Geophysical Abstracts 154 July-September 1953

(Numbers 14599–14804)

GEOLOGICAL SURVEY BULLETIN 1002-C

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By MARY C. RABBITT, S. T. VESSELOWSKY *and others*

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GEOPHYSICAL ABSTRACTS 154, JULY-SEPTEMBER 1953

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GENERAL INFORMATION

Geophysical Abstracts attempts to provide informative abstracts of published material on the physics of the solid earth, the application of physical methods and techniques to geologic problems, and geophysical exploration. Related material of interest to individual geophysicists will also be found in other abstracting journals such as the Bibliography of Seismology, Chemical Abstracts, Meteorological Abstracts, Nuclear Science Abstracts, and Physics Abstracts.

The form of the bibliographic reference is believed to be self-explanatory. Lists of abbreviations of journal titles were given in Geophysical Abstracts 152 and 153. Additions to that list are given below. Unless specifically indicated otherwise, the language in which the article is written is the same as that given in the title. The system of transliteration used by the United States Board on Geographic Names is employed for transliteration of Russian names and titles. Translations of author's abstracts are indicated as "Author's Abstract" followed by the initials of the translator.

Geographic names included within brackets are those recommended by the Board on Geographic Names.

ABSTRACTORS

Geophysical Abstracts are prepared and compiled under the direction of Mary C. Rabbitt with the assistance of S. T. Vesselowsky and Dorothy B. Vitaliano. Patent information is compiled by Louis C. Pakiser, Jr. Other abstracts in this issue have been prepared by the following: James R. Balsley, William J. Dempsey, Roland G. Henderson, F. W. Stead, and Isidore Zietz.

LIST OF JOURNALS

The following list gives the full titles of journals referred to in this issue of the Abstracts and not included in previous lists. The spon-

soring organization and place of publication are given where they are not part of the journal title.

Abbreviation	*Publication*
Acad. Colombiana Cienc. exactas fis. y nat. Rev.	Revista de la Academia Colombiana de Ciencias Exactas, Fisicas y Naturales. Bogotá.
Akad. Nauk Gruzinskoy SSR Soobshcheniya.	Akademii Nauk Gruzinskoy SSR Soobshcheniya. Tiflis.
Am. Soc. Testing Materials Special Tech. Pub.	American Society for Testing Materials Special Technical Publication. Philadelphia.
Berg- und Hüttenmänn. Montash	Berg- und Hüttenmännische Monatshefte. Vienna.
Boll. Geodesia e Sci. aff	Bollettino di Geodesia e Scienze affini. Istituto Geografico Militare. Trieste.
Cahiers géol. Thoiry	Cahiers géologique de Thoiry. Imprimerie Artisanale de Moret. Thoiry, Ain.
Cambridge Philos. Soc. Proc	Proceedings of the Cambridge Philosophical Society. London.
Colorado School of Mines Quart	Colorado School of Mines Quarterly. Golden, Colo.
Compass	The Compass of Sigma Gamma Epsilon. Lincoln, Nebr.
Earthquake Notes	Earthquake Notes. Eastern Section, Seismological Society of America, Washington.
Geol. Jahrb	Geologisches Jahrbuch. Geologisches Landesanstalten der Bundesrepublik Deutschland. Hannover.
Geol. Landesamt Baden-Wurttemberg Abh.	Abhandlungen des Geologisches Landesamt in Baden-Wurttemberg. Freiburg-im-Breisgau.
Geol. Rundschau	Geologische Rundschau. Stuttgart.
Geol. Soc. South Africa Trans	Transactions and Proceedings of the Geological Society of South Africa. Johannesburg.
Geophysica	Geophysica. Geofysiikan Seura. Helsinki.
Inst. Physique du Globe Strasbourg Annales.	Annales de l'Institut de Physique du Globe. Université de Strasbourg.
Israel Research Council Bull	Bulletin of the Research Council of Israel. Jerusalem.
Jour. Geology	Journal of Geology. University of Chicago Press. Chicago.
Michigan Acad. Sci. Papers	Papers of the Michigan Academy of Science, Arts and Letters. Ann Arbor, Mich.

Abbreviation	*Publication*
Minería	Minería. México, D. F.
Neues Jahrb. Geologie u. Paläontologie Abh., Monatsh.	Neues Jahrbuch für Geologie und Paläontologie Abhandlungen, and Monatshefte. Stuttgart.
Observatorio di fisica cosmica de San Miguel Mem.	Observatorio di fisica cosmica de San Miguel Memorias. Argentina.
Oil in Canada	Oil in Canada. National Geophysical Co. Calgary, Alberta.
Petroleos Mexicanos	Petroleos Mexicanos. Servicio de Informacion. México, D. F.
Phys. Verhandlungen	Physikalische Verhandlungen. Physik-Verlag. Mosbach im Baden.
Quartär	Quartär. Jahrbuch des Hugo Obermaier-Gesellschaft für Erforschung des Eiszeitalers und sein Kulturen. Bonn.
Science Progress	Science Progress. Edward Arnold and Co. London.
Sci. Monthly	Scientific Monthly. American Association for the Advancement of Science. Washington.
Service carte géol. Algerie Bull	Service de la Carte géologique de l'Algérie-Tunisie Bulletin. Gouvernement général de l'Algérie.
Soc. géol. France Comptes Rendus	Comptes Rendus de la Société géologique de France. Paris.
Soc. italiana scienze nat. Atti	Atti della Societa Italiana di Scienze Naturali e del Museo Civico di Storia Naturale in Milano.
Soc. physique et histoire nat. Génève Mem.	Société de Physique et d'Histoire Naturelle de Génève Memoires.
Soc. sci. nat. phys. Maroc Bull	Bulletin de la société des sciences naturelles et physiques du Maroc. Institute scientifique Chérifien à Rabat.
Univ. Alger Inst. Recherches sahariennes Travaux.	Travaux de l'Institut de Recherches Sahariennes. Universite d'Alger.
Univ. Coimbra Mus. Mineralog. Geol. Mem. e Noticias.	Memorias e Noticias, Publicaos do Museu Mineralogico e Geologico. Universidade de Coimbra. Coimbra.
Univ. Savariensis Annales, Naturwiss.-Sci.	Annales Universitatis Saraviensis. Universite de la Sarre. Saarbrücken.
Volcano Letter	Volcano Letter. University of Hawaii. Honolulu.
Zeitschr. Erzbergbau u. Metallhüttenwesen.	Zeitschrift für Erzbergbau und Metallhüttenwesen. Dr. Reiderer Verlag. Stuttgart.

GRAVITY

GENERAL AND THEORETICAL PAPERS, INCLUDING THOSE ON ISOSTASY

14599. Berroth, Alfred. Stand und Entwicklungsmöglichkeiten der absoluten Schweremessungen [Present state of absolute measurements of gravity and possibilities of their development]: Geofisica Pura e Appl., v. 22, fasc. 3–4, p. 147–160, 1952.

Detection of an error of 13 mgal in the International Standard gravitational system based on Potsdam measurements, makes necessary a change in the procedures used in absolute determinations of gravity. Three possibilities are open: use of the present type of pendulum, with certain added improvements; use of a pendulum with string-supported bob; or observations of bodies falling freely in vacuum.

