0.5022115	 1 1	0.080	10.2	4.2	1.8	1.5	1.0	3.0
87	572	28	— 0.07	61	0.5022028 029 034 0.5022030	1 1 1	0.048	10.7	2.3	0.7	1.5	0.5	2.3
88	573	28	— 0.05	67	0.5022077 069 066 0.5022071	1 1 1	0.042	10.3	2.1	1.3	1.5	0.5	2.6
89	574	28	— 0.05	56	0.5022050 . . . 058 0.5022054	1 1	0.042	10.7	2.0	1.6	0.7	0.5	2.4
90	575	28	— 0.01	47	0.5022024 043 030 0.5022032	1 1 1	0.018	10.7	0.9	2.2	0.7	0.2	2.4
91	576	28	— 0.01	58	0.5022019 032 042 0.5022031	1 1 1	0.048	11.8	1.9	2.6	1.5	0.4	3.4
92	577	28	— 0.01	54	0.5021993 991 993 0.5021992	1 1 1	0.094	12.5	3.2	0.3	1.5	0.7	2.3

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
93	578	28	— 0.07	58	0.5022118	1	0.164	11.8	6.4	2.5	1.5	1.5	3.6
					140	1							
					131	1							
					0.5022130								
94A	579	2	+ 0.13	58	0.5021923	1	0			0	0	0	
					923	1							
					923	1							1.5
					0.5021923								
94B	579	2	+ 0.01	67	0.5021928	1	0			1.9	0	0	
					938	1							
					921	1							
					0.5021929								
95	580	28	— 0.07	66	0.5021908	1	0.050	7.7	4.5	1.5	1.5	1.0	2.8
					...								
					910	1							
					0.5021909								
96	581	28	+ 0.06	57	0.5021850	1	0.085	8.8	5.9	2.7	1.5	1.4	3.7
					870	1							
					872	1							
					0.5021864								
97	582	28	— 0.06	61	0.5021808	1	0.072	9.4	4.4	1.8	1.5	1.0	3.0
					795	1							
					810	1							
					0.5021804								
98	583	28	— 0.08	55	0.5021573	1	0.078	9.8	4.4	1.9	1.5	1.0	3.0
					576	1							
					560	1							
					0.5021570								
99	584	28	+ 0.01	73	0.5021429	1	0.088	9.8	4.9	1.8	2.2	1.1	3.4
					443	1							
					443	1							
					0.5021438								
100	585	28	— 0.08	52	0.5021340	1	0.105	10.2	5.5	1.0	1.5	1.3	2.7
					344	1							
					349	1							
					0.5021344								
101	586	28	— 0.01	62	0.5021401	1	0.048	9.4	3.0	2.7	1.4	0.7	3.5
					384	1							
					378	1							
					0.5021388								
102	587	28	+ 0.06	61	0.5021312	1				2.5	1.4	0	3.3
					296	1							
					291	1							
					0.5021300								
103	588	18	+ 0.03	55	0.5020711	1	0.072	8.7	5.1	1.8	1.4	1.2	3.0
					714	1							
					730	1							
					0.5020718								

No. Voy. K 18	No. stat.	Depth Subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	∂g	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
104	589	28	— 0.09	60	0.5020642 645 642 0.5020643	1 1 1				0.4	1.4	0	2.1
105	590	28	— 0.06	52	0.5020524 512 514 0.5020517	1 1 1				1.5	1.4	0	2.6
106A	591′	2	+ 0.19	60	0.5020294 313 316 0.5020308	1 1 1				2.7	0	0	1.8
106B	591′	2	+ 0.07	50	0.5020280 278 284 0.5020281	1 1 1				0.7	0	0	
106C	591	2	+ 0.03	61	0.5020304 290 284 0.5020293	1 1 1				2.3	0	0	1.8
106D	591	2	+ 0.37	60	0.5020312 316 325 0.5020318	1 1 1				1.5	0	0	
107	592	28	— 0.02	59	0.5020155 143 143 0.5020147	1 1 1	0.045	8.1	3.7	1.6	0.7	0.8	2.5
108	593	28	— 0.02	63	0.5020063 . . . 069 0.5020066	1 1	0.088	9.8	4.9	1.5	1.4	1.1	2.8
109	594	28	+ 0.02	71	0.5020073 074 067 0.5020071	1 1 1	0.088	10.2	4.6	0.9	1.4	1.1	2.5
110	595	28	+ 0.03	68	0.5019814 821 831 0.5019822	1 1 1	0.075	9.7	4.3	1.9	1.4	1.0	3.0
111	596	28	— 0.05	50	0.5019402 414 410 0.5019409	1 1 1	0.035	9.7	2.0	1.4	2.1	0.5	3.0
112	597	28	— 0.07	60	0.5019119 131 130 0.5019127	1 1 1	0.131	10.7	6.2	1.5	2.1	1.4	3.3

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
113	598	28	— 0.01	57	0.5019128 152 144 0.5019141	1 1 1	0.055	10.9	2.5	2.8	2.0	0.6	3.8
114	599	28	— 0.04	47	0.5019068 072 063 0.5019068	1 1 1	0.101	10.0	5.5	1.0	2.0	1.3	3.0
115	600	28	+ 0.01	66	0.5018969 981 971 0.5018974	1 1 1	0.050	10.7	2.4	1.5	2.0	0.5	3.0
116	601	28	— 0.04	54	0.5018521 544 529 0.5018531	1 1 1	0.035	8.8	2.4	2.6	1.3	0.6	3.4
117	602	28	+ 0.07	52	0.5017990 005 979 0.5017991	1 1 1	0.272	11.3	27.6	2.9	2.0	3.4 ?	5.1 ?
118A	603	2	+ 0.18	53	0.5017854 816 828 0.5017833	1 1 1				4.4	0	0	
118B	603	2	+ 0.12	59	0.5017835 848 870 0.5017851	1 1 1				4.0	0	0	2.4
118C	603	2	+ 0.14	65	0.5017831 828 852 0.5017837	1 1 1				3.0	0	0	
119A	604	2	+ 0.08	60	0.5017979 973 986 0.5017979	1 1 1				1.5	0	0	
119B	604	2	+ 0.13	61	0.5017982 977 990 0.5017983	1 1 1				1.5	0	0	1.4
119C	604	2	+ 0.03	67	0.5017974 978 982 0.5017978	1 1 1				0.9	0	0	
119D	604	2	+ 0.14	55	0.5017968 974 964 0.5017969	1 1 1				1.1	0	0	

No. Voy. K 18	No. stat.	Depth Subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	∂g	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
120A	605	2	0	54	0.5017136 134 138 0.5017136	1 1 1				0.4	0	0	1.4
120B	605	2	+ 0.14	43	0.5017124 139 133 0.5017132	1 1 1				1.7	0	0	
121	606	28	— 0.04	54	0.5017271 293 278 0.5017281	1 1 1	0.419	12.0	15.7	2.5	2.4	3.6	5.2
122	607	28	+ 0.11	67	0.5017282 281 286 0.5017283	1 1 1	0.432	11.5	17.5	0.6	2.4	4.0	5.0
123	608	28	+ 0.04	51	0.5017297 309 294 0.5017300	1 1 1	0.233	11.5	9.4	1.8	1.8	2.2	3.7
124	609	28	+ 0.09	62	0.5017285 314 296 0.5017298	1 1 1	0.228	10.7	10.7	3.3	1.2	2.5	4.6
125	610	28	+ 0.10	54	0.5017354 325 342 0.5017340	1 1 1	0.148	10.3	7.5	3.3	1.2	1.7	4.2
126	611	28	— 0.10	38	0.5017392 416 405 0.5017404	1 1 1	0			2.7	1.2	0	3.3
127	612	28	+ 0.06	50	0.5017551 547 567 0.5017555	1 1 1	0.108	11.2	4.6	2.4	0.6	1.1	3.1
128	613	28	— 0.09	52	0.5017640 653 657 0.5017650	1 1 1	0.213	12.3	7.7	2.0	1.8	1.8	3.6
129	614	28	— 0.03	49	0.5017778 766 786 0.5017777	1 1 1	0.178	11.5	7.2	2.3	1.8	1.7	3.7
130	615	28	+ 0.01	36	0.5018336 353 337 0.5018342	1 1 1	0.068	8.7	4.9	2.2	1.8	1.1	3.4

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
131	616	28	+ 0.05	59	0.5018424 430 442 0.5018432	1 1 1	0.102	11.1	4.5	2.1	1.8	1.0	3.3
132	617	28	+ 0.08	53	0.5018453 . . . 450 0.5018452	1 1	0.261	13.2	8.1	1.5	1.8	1.9	3.4
133	618	28	— 0.05	54	0.5018512 519 517 0.5018516	1 1 1	0.258	12.4	9.1	0.8	1.2	2.1	3.0
134	619	28	+ 0.03	65	0.5018557 566 561 0.5018561	1 1 1	0.150	11.6	6.0	1.0	1.2	1.4	2.6
135	620	28	— 0.07	57	0.5018577 579 583 0.5018580	1 1 1	0.192	11.4	8.0	0.7	1.2	1.8	2.7
136	621	28	— 0.04	61	0.5018781 765 775 0.5018774	1 1 1	0.212	10.7	10.0	1.8	1.2	2.3	3.5
137	622	28	+ 0.01	57	0.5018239 244 229 0.5018237	1 1 1	0.207	10.3	10.4	1.7	1.3	2.4	3.6
138	623	28	— 0.02	49	0.5018474 465 0.5018470	1 1	0.286	10.5	14.0	1.8	1.3	3.2	4.2
139	624	28	0	46	0.5018294 298 287 0.5018293	1 1 1	0.368	10.8	17.0	1.3	1.3	3.9	4.6
140	625	28	0	47	0.5018121 111 139 0.5018124	1 1 1	0.373	10.9	16.9	3.2	1.2	3.9	5.4
141	626	28	+ 0.05	55	0.5017978 979 986 0.5017981	1 1 1	0.315	10.7	14.8	1.0	1.2	3.4	4.1
142	627	28	0	70	0.5017880 894 897 0.5017890	1 1 1	0.102	9.8	5.7	2.0	1.2	1.3	3.1

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
143	628	28	— 0.01	52	0.5017811	1	0.072	9.2	4.6	0.4	1.2	1.0	2.2
					813	1							
					810	1							
					0.5017811								
144	629	28	+ 0.13	54	0.5017761	1	0.101	9.0	6.8	1.2	1.2	1.6	2.8
					762	1							
					771	1							
					0.5017765								
145	630	28	+ 0.08	46	0.5017441	1	0.646	11.5	26.2	0.9	1.2	6.0	6.4
					449	1							
					443	1							
					0.5017444								
146	631	28	+ 0.17	57	0.5017212	1	0.139	11.3	5.8	1.5	0.6	1.3	2.8
					212	1							
					0.5017212								
147	632	28	— 0.02	60	0.5017526	1	0.258	11.2	11.1	1.6	1.2	2.5	3.5
					518	1							
					0.5017522								
148	633	28	+ 0.05	50	0.5017740	1	0.162	11.0	7.2	1.4	1.2	1.7	3.0
					751	1							
					740	1							
					0.5017744								
149	634	28	+ 0.06	60	0.5018034	1	0.094	11.2	4.0	1.5	1.2	0.9	2.6
					...								
					030	1							
					0.5018032								
150	635	28	— 0.01	50	0.5018289	1	0.070	10.9	3.2	1.5	1.3	0.7	2.6
					...								
					293	1							
					0.5018291								
151	636	28	— 0.06	69	0.5018524	1	0.068	11.5	2.8	1.5	1.3	0.6	2.6
					...								
					521	1							
					0.5018523								
152	637	28	+ 0.06	55	0.5018802	1	0.058	11.5	2.4	3.9	1.3	0.5	4.4
					...								
					822	1							
					0.5018812								
153	638	28	0	52	0.5018723	1	0.085	10.9	3.9	1.5	1.3	0.9	2.7
					710	1							
					715	1							
					0.5018716								
154	639	28	— 0.06	51	0.5018646	1	0.052	10.9	2.4	2.3	1.3	0.5	3.1
					...								
					634	1							
					0.5018640								