The first type of pendulum has been gradually improved, but even in its present form can hardly give an accuracy greater than ±1 mgal; moreover several systematic errors, caused mainly by supporting edges, cannot even be computed. Measurements with falling bodies are exceedingly difficult because of the short time intervals of observation.

The possibility of using a pendulum with a string-supported bob, tried by Bessel, but later completely abandoned, is considered. By introducing certain obvious improvements, such as an evacuated chamber, precise measurements of time intervals and of small variations of length, it is possible to construct an instrument with an expected accuracy of measurements comparable with those attainable with usual pendulum. An absence of indeterminable systematic errors and the possibility of computing all corrections is a great advantage of this instrument. Details of the operation and suggested methods of their theoretical analysis are discussed.—*S. T. V.*

14600. Cook, A. H. Approximations in the calculation of the form of the geoid from gravity anomalies: Royal Astron. Soc. Monthly Notices, Geophys. supp., v. 6, no. 7, p. 442–452, 1953.

The theory of the calculation of the detailed undulation of the geoid from gravity by Stokes' integral is usually given to the first order; one of the approximations which is important in mountainous places is the change of undulation with height. The definition of the geoid and of orthometric height are interdependent. By defining a model geoid and orthometric height as if only the ellipticity term in geopotential varied with height, the undulation of an external equipotential surface is the same as that of the geoid, and so the calculated form of the geoid gives the undulation at an external point directly without any correction for variation with height. This correction has been used in practice, though not in principle, in geodetic work.

The free-air correction to gravity is determined by these definitions and conditions. For geodetic purposes the fundamental quantity is not the change of gravity with height but the difference of geopotential. Cook suggests the use of the constant factor 0.3086 mgal per m in routine reductions of gravity

values, because the errors which this introduces in free-air values of gravity are negligible in geophysical uses. A different correction is applicable in calculating the figure of the Earth.—*D. B. V.*

14601. Mintrop, Ludger. Die Problematik der Gebirgswurzeln [The problem of the roots of the mountains]: Geol. Rundschau, Band 41, Sonderband p. 67–78, 1953.

This is a critical analysis of the Airy theory of isostasy based on recent seismologic studies in Europe and California. The conclusions are identical with those of Mintrop's previous study (see Geophys. Abs. 14373). The existence of roots of mountains under the Alps and under the Sierra Nevada is denied.—*S. T. V.*

14602. Arambourg, Camille. Eustatisme et isostasie [Eustatism and isostasy]: Acad. Sci. Paris Comptes Rendus, tome 234, no. 2, p. 226–227, 1952.

The theoretical isostatic rise of the continents due to removal of material by erosion has been calculated, on the basis of the classic figure for annual global erosion (16 km^3), as approximately 90 m. Many of the observed levels agree with the theoretical calculations, but many others have been affected by local conditions. One of these variables is local relief which affects the absolute rate of erosion. Consideration of this factor has been neglected in Depéret's classification of the Quatenary on the basis of vertical distribution of ancient shorelines.—*D. B. V.*

14603. Alvarez, Manuel, Jr. Isostasia [Isostasy]: Petroleos Mexicanos, 2ª época, tomo 1, no. 4, p. 241–253, 1953.

This is a brief discussion of the fundamental ideas of isostasy as presented by Airy, with modifications as suggested by Dutton, Pratt, Vening Meinesz, and others.—*S. T. V.*

INSTRUMENTS AND METHODS OF OBSERVATION

14604. Higgs, William R. The gravity meter and the study of gravitation: Compass, v. 30, no. 1, p. 31–33, 1952.

This is a short discussion of the principles and application of modern gravity meters.—*D. B. V.*

14605. Berroth, Alfred. Totalregistrierendes Fadenpendel für die absolute Schwerebestimmung [A total-registering string-suspended pendulum for the absolute determination of gravity]: Geofisica Pura e Appl., v. 24, p. 11–36, 1953.

In a previous study on the string-supported pendulum Berroth emphasized the great advantages of such a pendulum in absolute determinations of gravity, because many of the systematic errors peculiar to ordinary pendulums are eliminated and the exact values of other errors can be determined by analytic methods or by calibration.

To achieve satisfactory results, comparable with those obtainable with the best ordinary pendulums, it is necessary to find accurate methods of computing these corrections. In the present article the effects of several disturbing factors are discussed, special attention being paid to Foucault revolution and to elliptic deviation of the oscillations of the pendulum bob. Final results are presented in a form convenient for numerical calculation of individual errors.—*S. T. V.*

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METHODS OF ANALYSIS AND INTERPRETATION

14606. Goguel, Jean. Le terme du premier ordre de l'effet indirect [The first order terms of the indirect effect]: Annales Géophysique, tome 7, no. 3, p. 169–174, 1951.

In Vening Meinesz's system of linear equations for each of the terms of the harmonic analysis of the topography, the system of axes used implicitly has as its center the center of concentric spheroidal surfaces. While this holds for the terms of the second and higher order, it leads to an ambiguity in the case of the first-order harmonic. The ambiguity can be eliminated by taking as the center a point which, where the interior of the sphere is concerned, appears to be the center of attraction. Calculations show that this point is the correct center of reference for the coordinates of first-order terms.—*D. B. V.*

14607. Bragard, Lucien. Une simplification de la formule fondamentale de la géodesie dynamique [A simplification of the fundamental formula of dynamic geodesy]: Bull. géod. no. 28, p. 139–151, 1953.

From the equality of the volumes (and hence of the masses) of the cogeoid and the figure of reference, and from the coincidence of their centres of gravity, two relations can be derived satisfying the gravity anomalies Δg, supposed distributed over the sphere of unit radius. These two relations allow us to simplify Stokes' formula which becomes $\Delta r(P)=r_m/g_m S\int_s F(\psi).\ \Delta g(M)dS$ in which r_m and g_m are respectively the mean radius and the mean value of gravity and where $F=-1/\sin\frac{\psi}{2}-3\cos\psi\log\left[\sin\frac{\Phi}{2}\,(1+\sin\frac{\psi}{2}\right]$.—*Author's Summary.*

14608. Lecolazet, Robert. Sur le calcul pratique des derivées partielles du premier et du second ordre du potentiel gravifique d'un prisme indefini [On the practical calculation of the partial derivatives of the first and second order of the gravity potential of an undefined prism]: Annales Géophysique, tome 8, fasc. 3, p. 311–313, 1952.

In this paper formulas are derived for the first derivatives of the gravity potential of an undefined prism, analogous to those given by Charczenko [Geophys. Abs. 8965] for the second order. A practical example of their application to gravimetric prospecting is calculated.—*D. B. V.*

14609. Morelli, Carlo. Variazione diurna della gravità in Europa Nota 1ª: Data sperimentali [Diurnal variations of gravity in Europe. First note: Observational data]: Annali Geofisica, v. 6, no. 1, p. 113–124, 1953.

The increasing precision of gravimetric measurements, now ±0.01 mgal, makes it necessary to take into account the lunisolar effect on gravity. Computations of such corrections in an individual survey are very lengthy, and therefore the Osservatorio Geofisico di Trieste is preparing such corrections for stations in northern Italy. These data are also applicable to Central Europe and with slight modifications to nearly all Europe. The computations have been made assuming a rigid earth and with deformation taken into account by applying a factor 1.22 to computed amplitudes, as suggested by Baars.—*S. T. V.*

OBSERVATIONS OF GRAVITY AND GRAVITY SURVEYS

14610. Bean, Robert J. Relation of gravity anomalies to the geology of central Vermont and New Hampshire: Geol. Soc. America Bull., v. 64, no. 5, p. 509–538, 1953.

A total of 1,111 gravity stations were occupied in a rectangular area approximately 137 miles long and 23 miles wide in eastern New York, central Vermont, and central New Hampshire. The survey was carried out for the primary purpose of supplementing geologic data and contributing toward the solution of local and regional structural problems. Where possible, an aerial coverage method of surveying was used, and stations were located at intervals ranging from 1 to 1½ miles. The relative accuracy of the gravity measurements is approximately 1 milligal. Simple Bouguer anomalies were obtained by the usual method of reduction. Although the stations were not corrected for terrain effects for the regional analysis, this factor was taken into consideration for local analyses.

Several hypotheses were examined in an attempt to relate a large negative Bouguer anomaly field with the tectonic history of the Middlebury synclinorium, and an associated relative gravity high with the Green Mountain anticlinorium. The theory of warping of crustal layers is applied to this region. The possibility of high-angle thrust faulting of the crust is also considered. Calculations show that the maximum amplitude of the downwarp at the base of the granitic and intermediate layers beneath the Champlain lowland is approximately 16,000 feet. This amplitude is of the same order of magnitude as the depth to the Precambrian basement in the Middlebury synclinorium.

A gravity high over the Taconic allochthone indicates that the high density slates of the Taconic sequence attain their maximum thickness in the eastern part of the thrust sheet. Because the structure of the Taconic klippe is similar to that of the Middlebury synclinorium, the rocks of the thrust sheet were probably folded concurrently with those of the syclinorium. Consequently, the Taconic thrust appears to have been emplaced prior to the close of the orogeny in the Green Mountain region.

The north-south trending regional anomalies in the Green Mountains decrease eastward to a broad gravity low in the Connecticut Valley. In the latter area, the anomaly trends swing around to the northeast before attaining east-west trends in central and eastern New Hampshire.

Differences in residual anomalies as high as —5 milligals are associated with a series of domal uplifts in eastern Vermont. These anomalies must result from a mass of low density rock which occurs beneath the high density metamorphic rocks at the surface. Calculations show that the depth to the core rocks probably ranges from 1,000 to 2,500 feet. An analysis of gravity minima associated with the granite core of the Lebanon dome (—13 milligals) and the core rocks of the Mascoma dome (—10 milligals) yields information as to the shape of the plutons at depth. Calculations also show that the core rocks of these domes persist to depths which are the same order of magnitude as those of the domes of eastern Vermont (12,000 to 16,000 feet). Consequently, the core rocks may be either intrusions or uplifts of a low density rock which occurs at depth throughout the region.

Because local gravity anomalies in central and eastern New Hampshire are obscured by a regional gravity low centered over the White Mountains, a residual-anomaly map was prepared for this region. Computations indicate that the schists of the Littleton formation are cut off at relatively shallow depths (3,500 to 8,700 feet) by one or more of the magma series which occur in central New Hampshire.—*Author's Abstract*

14611. Howell, B. F. Jr. Potentialities of gravity surveys in locating oil in Pennsylvania: Producers Monthly, v. 17, no. 5, p. 16–19, 1953.

A Bouguer anomaly map based on gravity observations by several Pennsylvania State College investigators shows a generally northeasterly trend with

a minimum along the Allegheny Front near State College continuing northward into New York State, approximately along the eastern boundary of the known gas and oil fields. Gravity mapping seems to be of more use here in the study of regional tectonics than in locating shallow structures.—*M. C. R.*

14612. Goguel, Jean. La prospection gravimétrique du bassin parisien [Gravimetric prospecting in the Paris basin]: Soc. géol. France Comptes Rendus, no. 16, p. 339–341, 1952.

Gravimetric prospecting has been carried on in the Paris basin since 1944 by the Bureau des Recherches géologiques et géophysiques, the Compagnie Générale de Géophysique, and the Bureau de Recherches des Pétroles, using Thyssen and North American gravimeters. Complete coverage of the sedimentary basin is expected within a few months. Stations are spaced closely, never less than 1 per 7 km^2, often 1 per 2 or 3 km^2, and in the oil basin of the north, 1 per km^2. Many small anomalies were revealed which would have been missed with less dense coverage.

The results of these surveys will be published in the form of isoanomaly maps with contours at 1 mgal intervals and at scales of 1/80,000 and 1/200,000. The former, showing the position and Bouguer anomaly of each station, will serve as a basis for further detailed prospecting; the latter, giving the measured profiles, will suffice for geologic interpretation.—*D. B. V.*

14613. Vecchia, Orlando. Carta della densità sino al levello del mare nell'Italia settentrionale [Map of density to sea level in northern Italy]: Boll. geodesia e sci. aff., anno 11, no. 3, pp. 337–344, 1952.

A map of northern Italy and adjacent areas at a scale of 1:1,000,000 shows, by color, average densities to sea level at intervals of 0.2. These have been calculated on the basis of present knowledge of stratigraphy and tectonics in the area. Densities of igneous, metamorphic, and sedimentary rocks, compiled from the literature, are given in 3 tables.—*M. C. R.*

14614. Vecchia, Orlando. Sui principali caratteri strutturali dell'Italia settentrionale dedotti dalle misure gravimetriche [The principal structural characteristics of northern Italy deduced from gravimetric measurements]: Riv. Geofisica Appl., v. 13, no. 1, pp. 33–68, 1952.

Gravity maps of northern Italy have been plotted, representing both Bouguer and isostatic anomalies. The general geological interpretation of the gravity pattern is then developed by comparison with surface geology, seismicity, magmatism, thermo-mineral sources distribution and geomagnetism.

It is shown that on the inner side of the axial gravity-minimum zone of the Alps—representing the maximum thickening of the Sial—there is a maximum-gravity south Alpine belt, parallel to the first and extending from end to end of the chain. The positive belt, in agreement with the other geological and geophysical facts, represents a geanticlinal with a core of Sima, which in the eastern Alps has been active from the Permian onward whereas in the western Alps it goes back to more ancient times.

The south Alpine geanticlinal sends out several branches both toward the inner side—Po plain, Venetian plain and northern Adriatic Sea—and the Alpine axis. The main tectonic features of the Italian Alps are determined by the presence and the conflict between the sialic axial bulge and the simatic south Alpine intrusion.

The relations between the eastern and western Alps become more clear; and the last end abruptly at the Tenda Pass [Colle di Tenda] against an independent Provencal-Ligurian tectonic framework. The gravity pattern of the Apennines, only the northern side of which is known, does not show the very beginning of this orogen with the same evidence as in the Alps. The Apennine chain is different from the Alps chiefly because the negative gravity belt corresponding to the sialic root is shifted to the north and is found in the piedmont zone and in the hills facing the Po plain.

Every seismic zone of northern Italy, all thermo-mineral sources, its whole magmatic activity since the Paleozoic, coordinate with each other and find an explanation through the key furnished by the gravity pattern.—*Author's Abstract*

14615. Fabiani, Ramiro. Sulle interpretazioni geologiche delle anomalie negative della gravità regionale in Sicilia [On the geologic interpretation of negative anomalies of regional gravity in Sicily]: La Ricerca Sci., v. 23, no. 5, pp. 767–788, 1953.