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	$m\delta$	m_g
		m	°	10^{-7} sec									
155	640	28	— 0.03	54	0.5018565 595 585 0.5018582	1 1 1	0.080	9.4	4.9	3.5	1.3	1.1	4.2
156	641	28	0	54	0.5018218 217 206 0.5018214	1 1 1	0.113	9.4	6.9	1.5	1.3	1.6	3.0
157	642	28	+ 0.07	57	0.5018626 627 621 0.5018625	1 1 1	0.213	11.2	9.1	0.7	1.3	2.1	3.0
158	643	28	0	48	0.5018320 328 322 0.5018323	1 1 1	0.157	10.5	7.7	0.9	1.3	1.8	2.8
159	644	28	— 0.07	58	0.5018611 . . . 618 0.5018615	1 1	0.114	10.9	5.2	1.5	1.3	1.2	2.8
160	645	28	+ 0.01	66	0.5018448 . . . 446 0.5018447	1 1	0.050	9.7	2.9	1.5	1.3	0.7	2.6
161	646	28	— 0.09	52	0.5018452 . . . 454 0.5018453	1 1	0.075	11.1	3.3	1.5	1.3	0.8	2.6
162A	647	28	— 0.10	61	0.5018370 369 379 0.5018373	1 1 1	0.075	11.5	3.0	1.2	1.3	0.7	2.5
162B	647	28	+ 0.08	66	0.5018235 . . . 231 0.5018233	1 1	0.105	11.1	4.6	1.5	1.3	1.1	2.7
163	648	28	0	62	0.5018366 363 357 0.5018362	1 1 1	0.085	10.9	3.9	1.0	1.3	0.9	2.4
164	649	28	0	52	0.5018440 441 428 0.5018436	1 1 1	0.060	10.3	3.0	1.8	1.9	0.7	3.2
165	650	28	+ 0.02	63	0.5018506 489 528 0.5018508	1 1 1	0.065	10.7	3.1	4.4	1.9	0.7	5.1

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
166	651	28	— 0.03	49	0.5018554 543 544 0.5018547	1 1 1	0.100	10.2	5.2	1.4	1.9	1.2	3.1
167	652	28	+ 0.01	45	0.5018355 341 347 0.5018348	1 1 1	0.183	11.5	7.4	1.6	1.3	1.7	3.1
168	653	28	+ 0.09	57	0.5018233 246 245 0.5018241	1 1 1	0.216	10.5	10.5	1.6	1.3	2.4	3.5
169	654	28	+ 0.05	52	0.5018240 240 225 0.5018235	1 1 1	0.412	11.9	15.8	2.0	1.3	3.6	4.6
170	655	28	+ 0.10	42	0.5018150 165 149 0.5018155	1 1 1	0.447	12.1	16.4	2.0	1.3	3.8	4.7
171	656	28	— 0.09	45	0.5018169 157 175 0.5018167	1 1 1	0.397	14.0	16.2	2.1	1.3	2.8	4.0
172A₁	657	2	+ 0.15	44	0.5018087 108 088 0.5018094	1 1 1	0			2.7	0	0	
172A₂	657	2	+ 0.07	—	0.5018084 105 085 0.5018091	1 1 1	0			2.7	0	0	1.8
172B₁	657	2	0	44	0.5018116 096 0.5018106	1 1	0			3.9	0	0	
172B₂	657	2	+ 0.06	—	0.5018131 111 0.5018121	1 1	0			3.9	0	0	
174	659	18	+ 0.13	64	0.5017958 942 983 0.5017957	2 2 1	0.122	10.0	7.0	4.1	1.2	1.5	4.8
175	660	18	— 0.02	52	0.5017890 859 910 0.5017882	2 2 1	0.166	10.6	8.3	4.8	1.2	1.8	5.5

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
176	661	18	+ 0.05	46	0.5017969 945 951 0.5017955	1 1 1	0.255	11.4	12.4	2.8	1.2	2.5	4.2
177	662	18	+ 0.11	49	0.5017963 968 961 0.5017964	1 1 1	0.188	10.7	9.4	0.8	1.2	2.0	2.9
178	663	18	+ 0.03	56	0.5017907 909 894 0.5017903	1 1 1	0.234	9.4	14.1	1.8	1.2	3.3	4.2
179	664	28	+ 0.20	55	0.5017870 884 853 0.5017869	1 1 1	0.129	10.0	7.0	3.5	1.2	1.6	4.3
180	665	28	+ 0.03	58	0.5017707 719 715 0.5017714	1 1 1	0.147	9.5	8.8	1.4	1.2	2.0	3.1
181	666	28	0	48	0.5017435 444 457 0.5017445	1 1 1	0.208	10.3	10.7	2.5	1.2	2.5	4.0
182	667	28	0	58	0.5017376 389 391 0.5017385	1 1 1	0.158	9.2	10.0	1.8	1.8	2.3	3.8
183	668	28	+ 0.01	47	0.5017488 . . . 490 0.5017489	1 1	0.156	9.8	8.7	1.5	1.2	2.0	3.0
184	669	28	+ 0.27	62	0.5017929 935 943 0.5017936	1 1 1	0.598	10.7	28.1	1.6	1.2	6.5	7.0
185	670	28	+ 0.11	53	0.5018021 030 039 0.5018030	1 1 1	0.240	12.2	8.6	2.0	1.3	2.0	3.5
186	671	28	— 0.04	62	0.5018184 175 192 0.5018184	1 1 1	0.223	12.0	8.4	1.9	1.9	1.9	3.6
187	672	28	+ 0.13	51	0.5018. . . 269 273 0.5018271	 1 1	0.257	12.4	9.1	1.5	1.9	2.1	3.6

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
188	673	28	— 0.04	59	0.5018151 153 158 0.5018154	1 1 1	0.259	11.8	10.1	0.8	3.2	2.3	4.3
189A	674	2	+ 0.13	60	0.5018860 879 868 0.5018869	1 1 1	0			2.2	0	0	
189B	674	2	+ 0.04	52	0.5018855 853 854 0.5018854	1 1 1	0			0.2	0	0	1.4
189C	674	2	— 0.01	67	0.5018844 846 845 0.5018845	1 1 1	0			0.2	0	0	
190	675	28	+ 0.15	49	0.5018781 784 778 0.5018781	1 1 1	0.206	9.7	11.9	0.7	1.9	2.7	3.7
191	676	28	+ 0.02	59	0.5018. . . 979 973 0.5018976	 1 1	0.278	9.5	16.8	1.5	2.0	3.9	4.9
192	677	28	+ 0.03	59	0.5018959 971 0.5018965	1 1	0.196	10.7	9.2	2.3	2.0	2.1	4.0
193	678	28	— 0.03	48	0.5019071 085 098 0.5019085	1 1 1	0.159	10.3	8.0	3.0	2.0	1.8	4.3
194	679	28	— 0.10	56	0.5019098 105 080 0.5019094	1 1 1	0.271	11.4	11.2	2.9	1.3	2.6	4.4
195	680	28	+ 0.03	52	0.5019. . . 205 201 0.5019203	 1 1	0.222	12.8	7.4	1.5	1.3	1.7	3.0
196	681	28	+ 0.10	59	0.5019. . . 363 359 0.5019361	 1 1	0.058	11.5	2.3	1.5	1.3	0.5	2.6
197	682	28	— 0.08	54	0.5019479 486 0.5019483	1 1	0.139	11.4	5.8	1.4	2.0	1.3	3.2

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
198	683	28	+ 0.05	57	0.5019. . . 647 642 0.5019645	 1 1	0.134	11.0	6.0	1.5	3.4	1.4	4.3
199	684	18	+ 0.03	62	0.5019541 554 535 0.5019543	1 1 1	0.217	9.7	12.5	2.2	2.7	2.9	4.8
200	685	28	+ 0.06	58	0.5019697 720 734 0.5019724	1 1 3	0.141	11.5	5.7	4.0	2.0	1.3	4.9
201	686	28	— 0.09	56	0.5019792 788 767 0.5019782	1 1 1	0.114	11.9	4.4	3.0	2.0	1.0	4.0
202	687	28	+ 0.01	55	0.5019869 853 880 0.5019867	1 1 1	0.102	10.7	4.8	3.1	2.0	1.1	4.1
203A	688	2	+ 0.23	60	0.5019964 968 963 0.5019965	1 1 1	0		0	0.6	0	0	1.9
203B	688	2	+ 0.19	52	0.5019956 970 984 0.5019970	1 1 1	0		0	3.1	0	0	
204	689	27	— 0.14	64	0.5020540 529 541 0.5020537	1 1 1	0.157	9.1	10.2	1.5	1.4	2.4	3.5
205	690	28	0	59	0.5020393 . . . 402 0.5020397	1 1	0.194	10.0	10.5	1.8	1.4	2.4	3.7
206	691	28	+ 0.03	44	0.5020235 259 254 0.5020247	2 1 2	0.346	11.3	14.6	2.8	1.4	3.4	4.9
207	692	28	+ 0.10	56	0.5019999 003 003 0.5020001	2 1 2	0.669	11.2	28.7	0.6	1.4	6.6	6.9
208	693	28	+ 0.07	49	0.5019849 828 865 0.5019851	2 1 2	0.416	11.0	18.6	3.8	1.4	4.3	6.1

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
209	694	28	+ 0.09	54	0.5019630 646 626 0.5019634	1 1 1	0.465	11.2	20.0	2.4	2.0	4.6	5.8
210	695	28	+ 0.03	50	0.5019529 546 541 0.5019539	1 1 1	0.771	11.5	31.3	2.0	2.0	7.2	7.9
211	696	28	— 0.03	54	0.5019293 ... 309 0.5019301	1 1	0.530	11.6	21.1	3.1	1.3	4.9	6.1
212	697	28	0	58	0.5019205 ... 232 0.5019225	1 3	0.396	11.8	15.5	4.6	2.0	3.6	6.3
213	698	28	0	45	0.5019060 ... 081 0.5019076	1 3	0.276	10.4	13.7	3.6	2.0	3.1	5.4
214	699	28	— 0.05	51	0.5018942 ... 940 0.5018941	1 3	0.544	12.9	17.6	1.5	1.3	4.1	4.8
215	700	28	0	65	0.5018904 ... 913 0.5018908	1 1	0.308	11.5	12.5	1.8	1.3	2.9	3.9
216	701	28	— 0.04	58	0.5018913 ... 895 0.5018904	1 1	0.165	11.6	6.6	3.5	1.3	1.5	4.3
217A	702	28	0	47	0.5018872 ... 903 0.5018888	1 1	0.184	11.9	7.0	6.0	1.3	1.6	6.6
217B	702	28	+ 0.26	52	0.5018752 ... 765 0.5018758	1 1	0.157	10.5	7.7	2.5	1.3	1.8	3.7
218	703	28	+ 0.19	49	0.5018628 ... 616 0.5018622	1 1	0.625	12.2	22.5	2.3	1.3	5.2	6.0
219	704	28	+ 0.14	51	0.5018574 ... 579 0.5018576	1 1	0.649	13.0	20.6	1.5	1.9	4.7	5.6

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron 2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
220	705	28	0	37	0.5018571 . . . 590 0.5018581	1 1	0.845	12.8	28.0	3.7	1.9	6.4	7.8
221	706	28	+ 0.22	45	0.5018553 . . . 566 0.5018560	1 1	0.676	12.4	23.8	2.5	1.9	5.5	6.5
222	707	28	+ 0.02	43	0.5018602 609 0.5018606	1 1	0.617	12.9	20.0	1.5	1.3	4.6	5.2
223	708	28	+ 0.07	38	0.5018625 . . . 630 0.5018628	1 1	0.525	12.6	17.8	1.5	1.3	4.1	4.8
224A	709	2	+ 0.01	53	0.5018720 . . . 691 0.5018706	1 1	0		0	5.7	0	0	
224B	709	2	+ 0.07	47	0.5018710 . . . 720 0.5018715	1 1	0		0	2.0	0	0	2.8
224C	709	2	+ 0.05	50	0.5018685 . . . 711 0.5018698	1 1	0		0	5.1	0	0	
225	710	28	+ 0.05	49	0.5018570 575 0.5018572	1 1	0.892	12.5	30.8	1.5	1.9	7.1	7.6
226	711	28	+ 0.09	53	0.5018955 958 0.5018957	1 1	0.461	12.5	15.9	1.5	1.9	3.7	4.7
227	712	18	+ 0.12	57	0.5019627 . . . 641 0.5019634	1 1	0.666	12.9	21.6	2.7	1.4	5.0	6.1
228	713	28	0	42	0.5019969 . . . 996 0.5019982	1 1	0.199	12.5	6.9	5.3	1.4	1.6	5.9
229	714	28	+ 0.02	44	0.5020129 . . . 135 0.5020132	1 1	0.261	12.8	8.6	1.5	1.4	2.0	3.3

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
230	715	28	0	53	0.5020426 . . . 427 0.5020426	1 1	0.207	13.2	6.4	1.5	1.4	1.5	3.0
231	716	28	— 0.05	50	0.5020518 537 0.5020528	1 1	0.226	14.0	6.3	3.7	2.1	1.4	4.7
232	717	28	+ 0.03	56	0.5020. . . 856 848 0.5020852	1 1	0.281	14.5	7.3	1.6	1.4	1.7	3.1
233	718	28	+ 0.08	42	0.5020933 . . . 917 0.5020925	1 1	0.431	15.2	10.1	3.1	1.4	2.3	4.4
234	719	28	+ 0.02	62	0.5021179 171 0.5021175	1 1	0.391	14.8	9.6	1.6	1.4	2.2	3.8
235	720	28	— 0.01	54	0.5021360 . . . 342 0.5021351	1 1	0.674	15.0	16.2	3.5	1.4	3.7	5.5
236A	721	28	+ 0.01	48	0.5021378 . . . 373 0.5021376	1 1	0.330	14.5	8.5	1.5	1.5	2.0	3.3
236B	721	28	+ 0.11	54	0.5021238 . . . 233 0.5021236	1 1	0.272	13.6	7.9	1.5	1.5	1.8	3.2
237	722	28	— 0.02	63	0.5021451 . . . 476 0.5021464	1 1	0.341	14.3	9.0	4.9	1.5	2.1	5.8
238	723	28	— 0.05	38	0.5021559 . . . 563 0.5021561	1 1	0.200	14.3	5.3	1.5	1.5	1.2	2.9
239	724	2	— 0.04	60	0.5021923 . . . 941 0.5021932	1 1			0	3.5	0	0	3.8
240A	168	2	— 0.03	56	0.5021996 . . . 021 0.5022008	1 1	0		0	4.9	0	0	2.1

No. voy. K 18	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron 2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
240B	168	2	+ 0.08	55	0.5022010	1	0		0	5.7	0	0	
					... 981	1							
					0.5021996								
240C	168	2	+ 0.11	55	0.5021988	1	0		0	1.4	0	0	2.1
					... 981	1							
					0.5021985								
240D	168	2	— 0.01	56	0.5022013	1	0		0	1.0	0	0	
					... 018	1							
					0.5022016								

Voyage of Hr. Ms. O 16.