Gravity surveys of Sicily during the last 50 years, with both pendulums and Worden gravimeters, have outlined negative anomalies of regional dimensions in the south-central part of Sicily with gravity minima around the city of Caltanissetta. The anomalies are attributed by some to the low density of the upper layers consisting of salty clays, rock salt, gypsum, sulfur and similar materials. A contributing factor may also be the numerous caverns known to exist in limestone formations. Others point out that the gravity pattern is not substantially changed if different density values are used in computations of Bouguer or isostatic reductions and conclude that the anomaly is an indication of a subcrustral trough, filled with low-density submarine masses that have been horizontally displaced from some point north of Sicily, thus producing the present topography of the island. Neither hypothesis can be proved correct although recent investigations for sulfur and hydrocarbons may supply information.—*S. T. V.*

14616. Lagrula, Jean. Étude gravimétrique de l'Algérie-Tunisie [Gravimetric study of Algeria and Tunis]: Service carte géol. Algérie Bull., 4e sér., no. 2, 111 p., 1951.

This is a compilation of the results of gravimetric studies carried on in Algeria and Tunis since 1933 and prepared for the occasion of the 19th International Geologic Congress. It includes detailed theoretical discussions of the determinations of g and gravity anomalies, description of the Holweck-Lejay pendulum with which the measurements were made, and the procedure used. For each station, tables give the latitude and longitude, altitude, g, topographic correction, Bouguer anomaly, isostatic anomaly (Airy-Heiskanen, T=60 km) and isostatic anomaly (Vening Meinesz, T=30 km, R=232.4 km). A map shows the distribution of A-H anomalies.

Because the densities and consequently the anomalies generally increase algebraically with the age of the formations exposed, gravimetry affords an approximate method of geological reconnaissance. Old terrains show positive and recent, negative anomalies. The sedimentary terrains can be divided roughly into 3 groups, the Primary and Anteprimary (mean density=2.7), Secondary or Nummulitic (mean density=2.4) and Neocene and Quaternary (mean density=2.3). The isoanomalies and their relation to geologic structure are discussed in some detail.—*D. B. V.*

14617. Lagrula, Jean. Nouvelle contribution à la prospection gravimétrique due Sahara central [New contribution to the gravimetric survey of the central Sahara]: Acad. Sci. Paris Comptes Rendus, tome 234, no. 22, p. 2214–2216, 1952.

The gravimetric survey of the Sahara, begun with a Holweck-Lejay pendulum, has been completed with a Western gravimeter No. 53. Stations were uniformly 10 km apart. Some results are provisional, inasmuch as the topography of the Sahara is not known precisely; a few altitudes could be obtained only barometrically. In some places the resulting uncertainty in anomalies is as much as 10 mgal. Isostatic as well as Bouguer anomalies were calculated, according to the Airy system, with $T=60$ km. Data for 39 stations are given in a table. Correlation with geologic structure is striking, and is even better with a smaller value of T, for example, 20 km.—*D. B. V.*

14618. Lagrula, J[ean]. Sur la prolongation du reseau gravimétrique nord-africain au Sahara francais [On the extension of the North African gravimetric network to the French Sahara]: Univ. Alger Inst. Recherches sahariennes Travaux, tome 8, p. 165–188, 1952.

This paper tabulates the results of gravimetric measurements made in the Sahara region, partly with a Holweck-Lejay pendulum and mostly with a Western gravimeter. The Bouguer and Airy-Heiskanen ($T=60$ km) anomalies are calculated for each station. In general, the correlation between isostatic anomalies and geologic structure ascertained in North Africa extends into the Sahara, but in the absence of large scale maps only the broader features can be correlated. Significant details are pointed out for each traverse.—*D. B. V.*

14619. Cattala, Louis. Sur la gravité à Madagascar [On gravity at Madagascar]: Acad. Sci. Paris Comptes Rendus, tome 233, no. 25, p. 1651–1652, 1951.

Cattala has calculated the Bouguer and free-air anomalies for 46 of the 400–500 gravity measurements, made in Madagascar since 1948 with a North American gravimeter No. 73, assuming a density of 2.67. The results are presented in a table.—*D. B. V.*

14620. Crenn, Y[vonne], and Metzger, J. Étude gravimétrique d'un gisement de chromite [Gravimetric study of a chromite deposit]: Annales Géophysique, tome 8, fasc. 3, p. 269–274, 1952.

Gravimetric prospecting for chromite in mountainous terrain in southern New Caledonia showed an anomaly restricted to a zone 100 m in diameter, with a maximum of 0.60 mgal, which was attributed to a body of 70,000 tons of chromite. Subsequent exploitation disclosed the lens responsible for the anomaly. Crenn and Metzger stress the fact that only large ore bodies, of the order of 50,000 or more tons, can safely be determined gravimetrically, and that detailed gravimetric prospecting is justified only after a preliminary study consisting of 2 or 3 profiles; anomalies indicating ore should be apparent in these even if topographic corrections are neglected.—*D. B. V.*

MAGNETISM

MAGNETIC FIELD OF THE EARTH

14621. Jones, Harold Spencer, and Melotte, P. J. The harmonic analysis of the Earth's magnetic field, for epoch 1942: Royal Astron. Soc. Monthly Notices, Geophys. supp., v. 6, no. 7, p. 409–430, 1953.

The results are given of the harmonic analysis of the Admiralty magnetic charts of declination, horizontal intensity, and inclination for the epoch 1942.5. Within the limits of observational error, the Earth's magnetic field appears to be entirely of internal origin. There is no evidence of a dipole field of external origin greater than 0.1 percent of the field of internal origin. The intensity of the dipole field is at present decreasing at a rate of about 5 percent per century. The geomagnetic poles have a westerly drift at a rate of 4.5° per century; the north magnetic dip pole is moving in a direction a little to the west of north, but the south magnetic dip pole appears to be practically stationary. In consequence of the dearth of magnetic data over the oceans since 1929, magnetic charts are becoming less accurate and there is a great need for airborne magnetic surveys of ocean areas.—*Authors' Summary*

14622. Vestine, E. H. On variations of the geomagnetic field, fluid motions, and the rate of the Earth's rotation: Jour. Geophys. Research, v. 58, no. 2, p. 127–145, 1953.

Time fluctuations in the westward drift of geomagnetism are shown to be similar in form to the unexplained fluctuations in the Earth's rate of rotation as derived by Brouwer. Also the sense of the variations is in the proper direction for the conservation of angular momentum. From magnetohydrodynamic considerations, fluid motion near the surface of the core can be inferred from the migration characteristics of the geomagnetic field. Assuming that the outer and inner concentric parts of the core have equal volumes, Vestine calculated changes in the angular velocity of the inner core. The time constant of the electromagnetic couple between the core and the mantle as well as the conductivity of the mantle were estimated with the aid of Bullard's formula.

A smaller time fluctuation derived from the northerly drift of the geomagnetic field yielded a variation of latitude roughly compatible with preliminary results obtained from astronomy.—*R. G. H.*

14623. Bullard, E. C. Is the Earth's dipole moment increasing?: Jour. Geophys. Research, v. 58, no. 2, p. 277–278, 1952.

Measurements of the earth's magnetic moment show that it has been decreasing from 1829 to the middle 1930's. Two independent analyses of recent observations at 24 stations, though not statistically conclusive, indicate that during the last 20 years the moment may be increasing. To prove this hypothesis, it is recommended that a reduction be made of all available observations subsequent to 1940.—*J. R. B.*

14624. Stoyko, Nicolas. De l'influence de l'irregularité de la rotation terrestre sur le champ magnétique [On the influence of the irregularity of the earth's rotation on the magnetic field]: Acad. Sci. Paris Comptes Rendus, tome 234, no. 18, p. 1798–1800, 1953.

Stoyko shows that progessive variation in rotational velocity of a body can produce variations of the magnetic field for the whole body; both can be

expressed by the formula $\Delta t = +O_3\ .7232\ t + O_3\ .00299\ t^2 + \Delta Tm$ of Spencer-Jones, where t=years since 1900, ΔTm=chance variations in rotation. Thus, every body (Earth, Sun, Stars) having variable speed of rotation should possess a variable magnetic field, whose variation is proportional to that of the velocity.—*D. B. V.*

14625. Lewis, R. P. Waldo, and McIntosh, D. H. Diurnal and storm-time variations of geomagnetic and ionospheric disturbance. Atmos. Terrest. Physics Jour., v. 3, no. 4, p. 186–193, 1953.

The geomagnetic and ionospheric diurnal and storm-time variations occurring at Abinger and Slough over a period of 46 months are studied. The diurnal variations are shown to be highly complex, with significant differences appearing in different seasons and at various levels of activity. The 24-hourly component of daily variation is important in both phenomena, but a significant and regular 12-hourly component is observed only in ionospheric (foF2) disturbance. The storm-time variations of foF2 and absolute horizontal magnetic force are found to be statistically linked.—*Authors' Abstract*

14626. Sabben, D. van. Relationship between radio-propagation disturbance, geomagnetic activity and solar noise: Atmos. Terrest. Physics Jour., v. 3, no. 4, p. 194–199, 1953.

For the years 1948–49–50 ionospheric disturbance figures of transatlantic radio-communication (circuit New York-Amsterdam) were determined and compared with magnetic character figures. The general correspondence is clearly shown by a diagram, containing running graphs (with 3-hour steps) of both quantities. The maximum of radio disturbance showed a mean time lag of 7 hours behind the maximum of magnetic disturbance.

A second investigation concerned the flux of solar radio noise in relation to magnetic storms. There appeared to be a marked increase of flux on at least one of the 3 frequencies 80, 175 and 200 Mc/s at some time during the 5 days preceding the storm, except when the storm was of the recurrence type.—*Author's Abstract*

14627. Bondarenko, A. P. O svyazi zemnykh tokov i geomagnitnykh variatsiy [Correlation between telluric currents and geomagnetic variations]: Akad. Nauk SSSR Doklady, tom 89, no. 3, p. 443–445, 1953.

Bondarenko offers a new method of studying the relation between telluric currents and geomagnetic variations based on comparison of vertical projections of the curl of the electric field with the derived vertical component of geomagnetic variations and gives a formula applicable for a nonhomogeneous medium: $E_r \cong [(k_x - 1)/\Delta y] E_x + [1 - ky)/\Delta x] E_y \cong (\mu/c) H_z'$ (where E_r="curl" of electric field, Δx and Δ_y are measurable distances, and K_x and K_y also measurable quantities). Using measurements made at Pisarevka in September 1940, he plots the graphs for each expression and finds close agreement.—*S. T. V.* and *D. B. V.*

MAGNETIC PROPERTIES OF ROCKS AND MINERALS

14628. Godard, Louis. Étude sur les propriétés magnetiques des coulées de lave; Application à la détermination des thalwegs souterrains [Study of the magnetic properties of lava coulees; application to the determination of underground thalwegs]: Inst. Physique du Globe Strasbourg Annales, tome 6, 3e pt., p. 59–69, 1950.

A series of measurements of the components of the magnetic field was made along profiles essentially perpendicular to the axes of several lava coulees in the Puy-de-Dôme. By using the theoretical calculation of magnetic anomalies due to cylindrical structures the underground form of the Royat and Arnat coulees was then determined. Their magnetization is for the most part in the same direction as the earth's field and of greater intensity than that induced by the earth's field. The greater magnetization is largely due to the permanent magnetization of the lavas. On the basis of these measurements, it is concluded that interpretation of magnetic exploration data can be facilitated if intervals appropriate to the size of the disturbing mass are used and if the more sensitive vertical component rather than the horizontal is used.—*D. B .V.*

14629. Graham, John W. Changes of ferromagnetic minerals and their bearing on magnetic properties of rocks: Jour. Geophys. Research, v. 58, no. 2, p. 243–260, 1953.

Physical and chemical properties of samples from a group of pre-Cambrian diabase dikes characterized by an inverse magnetization have been determined. There are present two different ferromagnetic minerals intimately intermingled with one another and with non-magnetic ilmenite. Experiments to duplicate the original thermomagnetic behavior of these rocks cannot be carried out because by heating, non-reversible changes of physical structure are produced which alter the magnetic properties of the sample. Magnetization experiments show that the inverse magnetization is produced by particles having high coercive force; in natural samples a large part of the ferromagnetic material is demagnetized but can be easily magnetized. The hypothesis is advanced that the inverse magnetizations of these dikes having uniform magnetization could have been produced with the earth's magnetic field in its present-day sense, as a result of the partial low-temperature oxidation of primary magnetite forming small particles of high coercive force in the reversed induction field adjacent to large magnetite particles and the subsequent demagnetization of some of the larger particles. Various implications of the hypothesis are pointed out. The gross scattering of directions of magnetization observed in two dikes are proved not to have been caused by turbulent movements below the Curie point; the scatter is attributed to chemical changes, but no detailed mechanism for producing the scatter is proposed.—*Author's Abstract*

14630. Grabovskiy, M. A. Termoostatochnyy magnetizm gornykh porod [Thermoremanent magnetism of rocks]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 3, p. 215–224, 1953.

Every ferromagnetic rock is characterized by its induced (I_i) and remanent (I_r) magnetism. Induced magnetism is that component of the magnetic vector which is generated in the rock by the action of the present geomagnetic field; the remanent or natural magnetization cannot be produced by the existing geomagnetic field. According to the theory of ferromagnetism I_r must be smaller than I_i, but there are many exceptions to this rule. This phenomenon is explained as the result of slow cooling of the rock in a magnetic field that creates conditions favorable to the irreversible process of magnetization.

The intensity of this thermoremanent magnetization caused by the cooling of the rock is determined by its magnetic properties, such as the coercive force, magnetic anisotrophy, and magnetostriction. Reverse magnetization can be explained by the presence in the rock of two distinct magnetic components with different coercive forces and different Curie points.—*S. T. V.*

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INSTRUMENTS AND METHODS OF OBSERVATION

14631. Karus, Ye. V. O novykh priborakh dlya magnitnoy razvedki [New instruments for magnetic exploration]: Akad. Nauk SSSR Izv. Ser. geofiz. no. 3, p. 285, 1953.