No. voy. O 16	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
1	725	18	+ 0.40	39	0.5014312 303 0.5014308	1 1	0.052	7.0	6.4	1.8	1.0	1.3	2.9
2	726	33	+ 0.32	64	0.5014600 623 628 0.5014617	1 1 1	0.567	11.8	22.2	3.4	1.0	5.1	6.4
3	727	43	+ 0.10	67	0.5015017 016 0.5015017	1 1	0.642	13.3	19.5	2.0	1.0	4.5	5.3
4	728	33	+ 0.22	55	0.5015012 029 0.5015021	1 1	0.503	12.5	17.4	3.3	1.0	4.0	5.5
5	729	43	+ 0.19	72	0.5015144 219 193 0.5015169	4 1 2	0.327	11.1	14.3	8.2	1.0	3.3	9.0
6	730	48	+ 0.19	58	0.5015354 349 384 0.5015358	2 2 1	0.411	12.8	13.6	3.6	1.0	3.1	5.1
7	731	48	+ 0.44	81	0.5015275 276 318 0.5015284	2 2 1	0.917	13.0	29.2	4.7	1.1	6.7	8.4
8	732	48	+ 0.12	38	0.5015557 575 570 0.5015567	1 1 1	0.982	14.3	26.0	2.1	0.8	6.0	6.6
9	733	48	+ 0.27	49	0.5015606 617 637 0.5015620	1 1 1	1.133	15.8	24.5	3.5	0.8	5.6	6.8
10	734	48	+ 0.30	53	0.5015524		0.886	13.3	26.9	3.5	0.8	6.2	7.3
11	735	48	+ 0.17	66	0.5015930 952 949 0.5015940	2 1 1	0.518	13.3	15.7	2.8	0.6	3.6	4.9
12	736	48	+ 0.19	48	0.5016226 258 246 0.5016239	2 1 1	0.455	12.5	15.7	3.8	0.6	3.6	5.5

No. voy. O 16	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
13	737	48	+ 0.06	59	0.5016487 492 474 0.5016484	1 1 1	0.297	12.5	10.3	2.1	1.1	2.4	3.7
14	738	48	+ 0.10	78	0.5016447 479 500 0.5016475	1 1 1	0.808	13.6	23.5	6.0	1.4	5.4	8.3
15	739	58	+ 0.39	64	0.5016661 656 0.5016658	1 1	0.531	13.6	15.4	2.0	1.4	3.5	4.5
16	740	38	+ 0.01	70	0.5016918 898 910 0.5016909	1 1 1	0.374	12.2	13.5	2.3	0.6	3.1	4.2
17	741	38	+ 0.35	63	0.5016812 830 854 0.5016828	2 2 1	0.287	12.5	9.9	4.3	0.6	2.3	5.2
18A	47	2	+ 0.01	70	0.5016834 870 832 0.5016838	3 1 3	0		0	3.4	0	0	
18B	47	2	+ 0.16	58	0.5016797 815 813 0.5016808	1 1 1	0		0	2.2	0	0	1.9
18C	47	2	+ 0.12	50	0.5016805 772 803 0.5016799	3 1 3	0		0	3.0	0	0	
19	742	48	+ 0.21	62	0.5016903 881 904 0.5016899	2 1 2	0.930	13.6	27.0	3.6	0.6	6.2	7.4
20	743	48	+ 0.40	62	0.5016809 799 809 0.5016807	2 1 2	1.114	12.8	36.9	1.1	0.6	8.5	8.7
21	744	48	+ 0.20	52	0.5016675 681 669 0.5016674	2 1 2	0.591	12.0	22.2	1.2	0.6	5.1	5.5
22	745	48	+ 0.37	56	0.5016697 725 728 0.5016722	1 3 3	0.586	11.5	23.7	2.8	0.6	5.5	6.4

No. voy. O 16	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	∂g	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
23	746	48	+ 0.15	62	0.5017852 897 842 0.5017852	4 1 4	0.197	13.6	5.7	4.5	0.6	1.3	5.0
24	747	48	+ 0.44	56	0.5017729 749 0.5017739	1 1	0.269	12.5	9.3	3.9	0.6	2.1	4.7
25	748	48	+ 0.01	64	0.5017969 941 013 0.5017973	2 1 1	0.221	11.8	8.6	7.1	0.6	2.0	7.6
26	749	48	+ 0.02	50	0.5017872 859 872 0.5017868	1 1 1	0.310	11.3	13.1	1.7	0.6	3.0	3.8
27	750	48	+ 0.24	66	0.5017969 015 967 0.5017975	3 1 3	1.028	12.0	38.6	4.4	0.6	8.9	10.1
28	751	48	+ 0.29	62	0.5017761 775 789 0.5017775	3 1 3	1.704	13.0	54.2	3.6	0.6	12.5	13.1
29	752	38	+ 0.22	66	0.5017860 883 930 0.5017880	3 3 1	1.185	12.0	44.4	6.2	0.6	10.2	12.0
30	753	38	+ 0.18	73	0.5017898 899 891 0.5017896	1 1 1	0.832	12.5	28.8	1.0	0.6	6.6	6.9
31	754	38	+ 0.12	62	0.5018135 139 139 0.5018138	1 1 1	0.591	10.9	26.8	0.5	0.6	6.2	6.4
32	755	38	+ 0.29	58	0.5018284 350 314 0.5018316	1 1 2	0.397	10.7	18.7	6.4	0.9	4.3	8.0
33	756	38	+ 0.16	44	0.5018383 398 383 0.5018387	1 1 2	0.775	11.5	31.4	1.8	0.9	7.2	7.6
34	757	38	+ 0.49	56	0.5018403 404 0.5018404	1 1	0.185	9.1	12.1	2.0	0.9	2.8	3.9

No. voy. O 16	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
35	758	38	+ 0.50	66	0.5018363 372 371 0.5018369	1 1 1	0.385	9.4	23.7	1.1	0.9	5.5	5.9
36	759	38	+ 0.14	68	0.5018385 421 446 0.5018424	1 2 2	0.219	9.7	12.6	6.2	0.9	2.9	7.1
37	760	38	+ 0.07	30	0.5018335 352 349 0.5018347	1 2 2	0.627	9.7	36.1	1.8	1.3	8.3	8.7
38	761	38	+ 0.32	62	0.5018377 388 375 0.5018378	2 1 2	0.945	9.7	54.4	1.4	0.6	12.5	12.7
39	762	38	+ 0.23	73	0.5018284 293 339 0.5018299	2 2 1	1.394	11.5	56.5	5.7	0.6	13.0	14.3
40	763	38	+ 0.40	60	0.5018304 306 308 0.5018306	1 1 1	1.427	11.8	55.7	0.5	0.6	12.8	12.9
41	764	43	+ 0.13	58	0.5018304 322 360 0.5018329	1 1 1	0.713	12.2	25.7	6.4	0.6	5.9	8.9
42	765	38	+ 0.12	46	0.5018307 335 337 0.5018330	1 2 2	0.536	12.0	20.1	3.2	0.6	4.6	5.9
43A	766	2	+ 0.27	73	0.5017574 614 605 0.5017598	1 1 1	0		0	4.7	0	0	
43B	766	2	+ 0.32	42	0.5017579 624 611 0.5017605	1 1 1	0		0	5.2	0	0	2.7
43C	766	2	— 0.05	59	0.5017580 593 603 0.5017592	1 1 1	0		0	2.6	0	0	
44	767	28	0	68	0.5018351 344 347 0.5018347	1 1 1				0.8	0.6	0	1.8

No, voy. O 16	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	∂g	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
45	768	28	+ 0.06	62	0.5018 . . . 208 194 0.5018201	 1 1	0.147	7.8	13.1	2.7	0.6	3.0	4.4
46	769	28	+ 0.01	25	0.5017943 966 020 0.5017986	1 3 3	0.432	8.6	31.8	8.4	0.6	7.3	11.3
47	770	38	+ 0.16	68	0.5017960 933 960 0.5017956	3 1 3	0.156	9.4	9.6	2.6	0.6	2.2	3.8
48	771	28	+ 0.24	54	0.5017753 817 813 0.5017806	1 3 3				6.0	1.8	0	6.5
49	772	28	+ 0.17	62	0.5017 . . . 752 759 0.5017756	 1 1				2.0	3.0	0	3.9
50	773	28	+ 0.04	60	0.5017 . . . 591 567 0.5017579	 1 1				4.7	3.0	0	5.8
51	774	20	— 0.12	59	0.5017349 309 380 0.5017346	1 1 1				8.0	0	0	8.1
53	776	11	+ 0.51	52	0.5017291 301 288 0.5017293	1 1 1	0.128	7.4	12.8	1.5	0.6	2.9	3.7
54	777	18	+ 0.15	61	0.5017476 569 495 0.5017498	2 1 6	0.144	8.2	11.5	9.1	0.6	2.6	9.6
55	778	18	+ 0.26	52	0.5017467 498 564 0.5017539	1 2 6	0.092	8.6	6.7	10.2	6.0	1.5	12.0
56	779	18	+ 0.09	62	0.5017416 444 518 0.5017490	1 2 6	0.137	9.3	8.6	11.0	6.0	2.0	12.8
57	780	28	+ 0.42	52	0.5017376 396 381 0.5017384	1 1 1	0.381	9.6	22.3	2.3	6.0	5.1	8.4

No. voy. O 16	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
58	781	28	+ 0.44	54	0.5017231 247 249 0.5017242	1 1 1	0.440	10.7	20.7	2.2	3.5	4.8	6.5
59	782	28	+ 0.30	59	0.5017 . . . 141 121 0.5017131	 1 1	0.425	10.5	20.7	3.9	1.2	4.8	6.5
60	783	28	— 0.04	48	0.5017 . . . 142 158 0.5017150	 1 1	0.236	10.0	12.7	3.1	1.2	2.9	4.7
61	784	28	+ 0.16	44	0.5016 . . . 877 911 0.5016894	 1 1	0.278	11.3	11.7	6.6	1.2	2.7	7.4
62	785	38	+ 0.10	50	0.5016 . . . 963 930 0.5016947	 1 1	0.416	11.2	17.9	6.4	2.3	4.1	8.1
63	786	28	+ 0.16	56	0.5016 . . . 839 835 0.5016837	 1 1	0.473	10.9	21.5	2.0	2.3	4.9	6.0
64	787	28	+ 0.75	50	0.5016 . . . 698 715 0.5016706	 1 1	0.472	11.0	21.0	3.3	2.3	4.8	6.5
65	788	28	+ 0.19	72	0.5016 . . . 788 812 0.5016800	 1 1	0.266	10.2	13.7	4.7	2.3	3.1	6.3
66	789	28	+ 0.75	62	0.5016756 749 772 0.5016759	1 1 1	0.263	9.7	15.2	2.7	2.3	3.5	5.2
67	790	38	+ 0.32	45	0.5016 . . . 775 778 0.5016776	 1 1	0.791	11.6	31.5	2.0	2.3	7.2	8.0
68	791	48	+ 0.63	58	0.5016759 776 772 0.5016771	1 2 2	0.485	12.0	18.2	2.1	2.3	4.2	5.4
69	792	38	— 0.05	56	0.5016771 812 745 0.5016764	4 1 4	0.420	12.0	15.8	5.8	1.7	3.6	7.2