A brief review is given of new instruments for magnetic investigations tested in the Akademii Nauk Geofizicheskiy Institut. Among them is an apparatus for determination of the magnetic properties of formations in a drill hole. The method is based on measurements, using a photoelectric fluxmeter, of the variation of remanent magnetism in a permanent magnet and of the increase in intensity of the total magnetic flux. A magnetometer adapted for field work has been constructed for measuring and recording magnetic-field vectors in any desired direction with a sensitivity as high as 20×10^{-5} oersted per mm of scale.—*S. T. V.*

14632. Wingler, Hermann. Permeameter für schwache Ferromagnetika [Permeameter for feebly ferromagnetic substances]: Univ. Savariensis Annales, Naturwiss.-Sci. tome 2, no. 1–2, p. 43–46, 1953.

A new instrument for investigating substances of feeble permeability consists of a moving-coil galvanometer, with one member of the closed magnetic path formed by the tested specimen of standard dimensions, inserted in a magnetizing coil. Formulas are derived determining the permeability of the specimen as function of the deflection of the pointer.—*S. T. V.*

14633. McComb, H. E. Magnetic observatory manual: U. S. Coast and Geod. Survey Special Pub. 283, 232 p., 1952.

Included in this volume are discussions of magnetic forces, the magnetic field of the earth, the physical equipment of observatories, instrumental characteristics and methods of operation, and the processing of data at the observatory.—*M. C. R.*

14634. Sucksdorff, E. The Magnetic Observatory Nurmijärvi: Geophysica, v. 5, no. 1, p. 48, 1952.

The new observatory is situated about 40 km north-northwest of Helsinki. Recording started in April 1952. The variation house contains 3 recording instruments of the La Cour type. The absolute house uses an old Wild-Edelmann theodolite magnetometer, and the Danish QHM 84, 85, and 86, and BMZ 25; early in 1953 a new Askania theodolite magnetometer and a Wild-Edelmann earth inductor will be set up.—*D. B. V.*

14635. Sucksdorff, E. The Geophysical Observatory Sodankylä: Geophysica, v. 5, no. 1, p. 17–47, 1952.

This paper gives the history of the Sodankylä observatory, (at 67°22′ N. lat., 26°39′ E. long.) which has been rebuilt after being destroyed by the Germans in 1944. Established mainly as a base for geomagnetic field surveys, the observatory, maintained by the Finnish Academy of Science, has also investigated earth and atmospheric currents, aurora borealis, solar radiation, and meteorological conditions. Old and new buildings and instruments are described in detail.—*D. B. V.*

14636. Schaufelberger, William M., Herrick, Henry N., and Leggett, Jasper R. Apparatus for determining magnetic properties of well cores, U. S. patent 2,652,531, granted September 15, 1953. 3 claims. Assigned to California Research Corp.

An electronic method of orienting the magnetic axes of well cores.

14637. Tierney, Samuel, Jr. Instrument for measuring magnetic permeability, U. S. patent 2,644,920, granted July 7, 1953. 5 claims. Assigned to Rohr Aircraft Corp.

An instrument for determining the magnetic permeability of paramagnetic materials by vibrating two magnetic cores, fastened to a tuning fork and adjacent to a sample, in coils of wire, thus varying the reluctance of the magnetic circuit.

METHODS OF ANALYSIS AND INTERPRETATION

14638. Wait, James R., and Campbell, L. L[orne]. The fields of an oscillating magnetic dipole immersed in a semi-infinite conducting medium: Jour. Geophys. Research v. 58, no. 2, p. 167–177, 1953.

The complete solution is given for a loop antenna immersed in a semi-infinite conducting medium. The axis of the dipole is taken to be parallel to the interface between the conducting medium and the insulating space above it. The complete expression for the horizontal components of the magnetic field is given assuming the displacement currents to be negligible. If the dipole and the observer are located at a distance below the interface that is relatively small compared to their separation, the attenuation is determined only by the sum of the distances of the dipole and observer from the interface. Graphs are presented of the field of a horizontal magnetic dipole within the medium when the observations are made in the direction of and at right angles to the axis of the dipole. Simpler formulas are obtained when the dipole is at the interface and the observer is at a point in the conducting medium directly below the dipole.

No evaluation has been made for the case in which the separation between antenna and observer is of the order of a wavelength or more in the insulator, except that in which the dipole and observer are at the interface.—*I. Z.*

14639. March, W. H. The field of a magnetic dipole in the presence of a conducting sphere: Geophysics v. 18, no. 3, p. 671–684, 1953.

Formulas are derived for the field components of a magnetic dipole located near a conducting sphere in a homogeneous medium. Following the method of Mie and Debye, March considers the field to be resolved into two partial fields. For one case, the radial component of the magnetic field vanishes and for the other, the radial component of the electric field vanishes. Furthermore, all the field components are derivable from a scalar potential. To compute the field for a dipole of arbitrary orientation, the dipole moment is resolved into radial and transverse dipole components. The field components of these orientations are discussed in detail. From the general formulas, approximations are made for the induced field components where the conductivity is low, radius of sphere is small, and both the dipole and observer are in the vicinity of the sphere.—*I. Z.*

14640. Scott, H. S. The geologist and aeromagician: Geol. Assoc. Canada Proc., v. 5, p. 43–56, 1952.

This is essentially the same material as that abstracted in Geophys. Abs. 13927.—*W. J. D.*

MAGNETIC OBSERVATIONS AND SURVEYS

14641. Wier, Kenneth L., Balsley, James R., and Pratt, William P. Aeromagnetic survey of part of Dickinson County, Michigan, with preliminary geologic interpretation: U. S. Geol. Survey Geophys. Inv. Map GP 115, 1953.

An aeromagnetic survey of all but the easternmost part of Dickinson County, Mich., was made in 1948 as part of a comprehensive restudy of the iron-bearing districts of Michigan. The magnetic data are presented in a series of total-intensity profiles and are plotted on a base map to show strength, size, and location of anomalies and significant magnetic contours. An attempt is made to correlate the major, persistent anomalies with the geologic features as determined from all available published and unpublished records concerning the area.

The area is underlain by pre-Cambrian rocks in four horstlike "granite" blocks with intervening grabenlike troughs of metamorphosed sedimentary rocks of Huronian age. Most of the major anomalies are caused by the Vulcan iron-formation of Middle Huronian age. This rock produces strong linear anomalies in three of the four metasedimentary troughs and is probably the cause of a similar northwest-trending anomaly in the fourth. Other strong to moderate anomalies are caused by metamorphosed graywacke and slate and probably by magnetite-bearing quartzite, all associated with the troughs, and by metamorphosed basic volcanic rocks. Numerous small to moderate anomalies are caused by basic intrusives and magnetite-bearing slates and schists.—*Authors' Abstract*

ELECTRICITY

GENERAL AND THEORETICAL STUDIES

14642. Veshev, A. V., Semenov, A. S., and Novozhilova, M. E. Novyy vid yestestvennogo elektricheskogo polya v zemle [A new kind of natural electric field in the ground]: Akad. Nauk SSSR Doklady, tom. 87, no. 6, p. 939–941, 1952.

Regular diurnal variations of the value of electric self potential at a point in the ground have been observed. It is suggested that a correlation exists between these variations and the changes of temperature of the air and of the ground because the corresponding graphs of each show great similarity.—*S. T. V.*

14643. Troitskaya, V. A. Korotkoperiodicheskiye vozmushcheniya elektromagnitnogo polya zemli [Short-period disturbances of electromagnetic field of the earth]: Akad. Nauk SSSR Doklady, tom 91, no. 2, p. 241–244, 1953.

Changes in the intensity and direction of telluric currents take place each time an abrupt magnetic disturbance occurs and are much greater than the corresponding magnetic changes. Analysis of records of magnetic observatories in the U. S. S. R. and at Potsdam shows that the disturbance begins simultaneously at all stations, the usual time being $18–19^h$ universal time. It is probably caused by cosmic influences; the time of disturbance is the moment when the sun passes over the northern magnetic pole of the earth.—*S. T. V.*

14644. Bondarenko, A. P. Ob induktsionnom elektricheskom pole vertikal'noy sostavlyayushchey geomagnitnykh variatsiy [Electric field induced by vertical component of geomagnetic variations]: Akad. Nauk SSSR Doklady, tom 90, no. 3, p. 367–370, 1953.

In studying electric field generated by geomagnetic disturbances, especially the correlation between telluric currents and the vertical component of geomag-

netic disturbances, it is necessary to take into account electric heterogeneity of the upper layer of the crust. The effect of these heterogeneities is studied by applying the fundamental law of electromagnetic induction to two adjoining rectangles on the earth's surface with the sides parallel to latitude and longitude. The density of induced currents flowing through the sides of these rectangles is computed as a function of electric conductivity and of the thickness of conductive layer, which is different for the different sides of the rectangles under consideration. Proceeding in this manner, an equation is derived relating the derivative with respect to time of the vertical component H of the geomagnetic variation and the vertical projection of the curl of electric field, as computed from measured telluric currents. To check the derived relation graphs were constructed representing diurnal variations of these quantities as they were observed at eight magnetic observatories in the U. S. S. R., Spain, United States, and Japan. In most, the agreement between constructed graphs was satisfactory, the closest resemblance being found for data recorded at the Tucson Magnetic Observatory where the length of profiles over which the electric measurements were made is the greatest, thus eliminating local disturbing influences.—*S. T. V.*

INSTRUMENTS AND METHODS OF OBSERVATION

14645. Cagniard, Louis. Principe de la méthode magnéto-tellurique, nouvelle méthode de prospection géophysique [Principles of the magneto-telluric method, a new method of geophysical prospecting]: Annales Géophysique, tome 9, no. 2, p. 95–125, 1953. Translation published simultaneously as Basic theory of the magneto-telluric method of geophysical prospecting: Geophysics, v. 18, no. 3, p. 605–635, 1953.

From Ampere's Law (for a homogeneous earth) and from Maxwell's equations using the concept of Hertz vectors (for a multilayered earth), solutions are obtained for the horizontal components of the electric and magnetic fields at the surface due to telluric currents in the earth. The ratio of these horizontal components, together with their relative phases, is diagnostic of the structure and true resistivities of subsurface strata. The ratios of certain other pairs of electromagnetic elements are similarly diagnostic.

Normally, a magneto-telluric sounding is represented by curves of the apparent resistivity and the phase difference at a given station plotted as functions of the period of the various telluric current components. Specific formulae are derived for the resistivities, depths to interfaces, etc., in both the two- and three-layer problems.

For two sections which are geometrically similar and whose corresponding resistivities differ only by a linear factor, the phase relationships are the same and the apparent resistivities differ by the same proportionality constant which relates the corresponding true resistivities. This "principle of similitude" greatly simplifies the representation of a master set of curves, such as is given for use in geologic interpretation.

In addition to the usual advantages offered by the use of telluric currents (no need for current sources or long cables, greater depths of investigation, etc.), the magneto-telluric method of prospecting resolves the effects of individual beds better than do conventional resistivity methods. It seems to be an ideal tool for the initial investigation of large sedimentary basins with potential petroleum reserves.—*Abstract in Geophysics*

14646. Bleil, D. F. Induced polarization: A method of geophysical prospecting: Geophysics, v. 18, no. 3, p. 636–661, 1953.

Laboratory experiments have shown certain fundamental relationships concerning the induction of a polarization potential on a metallic body in an electrolyte. The potential induced is a linear function of the potential drop across the body in the energizing field up to a saturation potential of 1.2 volts. Diffusion of ions and chemical action are the predominant factors which determine the rate of growth or decay of the polarization potential. Polarization occurs only at the boundaries of electrically conducting minerals. The results of the laboratory experiments provide an explanation of the induced polarization potential of a homogeneous, uniformly mineralized earth. This potential falls off as I/r from a point electrode. Induced polarization susceptibility is defined and a method of analyzing field data is described. Field measurements over two mineralized zones (pyrrhotite and magnetite) substantiate the theory as developed.—*Author's Abstract*

14647. Davidson, Stanley. Electromagnetic induction method and apparatus for locating subterranean electrically conductive bodies, U. S. patent 2,652,530, granted September 15, 1953.

A low-frequency, two-coil electromagnetic induction apparatus adapted for mounting in a light aircraft.

14648. Bays, Carl A. Electromagnetic wave transmission system, U. S. patent 2,653,220, granted September 22, 1953. 10 claims.

A means of transmitting and receiving electromagnetic waves in a high resistivity lithologic stratum which is bounded by higher conductivity strata.

14649. Broding, Robert A. Electrical resistivity logging of mud invaded formations, U. S. patent 2,654,064, granted September 29, 1953. 6 claims. Assigned to Socony-Vacuum Oil Co.

14650. McMillan, Fred L., Jr. Apparatus for electrical well logging, U. S. patent 2,653,294, granted September 22, 1953. 11 claims. Assigned to Phillips Petroleum Co.

An electrical well-logging electrode structure.

14651. Martin, Philip W. Apparatus for logging wells while drilling, U. S. patent 2,650,067, granted August 25, 1953. 3 claims.

A resistivity logging device mounted in a drill string and adapted for logging operations while drilling.

14652. Glanville, Charles R. Method and apparatus for determining characteristics of earth formations, U. S. patent 2,645,752, granted July 14, 1953. 5 claims. Assigned to the Atlantic Refining Co.

A method of measuring the electrical resistance of rock cuttings.

ELECTRICAL SURVEYS AND WELL LOGGING

14653. Fritsch, Volker. Geoelektrische Untersuchungen zur Ermittlung der Blitzgefährdung [Geoelectric investigations in an inquiry on lightning danger of a site by lightning]: Geofisica Pure e Appl., v. 22, fasc. 1–2, p. 237–250, 1952.

A statistical survey by G. Lehmann on the frequency of lightning strokes in Saxony showed that the regions of ancient geologic formations are much more endangered than those of young formations. Fritsch's own measurements of the resistivity of the ground as well as statistical comparisons shows that the electric conductivity of the ground at sites more often hit by lightning is always greater than that of other places. He computes the electric resistivity of the ground for different parts of Austria and on the basis of statistical data makes a kind of zoning with reference to lightning danger of these sites. The possibility of evaluating this danger in advance on the basis of geoelectric resistivity measurements is pointed out.—*S. T. V.*

14654. Yriberry, A. J. Observatorio di fisica cosmica de San Miguel Argentina [The Observatory of cosmic physics San Miguel Argentina]: Observatorio di fisica cosmica de San Miguel Mem. no. 1, 54 p., 1952.