No. voy. O 16	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	∂g	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
70	793	38	+ 0.28	30	0.5016834 856 861 0.5016848	2 2 1	0.360	11.8	14.1	3.2	2.3	3.2	5.3
71	794	28	+ 0.28	46	0.5016 . . . 734 758 0.5016746	 1 1	0.430	10.7	20.2	4.7	1.2	4.7	6.9
72	795	38	+ 0.10	55	0.5016 . . . 808 756 0.5016782	 1 1	0.151	10.3	7.6	10.1	0.6	1.8	10.4
73	796	38	+ 0.05	42	0.5016715 732 731 0.5016729	1 3 3	0.154	10.7	7.2	1.6	1.1	1.7	3.0
74	797	38	+ 0.12	66	0.5016728 762 742 0.5016747	1 2 2	0.152	11.3	6.4	3.6	1.1	4.7	6.2
75	798	48	+ 0.07	53	0.5016730 769 768 0.5016763	1 3 3	0.735	13.6	21.4	3.7	0.6	4.9	6.4
76	799	48	+ 0.07	60	0.5016742 772 753 0.5016756	1 1 1	0.768	14.6	19.4	3.4	0.6	4.4	5.8
77A	800	48	+ 0.14	62	0.5016645 653 647 0.5016648	1 1 1	1.188	13.3	36.1	0.9	0.6	8.3	8.5
77B	800	49	+ 0.36	62	0.5016605 605 641 0.5016612	2 2 1	1.389	14.3	36.8	4.0	0.6	8.5	9.5
78	801	38	+ 0.13	74	0.5016789 809 781 0.5016789	3 1 3	2.221	16.2	45.7	2.5	1.2	10.5	10.9
79	802	28	+ 0.13	57	0.5017018 015 046 0.5017022	2 2 1	0.540	13.6	15.7	3.3	0.6	3.6	5.1
80A	803	28	0	66	0.5017024 050 978 0.5017019	2 1 1	1.275	14.3	33.7	7.2	0.6	7.8	10.7

No. voy. O 16	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
80B	803	28	+ 0.09	53	0.5016998 999 004 0.5017000	1 1 1	1.343	14.3	35.5	0.7	0.6	8.2	8.4
81A	437	2	+ 0.17	78	0.5016882 911 886 0.5016888	3 1 3	0		0	2.7	0	0	3.9
81B	437	2	+ 0.05	65	0.5016861 881 915 0.5016887	3 1 3	0		0	6.9	0	0	
82	804	28	+ 0.06	44	0.5017154 149 113 0.5017137	2 1 2	0.118	10.0	6.4	5.3	0.8	1.5	5.8
83	805	28	0	20	0.5017271 287 280 0.5017278	2 1 2	0.112	11.5	4.5	1.7	0.8	1.0	2.6
84	806	28	+ 0.20	55	0.5017211 269 260 0.5017254	2 3 6	0.183	10.0	9.9	5.6	0.6	2.3	6.3
85	807	28	+ 0.16	82	0.5017404 406 366 0.5017397	2 2 1	0.171	10.0	9.2	4.3	0.6	2.1	5.1
86	808	28	+ 0.13	70	0.5017581 554 533 0.5017556	1 1 1	0.305	10.3	15.4	5.4	0.6	3.5	6.7
87A	809	28	+ 0.06	67	0.5017053 073 051 0.5017059	1 1 1	0.200	9.7	11.5	2.7	0.6	2.6	4.1
87B	809	28	+ 0.21	70	0.5016975 963 979 0.5016972	1 1 1	0.226	9.4	13.9	1.9	0.6	3.2	4.1
88	810	28	— 0.10	64	0.5017024 989 077 0.5017032	6 2 3	0.321	9.1	21.0	8.4	0.6	4.8	9.8
89	811	38	+ 0.14	54	0.5016993 032 060 0.5017018	6 2 3	0.332	11.5	13.4	7.3	0.6	3.1	8.1

No. voy. O 16	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	∂g	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
90	812	38	+ 0.15	68	0.5017343 347 363 0.5017349	6 2 3	0.748	13.0	23.7	2.4	0.6	5.5	6.2
91A	813	28	+ 0.08	58	0.5017241 255 237 0.5017242	6 2 3	0.814	11.1	35.7	1.7	0.8	8.2	8.5
91B	813	48	+ 0.26	40	0.5017302 317 277 0.5017298	6 2 3	0.437	12.5	15.1	3.8	0.8	3.5	5.5
92	814	38	+ 0.02	56	0.5017278 243 279 0.5017272	6 2 3	0.557	12.0	20.9	3.8	0.8	4.8	6.4
93A	815	2	+ 0.05	60	0.5016974 941 982 0.5016966	1 1 1	0		0	4.9	0	0	
93B	815	2	+ 0.08	62	0.5016935 969 986 0.5016963	1 1 1	0		0	5.9	0	0	3.4
93C	815	2	+ 0.05	64	0.5016923 979 952 0.5016951	1 1 1	0		0	6.3	0	0	

Voyage of Hr. Ms. O 12.

No. voy. O 12	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
1A	816	2	+ 0.09	81	0.5021219		0		0	2.3	0	0	
1B	816	2	— 0.05	64	0.5021210		0		0	2.3	0	0	} 1.6
1C	816	2	— 0.05	68	0.5021221		0		0	2.3	0	0	
2	817	18	+ 0.13	64	0.5021861 817 0.5021828	1 3				7.4	2.9	0	8.1
3	818	18	+ 0.14	76	0.5021855 826 0.5021833	1 3				4.9	1.5	0	5.3
4	819	18	+ 0.24	68	0.5021975 000 0.5021994	1 3	0.030	6.1	4.3	4.2	1.5	1.0	4.8
5	820	28	+ 0.23	61	0.5021675 707 0.5021699	1 3	0.048	8.8	3.3	5.4	1.5	0.8	5.8
6	821	28	+ 0.20	73	0.5022137 153 0.5022145	1 1	0.052	9.1	3.4	3.1	1.5	0.8	3.8
7	822	28	+ 0.08	73	0.5021808 685 0.5021716	1 3	0.042	9.7	2.4	20.8	1.5	0.6	20.9
8	823	28	+ 0.09	81	0.5021539 396 0.5021432	1 3				24.2	1.5	0	25.1
9	824	28	+ 0.14	88	0.5021438 479 0.5021465	1 2	0.028	9.1	1.8	7.6	1.4	0.4	7.9
10	825	28	+ 0.19	63	0.5020679 665 0.5020672	1 1	0.094	9.4	5.8	2.7	0.7	1.3	3.5
12	826	28	+ 0.32	70	0.5020206 196 0.5020201	1 1	0.048	10.2	2.5	2.5	0.7	0.6	3.1
13	827	28	+ 0.14	70	0.5019923 967 0.5019956	1 3	0.075	9.8	4.2	7.4	0.7	1.0	7.7
14	828	28	+ 0.11	72	0.5019770 741 0.5019755	1 1	0.125	10.7	5.9	5.7	0.7	1.4	6.1

No. voy. O 12	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron. 2081) T(chron. 1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
15	829	28	+ 0.14	57	0.5019507 529 0.5019518	1 1	0.100	12.5	3.5	4.3	0.7	0.8	4.7
16	830	28	+ 0.10	72	0.5019577 584 0.5019581	1 1	0.125	11.5	5.1	2.5	0.7	1.2	3.2
17	831	28	+ 0.42	76	0.5019557 573 0.5019565	1 1	0.190	13.6	5.5	3.1	0.7	1.3	3.8
18	832	28	+ 0.19	72	0.5019412 428 0.5019417	2 1	0.523	9.7	30.1	2.9	1.3	6.9	7.8
19	833	28	+ 0.15	72	0.5018169 176 0.5018172	1 1	0.108	8.8	7.5	2.5	1.3	1.7	3.6
20	834	18	+ 0.19	54	0.5017427 354 0.5017390	1 1	0.090	9.2	5.7	14.2	1.2	1.3	14.4
21A	835	18	+ 0.19	44	0.5016527 481 0.5016515	3 1	0.210	10.4	10.4	7.8	0.6	2.4	8.4
21B	835	38	+ 0.31	60	0.5016517 417 0.5016492	3 1	0.061	10.7	2.9	16.9	0.6	0.7	17.0
22A	836	18	+ 0.06	57	0.5015377 377 0.5015377	1 1	0.389	11.1	17.0	2.5	0.5	3.9	4.9
22B	836	38	+ 0.15	60	0.5015450 462 0.5015458	1 2	0.099	11.1	4.3	2.5	0.5	1.0	3.1

Voyage of Hr. Ms. O 13.

No. voy. O 13	No. stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
1	837	18	+ 0.34	50	0.5013892 911 0.5013901	1 1	0.052	8.5	6.2	3.7	1.0	0.9	4.2
2	838	38	+ 0.45	60	0.5014314 318 0.5014316	1 1				1.5	1.0	0	2.4
3B	839	38	+ 0.45	49	0.5014548 567 0.5014557	1 1	0.062	9.7	3.6	3.7	1.0	0.8	4.2
4A	840	18	+ 0.25	61	0.5015090 009 0.5015050	1 1	0.160	7.7	14.6	15.8	1.0	3.4	16.3
4B	840	38	+ 0.37	72	0.5015071 058 0.5015065	1 1	0.067	11.5	2.7	2.5	1.0	0.6	3.2
5	841	38	+ 0.26	59	0.5015132 148 0.5015140	1 1	0.049	12.8	1.6	3.1	1.0	0.4	3.7
6	842	38	+ 0.37	42	0.5014703 692 0.5014698	1 1	0.028	11.8	1.1	2.1	5.0	0.3	5.7
7	843	18	+ 0.41	52	0.5013882 860 0.5013871	1 1	0.028	10.0	3.9	4.3	0.9	0.4	4.7

Voyage of Hr. Ms. O 19

No. voy. O 19	No stat.	Depth subm.	Change Temp.	d	T(chron. 212) T(chron.2081) T(chron.1287)	w	q	T_w	δg	m_v	m_e	m_δ	m_g
		m	°	10^{-7} sec									
1A	844	18	+ 0.16	76	0.5012929		0.069	10.0	3.8	0	0.4	0.8	1.8
1B	844	38	+ 0.18	79	0.5012930					0	0.4	0	1.6

TABLE II.

No. voy. K 18	No. stat.	Date 1934	Latitude φ	m_φ	Longitude λ	m_λ	Depth meters	g_0 obs.	m_g mgal	γ_0 norm.	Anom. fr. air mgal	Wave-length m.
1	487	Nov. 15	50°42′ N	0.1	0°35′ W	0.1	38	981.138	4.0	981.141	— 3	
2	488	,, 17	48 08 ,,	2	7 18 ,,	2	170	980.955	3.1	980.912	+ 43	101
3	489	,, 17	47 34 ,,	2	8 19 ,,	2	2340	980.861	4.4	980.861	0	121
4	490	,, 18	46 49 ,,	2	9 30 ,,	2	4220	980.801	4.4	980.794	+ 7	141
5	491	,, 18	46 02 ,,	1	10 50 ,,	1	4790	980.668	4.9	980.722	— 54	179
6	492	,, 19	45 21 ,,	2	11 50 ,,	2	4865	980.665	2.9	980.661	+ 4	141
7	493	,, 19	44 40 ,,	3	12 50 ,,	3	3740	980.677	2.6	980.600	+ 77	206
8	494	,, 19	43 45 ,,	2	13 25 ,,	2	4420	980.585	3.2	980.517	+ 68	232
9	495	,, 20	43 09 ,,	1	14 05 ,,	1	5360	980.413	5.7	980.463	— 50	206
10	496	,, 20	42 20 ,,	2	14 44 ,,	2	5295	980.379	4.4	980.389	— 10	232
11	497	,, 20	41 29 ,,	1	15 22 ,,	1	5350	980.304	6.1	980.313	— 9	256
12	498	,, 21	40 40 ,,	1	15 58 ,,	1	3680	980.290	3.6	980.240	+ 50	224
13	499	,, 21	39 48 ,,	2	16 20 ,,	2	3650	980.190	4.3	980.163	+ 27	206
14	500	,, 21	38 56 ,,	3	16 43 ,,	3	5290	980.095	4.3	980.086	+ 9	264
15	501	,, 22	38 02 ,,	3	17 04 ,,	3	5515	979.984	3.3	980.007	— 23	244
16	502	,, 22	37 09 ,,	2	17 25 ,,	2	4850	979.938	3.3	979.930	+ 8	232
17	503	,, 22	36 18 ,,	1	17 25 ,,	1	5040	979.831	3.2	979.857	— 26	264
18	504	,, 23	35 21 ,,	1	17 25 ,,	1	4400	979.786	3.4	979.775	+ 11	264
19	505	,, 23	34 26 ,,	1	17 25 ,,	1	4260	979.693	2.3	979.698	— 5	224
20	506	,, 23	33 16 ,,	1.5	17 26 ,,	1.5	3705	979.614	1.8	979.601	+ 13	185
21	469	,, 24	32 37.74 ,,	0.02	16 54.79 ,,	0.02	Funchal	979.779	2.5	979.548	+ 231	
HL 4	469a[1])	,, 29	32 39.8 ,,		16 54.25 ,,		— 510	979.885	5.2	979.551	+ 334	
HL 5	469b[2])	,, 29	32 43.1 ,,		16 54.8 ,,		— 1530	979.931	5.2	979.555	+ 376	
22	507	Dec. 5	31 49 ,,	2	16 45 ,,	3	4370	979.469	2.8	979.482	— 13	192
23	508	,, 6	30 56 ,,	2	16 42 ,,	3	4430	979.392	3.6	979.411	— 19	179
24	509	,, 6	30 01 ,,	1.5	16 34 ,,	1.5	3775	979.326	2.5	979.339	— 13	162
25	510	,, 6	29 09 ,,	2	16 19 ,,	2	3760	979.227	3.9	979.272	— 45	206
26	511	,, 7	28 06 ,,	1	16 00 ,,	1	2525	979.244	4.4	979.193	+ 51	232
27	512	,, 7	27 20 ,,	1	15 37 ,,	1	3150	979.090	3.1	979.135	— 45	264
28	513	,, 7	26 26 ,,	1.5	14 59 ,,	1.5	1190	979.039	3.2	979.070	— 31	276
29	514	,, 8	24 42 ,,	1.5	16 21 ,,	1.5	75	978.946	3.8	978.949	— 3	165
30	515	,, 8	24 54 ,,	1.5	17 08 ,,	1.5	2580	978.906	3.5	978.961	— 55	162
31	516	,, 8	25 06 ,,	1.5	17 57 ,,	1.5	3105	978.967	3.0	978.976	— 9	179
32	517	,, 9	23 52 ,,	1.5	18 53 ,,	1.5	3135	978.886	7.3	978.893	— 7	319
33	518	,, 9	23 38 ,,	1.5	19 13 ,,	1.5	3380	978.882	5.9	978.877	+ 5	319
34	519	,, 10	21 52 ,,	1	22 03 ,,	1	4650	978.752	5.2	978.764	— 12	255
35	520	,, 11	19 51 ,,	1	23 23 ,,	1	4340	978.645	4.2	978.647	— 2	306
36	521	,, 11	19 23 ,,	1	23 42 ,,	1	4140	978.611	3.3	978.616	— 5	289
37	522	,, 11	18 52 ,,	1	23 58 ,,	1	3925	978.587	3.6	978.588	— 1	264
38	523	,, 12	17 22 ,,	0.5	24 47 ,,	0.5	3280	978.528	2.8	978.508	+ 20	199
39	524	,, 12	16 53.34 ,,	0.02	24 59.88 ,,	0.02	S. Vinc.	978.740	2.4	978.483	+ 257	89
HL 6	524a[3])	,, 15	16 53.04 ,,		24 59.77 ,,		— 5	978.768	5.3	978.484	+ 284	
HL 7	524b[4])	,, 14	16 53.00 ,,		24 57.89 ,,		— 220	978.790	5.3	978.483	+ 307	
HL 8	524c[5])	,, 14	16 49.70 ,,		25 04.75 ,,		— 10	978.747	5.3	978.481	+ 266	
40	525	,, 16	16 28 ,,	1.5	25 46 ,,	1.5	4255	978.449	2.8	978.488	— 39	244
41	526	,, 17	15 39 ,,	2	27 16 ,,	2	4810	978.436	3.0	978.424	+ 12	217
42	527	,, 17	14 57 ,,	1.5	28 16 ,,	1.5	5280	978.389	2.8	978.392	— 3	199
43	528	,, 18	14 08 ,,	1	29 23 ,,	1	5480	978.347	3.2	978.356	— 9	217
44	529	,, 18	13 19 ,,	1	30 45 ,,	2	5740	978.305	2.8	978.322	— 17	179
45	530	,, 19	12 28 ,,	1	32 10 ,,	1	5845	978.268	3.1	978.289	— 21	276

[1]) Station 469a = Monte (Palace Hotel), Madeira.
[2]) Station 469b = Pico d'Arriere (cabin), Madeira.
[3]) Station 524a = Mindello (Netherlands Consulate), St. Vincent, Cape Verde Is.
[4]) Station 524b = House of Neth. Consul, Mr. Visgers, St. Vincent.
[5]) Station 524c = Chapel of San Pedro, St. Vincent.

No. voy. K 18	No. stat.	Date 1934/5	Latitude φ	m_φ	Longitude λ	m_λ	Depth meters	g_0 obs.	m_g mgal	γ_0 norm.	Anom. fr. air mgal	Wave-length m.
46	531	Dec. 20	11°26′ N	1	33°32′ W	1	5650	978.229	3.2	978.251	— 22	264
47	532	„ 21	10 00 „	1.5	33 50 „	1	5520	978.180	3.5	978.204	— 24	264
48	533	„ 21	8 39 „	1.5	34 08 „	1	4710	978.139	3.7	978.166	— 27	264
49	534	„ 22	6 57 „	5	34 24 „	2	2825	978.146	6.0	978.124	+ 22	156
50	535	„ 22	7 24 „	3	32 58 „	1.5	2600	978.182	3.0	978.134	+ 48	150
51	536	„ 23	8 14 „	2	31 40 „	2	4795	978.153	3.2	978.155	— 2	141
52	537	„ 23	8 56 „	2	30 37 „	2	5270	978.141	3.0	978.173	— 32	147
53	538	„ 24	9 40 „	1.5	29 08 „	1	5410	978.166	2.8	978.194	— 28	129
54	539	„ 24	10 25 „	1.5	27 38 „	1.5	5700	978.195	3.0	978.217	— 22	166
55	540	„ 25	11 21 „	1.5	25 42 „	1.5	5355	978.238	4.4	978.248	— 10	166
56	541	„ 25	11 53 „	1	24 31 „	1	5155	978.266	4.1	978.267	— 1	232
57	542	„ 26	12 42 „	1	22 48 „	1	4880	978.282	4.1	978.301	— 19	156
58	543	„ 26	13 22 „	2	21 43 „	1	4640	978.325	3.7	978.324	+ 1	225
59	544	„ 27	13 56 „	1	20 28 „	1	4360	978.330	4.7	978.348	— 18	244
60	545	„ 27	14 24 „	1	19 04 „	1	3545	978.363	3.4	978.368	— 5	264
61	546	„ 28	14 35 „	1	18 08 „	1	2380	978.394	6.1	978.375	+ 19	289
62	547	„ 28	14 40.44 „	0.01	17 25.67 „	0.01	Dakar	978.484	1.7	978.379	+ 105	
HL 9	547a[1]	Jan. 4	14 44.65 „		17 08.58 „		— 21	978.443	5.0	978.383	+ 60	
63	548	„ 6	12 24 „	1	17 25 „	1	60	978.332	3.0	978.286	+ 46	185
64	549	„ 6	11 33 „	1.5	17 30 „	1.5	300?	978.241	3.7	978.256	— 15	186
65	550	„ 7	10 35 „	1.5	17 04 „	1.5	170	978.241	3.2	978.223	+ 18	207
66	551	„ 7	9 57 „	1.5	16 29 „	1.5	350	978.247	3.4	978.203	+ 44	244
67	552	„ 7	9 07 „	1	15 26 „	2	450	978.214	3.1	978.178	+ 36	192
68	553	„ 8	7 57 „	1	15 49 „	2	4390	978.134	3.6	978.148	— 14	207
69	554	„ 8	7 15 „	1	16 03 „	1	4680	978.127	3.5	978.131	— 4	244
70	555	„ 8	6 41 „	1	16 15 „	2	4890	978.115	2.7	978.119	— 4	192
71	556	„ 9	5 44 „	1	16 35 „	2	4990	978.091	2.7	978.100	— 9	207
72	557	„ 9	4 49 „	1	16 55 „	2	4980	978.069	4.0	978.085	— 16	217
73	558	„ 9	3 58 „	1	16 55 „	1.5	5020	978.067	2.4	978.074	— 7	217
74	559	„ 10	3 09 „	1	17 04 „	1.5	4905	978.052	3.3	978.065	— 13	150
75	560	„ 10	2 12 „	1	17 18 „	1.5	5130	978.025	2.7	978.057	— 32	179
76	561	„ 10	1 14 „	1	17 40 „		5070	978.043	3.1	978.051	— 8	172
77	562	„ 11	0 17 „	1	18 05 „	2	3570	978.107	4.2	978.049	+ 58	156
78	563	„ 11	0 13 S	1	18 17 „	2	7300	977.877	4.3	978.049	— 172	162
79	564	„ 11	0 41 „	1	18 29 „	2	4260	978.064	3.4	978.050	+ 14	165
80	565	„ 11	1 16 „	1	19 00 „	2	4170	978.044	2.9	978.052	— 8	138
81	566	„ 12	2 08 „	2	19 34 „	3	5030	978.029	3.6	978.056	— 27	118
82	567	„ 12	2 59 „	2	20 07 „	2	5210	978.029	3.8	978.063	— 34	132
83	568	„ 12	3 36 „	2	20 51 „	2	5240	978.053	3.2	978.069	— 16	147
84	569	„ 13	3 54 „	2	21 52 „	2	5230	978.045	2.8	978.073	— 28	147
85	570	„ 13	4 12 „	2	22 53 „	2	5020	978.069	2.7	978.077	— 8	186
86	571	„ 13	4 28 „	1.5	23 49 „	1.5	5500	978.051	3.0	978.080	— 29	162
87	572	„ 14	5 00 „	1	25 30 „	1	4570	978.085	2.3	978.088	— 3	179
88	573	„ 14	5 27 „	1	26 50 „	1	5600	978.072	2.6	978.096	— 24	165
89	574	„ 15	5 56 „	1	28 22 „	1	5380	978.080	2.4	978.104	— 24	179
90	575	„ 15	6 22 „	1	29 41 „	1	5280	978.090	2.4	978.112	— 22	179
91	576	„ 16	6 50 „	1	31 11 „	1	5125	978.087	3.4	978.122	— 35	217
92	577	„ 16	7 19 „	1	32 54 „	1	4775	978.100	2.3	978.133	— 33	244
93	578	„ 17	7 41 „	1	33 59 „	1	3750	978.043	3.6	978.141	— 98	217
94	579	„ 17	8 04.03 „	0.01	34 52.35 „	0.01	Pernamb.	978.166	1.5	978.151	+ 15	

[1]) Station 547a = Sebikhotane (railway-station), near Dakar.

No. voy. K 18	No. stat.	Date 1935	Latitude φ	m_φ	Longitude λ	m_λ	Depth meters	g_0 obs.	m_g mgal	γ_0 norm.	Anom. fr. air mgal	Wave-length m.
HL 12	579a[1]	Jan. 21	8°11′.3 S		35°00′.0 W		— 30	978.186	5.0	978.154	+ 32	
HL 13	579b[2]	,, 22	8 09.8 ,,		35 16.3 ,,		— 146	978.168	5.0	978.153	+ 15	
95	580	,, 25	10 03 ,,	1.5	35 49 ,,	1.5	445	978.180	2.8	978.206	— 26	92
96	581	,, 25	10 40 ,,	1	35 18 ,,	2	3705	978.197	3.7	978.226	— 29	121
97	582	,, 25	11 26 ,,	1	34 42 ,,	1	4385	978.222	3.0	978.251	— 29	138
98	583	,, 26	12 58 ,,	1	35 22 ,,	2	4340	978.285	3.0	978.308	— 23	150
99	584	,, 26	14 33 ,,	1.5	35 55 ,,	1	4530	978.322	3.4	978.374	— 52	150
100	585	,, 27	15 02 ,,	1.5	37 03 ,,	1.5	4200	978.355	2.7	978.395	— 40	162
101	586	,, 27	15 26 ,,	1.5	37 59 ,,	2	3305	978.340	3.5	978.414	— 74	138
102	587	,, 27	15 44 ,,	1	38 41 ,,	1	800	978.429	3.3	978.428	+ 1	
103	588	,, 28	19 13 ,,	1	38 49 ,,	1		978.619	3.0	978.607	+ 12	118
104	589	,, 29	20 42 ,,	1.5	39 24 ,,	1.5	2130	978.646	2.1	978.693	— 47	
105	590	,, 29	21 12 ,,	2	39 50 ,,	2	1600	978.688	2.6	978.723	— 35	
106′	591′	,, 31	22 53.19 ,,	0.02	43 11.10 ,,	0.02	Rio d. J′.	978.802	1.8	978.828	— 26	
106	591	Feb. 12	22 53.72 ,,	0.01	43 10.80 ,,	0.01	Rio d. J′.	978.798	1.8	978.829	— 31	
HL 15	591a[3]	,, 6	22 33 ,,		43 09 ,,		— 825	978.837	4.7	978.807	+ 30	
HL 16	591b[4]	,, 7	22 06.8 ,,		43 12.6 ,,		— 268	978.750	4.7	978.779	— 29	
HL 17	591c[5]	,, 8	21 13.4 ,,		43 46.1 ,,		—1120	978.756	4.7	978.724	+ 32	
HL 18	591d[6]	,, 9	22 53.70 ,,		43 13.40 ,,		— 28	978.797	4.7	978.829	— 32	
107	592	,, 12	23 28 ,,	1	43 04 ,,	1	115	978.853	2.5	978.866	— 13	102
108	593	,, 13	24 3 ,,	1	42 54 ,,	2	710	978.884	2.8	978.905	— 21	150
109	594	,, 13	24 40 ,,	1	42 46 ,,	2	2050	978.881	2.5	978.947	— 66	162
110	595	,, 13	25 34 ,,	1	42 34 ,,	1.5	2190	978.978	3.0	979.009	— 31	147
111	596	,, 14	27 47 ,,	1	44 32 ,,	1	3180	979.123	3.0	979.169	— 46	147
112	597	,, 14	28 51 ,,	1.5	45 28 ,,	1.5	3245	979.220	3.3	979.249	— 29	179
113	598	,, 15	28 53 ,,	1.5	46 19 ,,	1.5	2535	979.218	3.8	979.251	— 33	186
114	599	,, 15	28 55 ,,	1.5	47 09 ,,	1.5	1255	979.245	3.0	979.254	— 9	156
115	600	,, 15	28 59 ,,	1	48 05 ,,	1	105	979.284	3.0	979.259	+ 25	179
116	601	,, 16	31 22 ,,	1.5	49 41 ,,	1.5	475	979.470	3.4	979.446	+ 24	121
117	602	,, 17	34 07 ,,	1.5	52 39 ,,	1.5	60	979.647	5.1?	979.671	— 24	189
118	603	,, 18	34 54.19 ,,	0.01	56 13.13 ,,	0.01	Montevid.	979.760	2.4	979.737	+ 23	
119	604	,, 24	34 35.26 ,,	0.01	58 21.84 ,,	0.01	B. Ayres	979.706	1.4	979.711	— 5	
HL 20	604a[7]	,, 25	34 54.53 ,,		57 55.90 ,,		— 11	979.780	7.7	979.737	+ 43	
HL 21	604b[8]	,, 28	34 34.19 ,,		58 26.25 ,,		— 12	979.704	7.7	979.709	— 5	
120	605	March 7	38 02.19 ,,	00.2	57 32.12 ,,	0.02	Mar d. P.	980.036	1.4	980.007	+ 29	
HL 23	605a[9]	,, 5	37 39.8 ,,		57 39.5 ,,		— 29	979.990	5.0	979.975	+ 15	
HL 24	605b[10]	,, 6	38 16.9 ,,		57 50.4 ,,		— 2	980.037	5.0	980.029	+ 8	
121	606	,, 8	37 40 ,,	1	54 51 ,,	2	670	979.981	5.2	979.975	+ 6	225
122	607	,, 8	37 40 ,,	1	53 55 ,,	2	1495	979.976	5.0	979.975	+ 1	206
123	608	,, 8	37 44 ,,	1	52 51 ,,	1	3785	979.980	3.7	979.981	— 1	206
124	609	,, 9	37 53 ,,	1	51 44 ,,	1	4410	979.979	4.6	979.994	— 15	179
125	610	,, 9	37 36 ,,	1	50 23 ,,	1	4940	979.966	4.2	979.969	— 3	165
126	611	,, 10	37 28 ,,	1	48 39 ,,	1	5095	979.949	3.3	979.957	— 8	
127	612	,, 10	36 51 ,,	1	47 09 ,,	1	5085	979.882	3.1	979.904	— 22	196
128	613	,, 11	36 10 ,,	1.5	45 36 ,,	1.5	4960	979.848	3.6	979.845	+ 3	236
129	614	,, 11	35 36 ,,	1.5	44 25 ,,	1.5	4865	979.790	3.7	979.797	— 7	206
130	615	,, 13	33 10 ,,	1	39 13 ,,	1	4450	979.576	3.4	979.592	— 16	118
131	616	,, 13	32 50 ,,	2	38 25 ,,	2	4750	979.541	3.3	979.568	— 27	192
132	617	,, 13	32 33 ,,	1	37 47 ,,	1	4525	979.530	3.4	979.542	— 12	272
133	618	,, 14	32 05 ,,	2	36 30 ,,	2	3020	979.507	3.0	979.504	+ 3	240

[1]) Station 579a = Gurjahu (water-reservoir), near Pernambuco.
[2]) Station 579b = Victoria (railway-station), State of Pernambuco.
[3]) Station 591a = Petropolis (Grand Hotel).
[4]) Station 591b = Entrerios (Hotel Central).
[5]) Station 591c = Barbacena (railway-station).
[6]) Station 591d = Observatorio Astronomico, Rio de Janeiro.
[7]) Station 604a = Observatorio Astronomico, Nacional, La Plata, Argentina.
[8]) Station 604b = Instituto Geográfico Militar (Sotana Gravimetrico), Buenos Ayres.
[9]) Station 605a = Vivoratá (goods-shed, railway-station).
[10]) Station 605b = Miramar (Playa Hotel).

No. voy. K 18	No. stat.	Date 1935	Latitude φ	m_φ	Longitude λ	m_λ	Depth meters	g_0 obs.	m_g mgal	γ_0 norm.	Anom. fr. air mgal	Wave-length m.
134	619	March 14	31°34′ S	1.5	35°33′ W	1.5	1610	979.484	2.6	979.462	+ 22	210
135	620	,, 14	31 10 ,,	1.5	35 10 ,,	1.5	770	979.483	2.7	979.430	+ 53	203
136	621	,, 15	31 33 ,,	1.5	33 59 ,,	1.5	2840	979.406	3.5	979.460	— 54	179
137	622	,, 15	31 58 ,,	1	32 46 ,,	1	1490	979.614	3.6	979.494	+ 120	165
138	623	,, 15	32 26 ,,	1	31 15 ,,	1	4100	979.520	4.2	979.532	— 12	172
139	624	,, 16	33 04 ,,	1	29 25 ,,	1	3180	979.586	4.6	979.584	+ 2	182
140	625	,, 16	33 42 ,,	1	27 29 ,,	1	4160	979.651	5.4	979.636	+ 15	186
141	626	,, 16	34 21 ,,	1	25 30 ,,	1	3825	979.710	4.1	979.691	+ 19	179
142	627	,, 17	34 47 ,,	1	23 27 ,,	1	3700	979.755	3.1	979.727	+ 28	150
143	628	,, 18	35 08 ,,	2	21 21 ,,	2	3650	979.787	2.2	979.760	+ 27	132
144	629	,, 18	35 29 ,,	1	19 20 ,,	1	3630	979.803	2.8	979.787	+ 16	126
145	630	,, 21	36 38 ,,	1.5	12 10 ,,	1	3890	979.883	6.4	979.888	— 5	206
146	631*)	,, 22	36 59.7 ,,	0.3	12 16.0 ,,	0.3	1415	980.003	2.8	979.917	+ 86	199
147	632	,, 22	36 36 ,,	1	11 43 ,,	1	3820	979.884	3.5	979.882	+ 2	196
148	633	,, 23	35 28 ,,	1.5	10 29 ,,	1.5	3335	979.801	3.0	979.785	+ 16	189
149	634	,, 23	34 26 ,,	1.5	9 24 ,,	1.5	4410	979.691	2.6	979.698	— 7	196
150	635	,, 24	33 16 ,,	1	8 11 ,,	1	3955	979.591	2.6	979.600	— 9	186
151	636	,, 24	32 04 ,,	1.5	7 03 ,,	2	4235	979.501	2.6	979.503	— 2	206
152	637	,, 25	30 49 ,,	1.5	5 53 ,,	3	4735	979.389	4.4	979.402	— 13	206
153	638	,, 25	30 57 ,,	1.5	4 23 ,,	3	4220	979.434	2.7	979.413	+ 21	186
154	639	,, 26	31 14 ,,	1.5	2 31 ,,	3	3345	979.465	3.1	979.435	+ 30	186
155	640	,, 26	31 30 ,,	1	0 57 ,,	2	3255	979.485	4.2	979.457	+ 28	138
156	641	,, 27	31 42 ,,	1	0 35 E	2	1455	979.628	3.0	979.473	+ 155	138
157	642	,, 27	31 48 ,,	1	1 23 ,,	2	4440	979.465	3.0	979.481	— 16	196
158	643	,, 27	31 56 ,,	1	1 58 ,,	2	1455	979.584	2.8	979.491	+ 93	172
159	644	,, 27	32 05 ,,	1	2 52 ,,	1	4905	979.473	2.8	979.503	— 30	186
160	645	,, 28	32 17 ,,	1	4 13 ,,	1	4880	979.541	2.6	979.520	+ 21	147
161	646	,, 28	32 29 ,,	1	5 28 ,,	1	5135	979.536	2.6	979.536	0	192
162	647	,, 29	32 44 ,,	1	7 12 ,,	1	5055	979.570	1.8	979.557	+ 13	199
163	648	,, 29	32 55 ,,	1	8 35 ,,	1	5130	979.570	2.4	979.572	— 2	186
164	649	,, 30	32 25 ,,	1	10 10 ,,	2	4955	979.540	3.2	979.531	+ 9	165
165	650	,, 30	32 09 ,,	1	11 14 ,,	3	4690	979.514	5.1	979.509	+ 5	179
166	651	,, 30	32 01 ,,	2	12 01 ,,	3	4155	979.498	3.1	979.498	0	162
167	652	,, 31	32 37 ,,	2	13 00 ,,	2	3715	979.568	3.1	979.547	+ 21	206
168	653	,, 31	33 21 ,,	1	13 54 ,,	1	4250	979.606	3.5	979.607	— 1	172
169	654	April 1	33 22 ,,	1.5	15 21 ,,	2	3650	979.610	4.6	979.609	+ 1	221
170	655	,, 1	33 17 ,,	1	16 38 ,,	2	1286	979.639	4.7	979.602	+ 37	228
171	656	,, 1	33 17 ,,	1	17 47 ,,	2	100	979.636	4.0	979.602	+ 34	296
172	657	,, 2	33 54.36 ,,	0.01	18 25.50 ,,	0.01	Cape T.	979.656	1.8	979.654	+ 2	
173	658	,, 16-18	33 56.10 ,,	0.00	18 28.68 ,,	0.00	Roy. Obs. — 16	979.664	1.4	979.656	+ 8	
HL 26	658a[1])	,, 8	33 28.35 ,,		18 38.48 ,,		— 262	979.659	2.5	979.618	+ 41	
HL 27	658b[2])	,, 9	33 22.1 ,,		19 18.2 ,,		— 452	979.593	2.5	979.609	— 16	
HL 28	658c[3])	,, 9	33 10.34 ,,		19 47.93 ,,		— 676	979.622	2.5	979.593	+ 29	
HL 29	658d[4])	,, 10	33 20.5 ,,		20 02.4 ,,		— 772	979.615	2.5	979.607	+ 8	
HL 30	658e[5])	,, 12	33 55.9 ,,		18 51.2 ,,		— 118	979.658	2.5	979.656	+ 2	
174	659	,, 29	34 26.7 ,,	0.5	18 29.0 ,,	0.5	80	979.729	4.8	979.699	+ 30	156
175	660	,, 29	34 44.4 ,,	1	19 16.0 ,,	1	90	979.757	5.5	979.724	+ 33	175
176	661	,, 30	34 48 ,,	1.5	21 31 ,,	1.5	80	979.724	4.2	979.729	— 5	200
177	662	,, 30	34 36 ,,	2	22 54 ,,	2	90	979.723	2.9	979.712	+ 11	179
178	663	,, 30	34 25 ,,	1.5	24 19 ,,	1.5	120	979.724	4.2	979.696	+ 28	138

*) Near Tristan da Cunha.
[1]) Station 658a = Malmesbury (trigonometrical station).
[2]) Station 658b = Ceres (Town Hall).
[3]) Station 658c = Juriesfontein (trigonometrical beacon).
[4]) Station 658d = Touws Rivier (Douglas Hotel).
[5]) Station 658e = Stellenbosch (University, annex).

No. voy. K 18	No. stat.	Date 1935	Latitude φ	m_φ	Longitude λ	m_λ	Depth meters	g_0 obs.	m_g mgal	γ_0 norm.	Anom. fr. air mgal	Wave-length m.
179	664	April 30	35°20′ S	2	24°38′ E	2	2317	979.754	4.3	979.774	— 20	156
180	665	May 1	36 01 ,,	1.5	25 21 ,,	1.5	4792	979.809	3.1	979.832	— 23	141
181	666	,, 1	36 36 ,,	1.5	26 02 ,,	1.5	2850	979.913	4.0	979.882	+ 31	165
182	667	,, 1	37 08 ,,	1	26 44 ,,	1.5	3380	979.940	3.8	979.929	+ 11	132
183	668	,, 1	36 39 ,,	1	27 28 ,,	1	4070	979.902	3.0	979.887	+ 15	150
184	669	,, 2	34 43 ,,	1	29 53 ,,	1	4342	979.707	7.0	979.722	— 15	179
185	670	,, 2	33 55 ,,	1	30 54 ,,	1	4000	979.657	3.5	979.654	+ 3	232
186	671	,, 2	33 21 ,,	1	30 23 ,,	1	3705	979.596	3.6	979.607	— 11	225
187	672	,, 2/3	32 49 ,,	2	29 51 ,,	2	3360	979.562	3.6	979.563	— 1	240
188	673	,, 3	32 28 ,,	2	28 57 ,,	2	590	979.593	4.3	979.535	+ 58	217
189	674	,, 4	29 51.97 ,,	0.01	31 02.20 ,,	0.01	Durban	979.363	1.4	979.327	+ 36	
HL 32	674a[1]	,, 8	29 45.50 ,,		30 43.25 ,,		— 746	979.386	6.9	979.319	+ 67	
HL 33	674b[2]	,, 8	29 32.50 ,,		30 17.25 ,,		—1091	979.322	6.9	979.302	+ 20	
190	675	,, 13	30 07 ,,	1	31 58 ,,	3	1080	979.392	3.7	979.347	+ 45	147
191	676	,, 14	29 39 ,,	1	34 06 ,,	1	2650	979.321	4.9	979.311	+ 10	141
192	677	,, 15	29 34 ,,	1	35 36 ,,	2	1930	979.332	4.0	979.304	+ 28	179
193	678	,, 15	29 30 ,,	1	36 50 ,,	1	4040	979.287	4.3	979.299	— 12	165
194	679	,, 15	29 26 ,,	1.5	38 01 ,,	1.5	4990	979.282	4.4	979.294	— 12	203
195	680	,, 16	28 44 ,,	2	39 15 ,,	2	4942	979.240	3.0	979.240	0	256
196	681	,, 16	28 01 ,,	1.5	40 27 ,,	1.5	4605	979.184	2.6	979.186	— 2	206
197	682	,, 17	26 54 ,,	1	42 22 ,,	3	4305	979.127	3.2	979.104	+ 23	203
198	683	,, 17	26 22 ,,	1	43 19 ,,	2	3855	979.064	4.3	979.066	— 2	189
199	684	,,17/18	26 04 ,,	1	44 49 ,,	2	150	979.080	4.8	979.044	+ 36	147
200	685	,, 18	26 01 ,,	1	46 06 ,,	1.5	1465	979.040	4.9	979.041	— 1	206
201	686	,, 18	25 47 ,,	1	47 17 ,,	1	2175	979.018	4.0	979.024	— 6	221
202	687	,,18/19	25 36 ,,	2	48 16 ,,	2	4525	978.985	4.1	979.011	— 26	179
203	688	,, 22	20 09.50 ,,	0.05	57 29.88 ,,	0.05	Maurit.	978.930	1.9	978.661	+ 269	
204	689	,, 31	20 39 ,,	1	57 15 ,,	1	2860	978.697	3.5	978.690	+ 7	129
205	690	June 1	21 31 ,,	2	57 30 ,,	2	4425	978.752	3.7	978.742	+ 10	156
206	691	,, 1	22 28 ,,	2	57 44 ,,	2	4910	978.806	4.9	978.801	+ 5	199
207	692	,, 2	23 46 ,,	2	58 04 ,,	4	4905	978.889	6.9	978.886	+ 3	195
208	693	,, 2	24 45 ,,	3	58 18 ,,	2	5100	978.957	6.1	978.952	+ 5	189
209	694	,, 3	26 01 ,,	2	58 47 ,,	2	5320	979.050	5.8	979.041	+ 9	195
210	695	,, 3	26 58 ,,	1.5	59 18 ,,	3	5960	979.072	7.9	979.109	— 37	206
211	696	,, 4	27 43 ,,	1.5	60 42 ,,	2	4050	979.186	6.1	979.164	+ 22	210
212	697	,, 4	28 16 ,,	2	61 49 ,,	1.5	4570	979.221	6.3	979.205	+ 16	217
213	698	,, 5	29 16 ,,	2	63 41 ,,	2	5020	979.285	5.4	979.281	+ 4	169
214	699	,, 5	29 47 ,,	2	65 24 ,,	2	4885	979.336	4.8	979.321	+ 15	260
215	700	,, 6	29 49 ,,	3	67 27 ,,	2	4570	979.353	3.9	979.323	+ 30	206
216	701	,, 6	29 51 ,,	2	69 18 ,,	2	4270	979.361	4.3	979.326	+ 35	210
217	702	,, 7	29 53 ,,	2	71 26 ,,	2	3600	979.366	3.7	979.329	+ 37	196
218	703	,, 13	30 39 ,,	1	91 11 ,,	1	1605	979.454	6.0	979.389	+ 65	232
219	704	,, 18	31 49 ,,	1.5	106 42 ,,	2	5120	979.474	5.6	979.482	— 8	264
220	705	,, 18	31 55 ,,	1	108 34 ,,	2	5355	979.464	7.8	979.490	— 26	256
221	706	,, 19	31 55 ,,	1	110 19 ,,	2	5130	979.477	6.5	979.490	— 13	240
222	707	,, 19	31 52 ,,	1.5	112 18 ,,	1	5095	979.461	5.2	979.486	— 25	260
223	708	,, 20	31 52 ,,	1.5	113 59 ,,	1	4560	979.455	4.8	979.486	— 31	248
224	709	,, 20	32 02.80 ,,	0.01	115 44.60 ,,	0.01	Fremant.	979.420	2.8	979.501	— 81	
HL 35	709a[3]	,, 24	31 58.57 ,,		115 48.85 ,,		— 11	979.393	4.1	979.495	— 102	
HL 36	709b[4]	,, 26	31 52.52 ,,		116 19.12 ,,		— 278	979.498	4.1	979.487	+ 11	

[1]) Station 674a = Alverstone (old railway-station).
[2]) Station 674b = Hilton Road (roadside station past Pietermaritzburg).
[3]) Station 709a = Perth (University of W. Australia, Physics Laboratory, Electr. Lab.).
[4]) Station 709b = The Lakes (hostel), on road to York.

No. voy. K 18	No. stat.	Date 1935	Latitude φ	m_φ	Longitude λ	m_λ	Depth meters	g_0 obs.	m_g mgal	γ_0 norm.	Anom. fr. air mgal	Wave-length m.
HL 37	709c[1])	June 26	31°53′42 S		116°46′10 E		— 177	979.482	4.1	979.488	— 6	
HL 38	709d[2])	„ 26	32 00.60 „		117 23.87 „		— 250	979.501	4.1	979.498	+ 3	
HL 39	709e[3])	„ 27	31 52.75 „		118 08.68 „		— 282	979.478	4.1	979.485	— 7	
HL 40	709f[4])	„ 27	31 28.85 „		118 16.52 „		— 320	979.453	4.1	979.455	— 2	
HL 41	709g[5])	„ 27	31 39.25 „		116 40.08 „		— 151	979.485	4.1	979.469	+ 16	
225	710	July 2	31 57 „	1	115 05 „	1.5	1120	979.410	7.6	979.493	— 83	244
226	711	„ 3	30 00 „	1.5	113 48 „	1.5	2900	979.289	4.7	979.338	— 49	244
227	712	„ 4	25 19 „	1.5	112 25 „	1.5	100	979.032	6.1	978.991	+ 41	260
228	713	„ 4	23 42 „	2	112 54 „	1.5	160	978.898	5.9	978.882	+ 16	244
229	714	„ 4	22 50 „	2	112 25 „	1.5	1670	978.838	3.3	978.825	+ 13	256
230	715	„ 5	21 50 „	1.5	111 53 „	1.5	4970	978.726	3.0	978.762	— 36	271
231	716	„ 5	20 48 „	2	111 20 „	2	2505	978.684	4.7	978.699	— 15	306
232	717	„ 6	19 21 „	1.5	111 39 „	1.5	2392	978.577	3.1	978.615	— 38	328
233	718	„ 6	18 08 „	1	112 02 „	1.5	4860	978.548	4.4	978.548	0	360
234	719	„ 6	16 51 „	1	112 25 „	2	4610	978.451	3.8	978.482	— 31	342
235	720	„ 7	15 38 „	1.5	112 43 „	1.5	4755	978.376	5.5	978.423	— 47	351
236	721	„ 7	14 33 „	1.5	113 02 „	2	3800	978.392	2.4	978.374	+ 18	308
237	722	„ 7	13 41 „	1.5	113 15 „	1	5280	978.338	5.8	978.337	+ 1	319
238	723	„ 7	12 51 „	1.5	113 27 „	1.5	5580	978.304	2.9	978.304	0	319
239	724	„ 9	8 12.5 „	0.1	114 24.1 „	0.1	Banjoew.	978.164	3.8	978.154	+ 10	
240	168	„ 16	7 12.1 „	0.0	112 44.6 „	0.0	Soerab.	978.136	2.1	978.130	+ 6	

[1]) Station 709c = York (Town Hall).
[2]) Station 709d = Quairading (Town Hall).
[3]) Station 709e = Bruce Rock (Bruce Rock Roadboard Hall).
[4]) Station 709f = Merredin (Court House).
[5]) Station 709g = Northam (Commonwealth Bank of Australia).

No. voy. O 16	No. stat.	Date 1937	Latitude φ	m_φ	Longitude λ	m_λ	Depth meters	g_0 obs.	m_g mgal	γ_0 norm.	Anom. fr. air mgal	Wave-length m.
1	725	Jan. 12	49°37′ N	1	00°29′ W	1	45	981.109	2.9	981.044	+ 65	76
2	726	,, 13	48 29.5 ,,	1	05 27.5 ,,	1	105	980.975	6.4	980.944	+ 31	217
3	727	,, 14	47 42 ,,	1	09 25 ,,	1	4112	980.813	5.3	980.873	— 60	276
4	728	,, 14	47 23 ,,	2	10 58 ,,	2	4505	980.816	5.5	980.844	— 28	244
5	729	,, 15	46 35 ,,	3	12 08 ,,	3	4732	980.767	9.0	980.773	— 6	208
6	730	,, 15	45 39 ,,	3	13 07 ,,	3	4620	980.692	5.1	980.688	+ 4	256
7	731	,, 15	45 31 ,,	3	13 16 ,,	3	4110	980.706	8.4	980.676	+ 30	264
8	732	,, 16	44 50 ,,	3	14 38 ,,	2	4450	980.594	6.6	980.614	— 20	319
9	733	,, 16	44 06 ,,	3	16 10 ,,	2	4635	980.574	6.8	980.548	+ 26	390
10	734	,, 16	43 54 ,,	3	16 29 ,,	2	3620	980.612	7.3	980.530	+ 82	276
11	735	,, 17	42 52 ,,	3	17 37 ,,	2	4570	980.463	4.9	980.437	+ 26	276
12	736	,, 17	41 53 ,,	3	18 33 ,,	2	4875	980.346	5.5	980.349	— 3	244
13	737	,, 17	41 00 ,,	3	19 21 ,,	2	5045	980.257	3.7	980.270	— 13	244
14	738	,, 19	40 21 ,,	3	26 28 ,,	2	2845	980.249	8.3	980.212	+ 37	289
15	739	,, 19	39 36 ,,	3	27 06 ,,	2	1560	980.185	4.5	980.145	+ 40	289
16	740	,, 19	38 47.6 ,,	1	27 36.3 ,,	1	1880	980.091	4.2	980.074	+ 17	233
17	741	,, 19	38 41.6 ,,	1	27 40.1 ,,	1	1305	980.127	5.2	980.065	+ 62	244
18	47	,, 21	38 31.77 ,,	0.02	28 37.47 ,,	0.02	Horta	980.157	1.9	980.050	+ 107	
19	742	,, 25	38 05 ,,	1	29 05 ,,	1	990	980.076	7.4	980.011	+ 65	289
20	743	,, 25	37 55 ,,	1	29 14 ,,	1	380	980.102	8.7	980.003	+ 99	256
21	744	,, 26	38 52 ,,	2	30 29 ,,	2	1145	980.167	5.5	980.081	+ 86	225
22	745	,, 26	38 58 ,,	2	30 37 ,,	2	1480	980.146	6.4	980.089	+ 57	206
23	746	,, 28	34 34 ,,	2.5	36 25 ,,	1.5	2540	979.757	5.0	979.709	+ 48	289
24	747	,, 28	34 24 ,,	2.5	36 25 ,,	1.5	1830	979.779	4.7	979.695	+ 84	244
25	748	,, 28	33 48 ,,	1.5	37 01 ,,	1	3090	979.666	7.6	979.645	+ 21	217
26	749	,, 28/9	33 52 ,,	1.5	38 09 ,,	1.5	2600	979.696	3.8	979.650	+ 46	199
27	750	,, 29	33 54 ,,	1.5	39 30 ,,	1.5	3742	979.633	10.1	979.653	— 20	225
28	751	,, 29	33 50 ,,	1.5	40 59 ,,	1.5	2640	979.696	13.1	979.648	+ 48	264
29	752	,, 30	33 58 ,,	1.5	42 44 ,,	1.5	4560	979.669	12.0	979.659	+ 10	225
30	753	,, 30	33 58 ,,	2	43 57 ,,	2	4175	979.678	6.9	979.659	+ 19	244
31	754	,, 31	33 03 ,,	2	47 19 ,,	2	5100	979.586	6.4	979.583	+ 3	186
32	755	Feb. 1	32 51 ,,	1.5	49 00 ,,	1.5	5420	979.558	8.0	979.566	— 8	179
33	756	,, 1/2	32 09 ,,	1.5	51 56 ,,	1.5	5640	979.486	7.6	979.509	— 23	206
34	757	,, 2	32 02 ,,	2.5	53 55 ,,	2.5	5600	979.499	3.9	979.500	— 1	129
35	758	,, 2	32 01 ,,	2.5	54 07 ,,	2.5	5630	979.501	5.9	979.498	+ 3	138
36	759	,, 2/3	31 56 ,,	2.5	55 30 ,,	2.5	5530	979.491	7.1	979.491	0	147
37	760	,, 3	31 51 ,,	2	57 05 ,,	2	5565	979.493	8.7	979.485	+ 8	147
38	761	,, 3	31 50 ,,	2	57 21 ,,	2	5590	979.462	12.7	979.483	— 21	147
39	762	,, 4	32 02 ,,	3	59 46 ,,	3	5310	979.492	14.3	979.500	— 8	206
40	763	,, 4	32 04 ,,	3	59 58 ,,	3	5098	979.490	12.9	979.502	— 12	217
41	764	,, 4/5	32 02 ,,	2	62 06 ,,	2	4645	979.501	8.9	979.500	+ 1	233
42	765	,, 5	32 05 ,,	1	63 55 ,,	1	4515	979.510	5.9	979.504	+ 6	225
43	766	,, 5/6	32 17.47 ,,	0.01	64 46.82 ,,	0.02	Hamilton	979.852	2.7	979.520	+ 332	
44	767	,, 10	32 46 ,,	1.5	65 27 ,,	1.5	4805	979.535	1.8	979.559	— 24	
45	768	,, 11	33 33 ,,	2	67 31 ,,	2	5240	979.579	4.4	979.624	— 45	93
46	769	,, 11	34 09 ,,	2.5	69 07 ,,	2.5	5345	979.645	11.3	979.674	— 29	115
47	770	,, 11/2	34 39 ,,	4	70 24 ,,	3	5290	979.676	3.8	979.716	— 40	138
48	771	,, 12	35 23 ,,	1	72 41 ,,	1.5	4242	979.745	6.5	979.778	— 33	
49	772	,, 12	35 45 ,,	1	73 42 ,,	2	3385	979.776	3.9	979.809	— 33	
50	773	,, 12/3	36 21 ,,	1	74 27 ,,	1	2060	979.844	5.8	979.861	— 17	

No. voy. O 16	No. stat.	Date 1937	Latitude φ	m_φ	Longitude λ	m_λ	Depth meters	g_0 obs.	m_g mgal	γ_0 norm.	Anom. fr. air mgal	Wave-length m.
51	774	Feb. 13	36°39′ N	1	75°03′ W	1	30	979.936	8.1	979.887	+ 49	
53	776	,, 25	37 20 ,,	1	74 30 ,,	1	60?	979.975	3.7	979.946	+ 29	86
54	777	,, 25	37 15 ,,	1	73 33 ,,	1	2596	979.897	9.6	979.939	— 42	105
55	778	,, 25/6	37 09.7 ,,	1	72 28.3 ,,	1	3285	979.894	12.0	979.931	— 37	115
56	779	,, 25/6	37 07 ,,	3	71 15 ,,	5	3990	979.918	12.8	979.927	— 9	135
57	780	,, 26	37 32 ,,	3	68 51 ,,	7	4315	979.939	8.4	979.963	— 24	144
58	781	,, 26	37 56 ,,	3	66 45 ,,	2	4735	979.992	6.5	979.998	— 6	179
59	782	,, 27	38 28 ,,	2	64 04 ,,	2	4969	980.031	6.5	980.045	— 14	172
60	783	,, 27	38 47 ,,	2	62 45 ,,	1.5	5088	980.031	4.7	980.073	— 42	156
61	784	,, 27/8	39 05 ,,	3	61 11 ,,	2	4435	980.130	7.4	980.099	+ 31	199
62	785	,, 28	39 28 ,,	3	59 53 ,,	2	5183	980.104	8.1	980.133	— 29	196
63	786	,, 28	40 08 ,,	3	56 49 ,,	4	5180	980.157	6.0	980.192	— 35	186
64	787	Mch 28/1	40 09 ,,	3	56 17 ,,	4	5210	980.201	6.5	980.194	+ 7	189
65	788	,, 1	40 10 ,,	3	53 18 ,,	6	5225	980.171	6.3	980.195	— 24	162
66	789	,, 1	40 10 ,,	3	53 00 ,,	6	5224	980.187	5.2	980.195	— 8	147
67	790	,, 2	39 40 ,,	1.5	48 44 ,,	3	5332	980.160	8.0	980.151	+ 9	210
68	791	,, 2	39 42 ,,	1.5	48 29 ,,	2.5	5327	980.155	5.4	980.154	+ 1	225
69	792	,, 2	39 45 ,,	1.5	46 23 ,,	1.5	4235	980.179	7.2	980.158	+ 21	225
70	793	,, 3	39 45 ,,	1.5	45 02 ,,	1.5	4493	980.146	5.3	980.158	— 12	217
71	794	,, 3	39 45 ,,	1	43 25 ,,	1	4724	980.179	6.9	980.158	+ 21	179
72	795	,, 3	39 57 ,,	1	42 11 ,,	1	5000	980.173	10.4	980.176	— 3	165
73	796	,, 4	40 01 ,,	1	40 07 ,,	1	4654	980.195	3.0	980.182	+ 13	179
74	797	,, 4	40 01 ,,	1	37 40 ,,	1	4548	980.194	6.2	980.182	+ 12	199
75	798	,, 5	39 41 ,,	1	33 52 ,,	1	3648	980.166	6.4	980.152	+ 14	289
76	799	,, 5	39 22 ,,	1	32 35 ,,	1	2129	980.171	5.8	980.124	+ 47	332
77A	800	,, 5/6	39 16.0 ,,	0.5	31 17.9 ,,	0.5	1630	980.160	8.5	980.116	+ 44	276
77B	800′	,, 5/6	39 16.8 ,,	0.5	31 20.7 ,,	0.5	1613	980.173	9.5	980.115	+ 58	319
78	801	,, 6	38 39 ,,	1.5	29 34 ,,	1.5	2114	980.132	10.9	980.061	+ 71	410
79	802	,, 6	38 13 ,,	1	27 51 ,,	1	1341	980.076	5.1	980.023	+ 53	289
80A	803	,, 6/7	38 03 ,,	1	26 49 ,,	1	1750	980.057	10.7	980.008	+ 49	319
80B	803′	,, 6/7	38 03 ,,	1	26 46 ,,	1	1506	980.063	8.4	980.008	+ 55	319
81	437	,, 7	37 43.93 ,,	0.01	25 40.60 ,,	0.01	P.Delgada	980.130	3.9	979.981	+ 149	
82	804	,, 8	37 28 ,,	1	24 17 ,,	1	1816	980.038	5.8	979.981	+ 57	156
83	805	,, 9	37 06 ,,	1	22 41 ,,	2	3863	979.982	2.6	979.926	+ 56	206
84	806	,, 9	37 03 ,,	1	20 10 ,,	2	3940	979.993	6.3	979.921	+ 72	156
85	807	,, 9	37 02 ,,	1	18 45 ,,	2.5	5170	979.937	5.1	979.920	+ 17	156
86	808	,, 10	37 00 ,,	1	15 47 ,,	2	4710	979.868	6.7	979.917	— 49	165
87A	809	,, 10	36 54 ,,	1	14 21 ,,	2	666	980.065	4.1	979.908	+ 157	147
87B	809′	,, 10	36 55 ,,	1	14 21 ,,	1	753	980.078	4.1	979.910	+ 168	138
88	810	,, 10	37 22 ,,	1	14 10 ,,	1	1900	980.053	9.8	979.949	+ 104	129
89	811	,, 11	38 04 ,,	1	13 56 ,,	1	4050	980.076	8.1	980.010	+ 66	206
90	812	,, 11	37 46 ,,	1	11 22 ,,	1	5053	979.938	6.2	979.984	— 46	264
91	813	,, 11	38 05 ,,	1	10 34 ,,	1	4842	979.965	4.6	980.011	— 46	244
92	814	,, 12	38 22 ,,	1	09 56 ,,	1	4056	979.968	6.4	980.036	— 68	225
93	815	,, 14	38 42 ,,	0.02	09 10.17 ,,	0.02	Lisboa	980.101	3.4	980.066	+ 35	

No. voy. O 12	No. stat.	Date 1937	Latitude φ	m_φ	Longitude λ	m_λ	Depth meters	g_0 obs.	m_g mgal	γ_0 norm.	Anom. fr. air mgal	Wave-length m.
1	816	Nov. 21/2	12°06'.97N	0.02	68°55'.58W	0.02	Curaçao II	978.439	1.6	978.276	+ 163	
2	817	,, 22	12 40 ,,	1	69 17 ,,	1	1820	978.220	8.1	978.297	— 77	
3	818	,, 22	13 32 ,,	2	69 26 ,,	2	4445	978.217	5.3	978.331	— 114	
4	819	,, 23	12 38 ,,	1	68 41 ,,	1	3000	978.157	4.8	978.295	— 138	58
5	820	,, 26	11 34 ,,	1	67 50 ,,	1	1825	978.272	5.8	978.256	+ 16	121
6	821	,, 27	12 21 ,,	1	67 19 ,,	1	4718	978.087	3.8	978.285	— 198	129
7	822	,, 27	13 08 ,,	1	66 56 ,,	2	5083	978.238	20.9	978.315	— 77	147
8	823	,, 27	14 11 ,,	1	66 30 ,,	2	5074	978.350	25.1	978.358	— 8	
9	824	Dec. 1	19 12 ,,	1.5	65 22 ,,	1.5	7370	978.362	7.9	978.606	— 244	129
10	825	,, 2	20 22 ,,	1.5	63 00 ,,	1.5	5530	978.666	3.5	978.673	— 7	138
12	826	,, 4	23 30 ,,	1	56 04 ,,	1	6565	978.844	3.1	978.868	— 24	162
13	827	,, 5	25 00 ,,	1	52 31 ,,	1	5290	978.936	7.7	978.969	— 33	150
14	828	,, 6	25 39 ,,	1	48 29 ,,	1	4380	979.023	6.1	979.015	+ 8	179
15	829	,, 7	26 08 ,,	1	45 22 ,,	1	2360	979.111	4.7	979.049	+ 62	244
16	830	,, 7	26 17 ,,	1	44 19 ,,	1	2940	979.079	3.2	979.060	+ 19	206
17	831	,, 8	26 42 ,,	1	40 46 ,,	1	4685	979.095	3.8	979.090	+ 5	289
18	832	,, 9	27 17 ,,	1	36 51 ,,	1	5390	979.117	7.8	979.132	— 15	147
19	833	,, 13	33 28 ,,	1	31 30 ,,	1.5	3405	979.638	3.6	979.617	+ 21	121
20	834	,, 14	36 27 ,,	2	28 23 ,,	2	3105	979.924	14.4	979.870	+ 54	132
21	835	,, 18	40 52 ,,	2	20 24 ,,	2	4370	980.271	8.0	980.258	+ 13	174
22	836	,, 20	45 29 ,,	2	13 20 ,,	2	4540	980.704	2.7	980.673	+ 29	192
voy. O 13		1938										
1	837	May 4'38	52°06' N	1	02°46' E	1	42	981.272	4.2	981.264	+ 8	111
2	838	,, 5 ,,	49 48 ,,	1	03 31 W	1	75	981.108	2.4	981.061	+ 47	
3	839	,, 6 ,,	48 56 ,,	1	07 36 ,,	2	135	981.014	4.2	980.983	+ 31	147
4	840	,, 7 ,,	47 09 ,,	1	10 02 ,,	1	4250	980.832	3.2	980.823	+ 9	144
5	841	,, 7 ,,	47 15 ,,	1	09 09 ,,	2	4400	980.803	3.7	980.832	— 29	256
6	842	,, 8 ,,	48 36 ,,	1	06 30 ,,	2	125	980.974	5.7	980.954	+ 20	217
7	843	,, 10 ,,	52 22 ,,	1	03 01 E	1	40	981.300	4.7	981.287	+ 13	144
voy. O 19		1939										
1	844	July 12'39	56 18 N	3	01 39 E	3	90	981.672	1.2	981.624	+ 48	156