The observatory at 34°33′ S. lat., 58°44′ W. long., is equipped primarily for studies of cosmic rays, but contains also instruments for measuring and recording telluric currents. These are measured over a north-south line 3,000 m long. and an east-west line 2,580 m. Readings in mv per km are recorded and published in Boletin Mensual.—*S. T. V.*

14655. Kamprath, H. E. Bemerkungen zu dem Aufsatz von O. Keunecke über: Die Bedeutung geoelektrischer Untersuchungen für die Aufsuchung und Erschliessung von Erzlagerstätten [Remarks on the article by O. Keunecke on: The value of geoelectrical investigations in search and exploration of ore deposits]: Zeitschr. Erzbergbau u. Metallhüttenwesen, Band 4, Heft 12, p. 467–468, 1951.

Kamprath corrects some inaccuracies in Keunecke's article (See Geophys. Abs. 13030) as to persons managing the mines in question and disagrees with the Keunecke's interpretation of the results of geoelectrical investigation. In his opinion this investigation produced only negative results, later confirmed by exploratory mining.—*S. T. V.*

14656. Nöring, F. Die geoelektrischen Messungen im Schwanheimer Wald bei Frankfurt a. M. [Geoelectric measurements in Schwanheimer Wald near Frankfurt am Main]: Bohrtechnik-Brunnenbau, Jahrg. 1, Heft 10, p. 319–320, 1950.

Four wells were drilled to 50 m in an area which had been thoroughly investigated by geoelectric methods. The poor correspondence between actual and predicted strata confirms the value of test borings.—*D. B. V.*

14657. Schneider, Hans. Kann der spez. Widerstand der geoelektrischen Vermessungen als eine markante hydrologische Kennzahl bezeichnet werden? [Can the resistivity of geoelectric measurements be considered as an indicative hydrologic characteristic]: Bohrtechnik-Brunnenbau, Jahrg. 4, Heft 3, p. 75–87, 1953.

The region around Minden and Bocholt, Germany, was extensively explored for available underground water resources, using electrical-resistivity measurements by R. Ambronn and records of numerous test wells and geologic and petrographic investigations. From comparison of the results obtained by customary methods of interpreting resistivity curves with the evidence obtained from wells and pumping tests, Schneider concludes that the electrical method does not permit unequivocal interpretation, and that only with some drill-hole data and data on

the porosity and composition of the ground is it possible to make a correct or unique interpretation. The resistivity determined from geoelectric measurements is thus not a hydrologic characteristic.—*S. T. V.*

SEISMOLOGY

ELASTIC WAVES

14658. Coloma Perez, Antonio. Sobre la velocidad de propagacion de las ondas superficiales en un medio elastico-viscoso [On the velocity of propagation of surface waves through an elastico-viscous medium]: Rev. Geofísica, v. 11, no. 44, p. 319–327, 1952.

This is a mathematical study of wave motion along the surface of discontinuity separating two media, in a special case these media being the ground and the air. The ground is assumed to be isotropic, its elastic properties characterized by two Love coefficients, its viscosity by Sezawa coefficients. The velocities of propagation of longitudinal and transverse waves through the ground are given, and velocity of propagation of surface waves is sought. The two velocities (Rayleigh and Love) are determined by two equations of fourth power. If in these equations the coefficients of viscosity become zero, the equations take the form of the equations given by K. E. Bullen for Rayleigh and Love waves.—*S. T. V.*

14659. Heelan, Patrick Aidan. Radiation from a cylindrical source of finite length: Geophysics, v. 18, no. 3, p. 685–696, 1953.

This paper presents the results of a theoretical study of radiation from a cylindrical source of finite length, the walls of which are subjected to symmetric lateral and tangential stresses. Three divergent wave systems are generated, *P*, *SV*, and *SH*, and their amplitudes are calculated in terms of the stresses operative on the walls of the "equivalent cavity." The zonal distribution of amplitude in the three wave systems is calculated, and the total amount of energy in each is estimated. It is shown that under the action of a lateral pressure only, an *SV* wave of amplitude 1.6 times the maximum amplitude of the associated *P*-wave is beamed from the source in directions making angles of 45° with the axis of the source.—*Author's Abstract*

INSTRUMENTS AND METHODS OF OBSERVATION

14660. Dörmann, H. Das Magnettonverfahren bei Nahbebenregistrierungen [The magnetic tape recorder in recording near earthquakes]: Annales Géophysique, tome 8, fasc. 3, p. 286–293, 1952.

It is shown that it pays to use, for recording near earthquakes, seismographs with higher limiting frequencies than those used so far. The running cost may be kept low by the intermediate use of magnetic-tape recorders. After the evaluation and copying of each recorded earthquake, the tape can be wiped and used again. An instrument of this type is described, and first results are discussed. Application of the magnetic-tape recorder is recommended in geophysics wherever only short pieces of the records are used, that is, wherever rare events shall be recorded with high time resolution.—*Author's summary*

14661. Gamburtsev, G. A. Dva rezhima raboty gorizontalnykh mayatinkov [Two manners of the operation of horizontal pendulums]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 3, p. 201–208, 1953.

Two possibilities are analyzed of operating astatically adjusted horizontal seismograph. These two modes show great differences in attainable length of

the period of natural oscillations and therefore in sensitivity to inclination. To make possible the more advantageous mode of operation it is necessary to adjust the instrument so that the supporting wire is free of torsional force in the position of equilibrium. In this case the position of equilibrium of the system under the combined action of forces of elasticity and of gravity coincides with that when no elastic forces are acting. Results of the computations are represented by curves showing the rapid decrease of sensitivity of the seismograph when its supporting wire is twisted by even a fraction of a degree.—*S. T. V.*

14662. Debrach, J., and Bidault, G. Tremblement de terre au Japon enregistré au Maroc sur des magnétographes [Japanese earthquake recorded in Morocco on the magnetographs]: Soc. sci. nat. phys. Maroc Bull., tome 32, p. 3–9, 1952.

A destructive earthquake in northern Japan on March 4, 1952, was recorded at the observatory of Averroës, Morocco, not only on the three seismographs, but also on the magnetographs which were in operation at the time.

As the times of arrival of the different waves on the magnetograms coincided with those on seismograms, although the amplitudes were different, it is concluded that the recorded waves were the reproduction of mechanical impulses to which the instruments were exposed rather than the result of magnetic phenomena produced in the ground by seismic waves.—*S. T. V.*

14663. Girlanda, Antonino. La stazione sismica di Messina [The Messina seismic station]: Annali Geofisica, v. 6, no. 1, p. 47–59, 1953.

This is a brief historical sketch of the development of this observatory at lat. 38° 11.8′ N, long. 15° 33.3′ E, and a description of its present instrumental equipment, 2 Wiechert seismographs with mechanical registration, 2 Galitzin horizontal seismographs and 1 Sprengnether vertical seismograph, with photographic registration.—*S. T. V.*

14664. Vesanen, Eijo. The seismological station of Helsinki University: Geophysica, v. 5, no. 1, p. 11–16, 1952.

The seismological station at Helsinki University, damaged during the war, is being modernized. The two old Mainka horizontal seismographs are still in operation, and a new Galitzin type vertical seismograph was installed in January 1950. The constants of these instruments are given. A more sensitive horizontal torsion seismograph has been constructed and will be ready for use as soon as its recorder is completed.—*D. B. V.*

14665. Frank, Harold R., and Doty, William E. N. Signal-to-noise improvements by filtering and mixing: Geophysics, v. 28, no. 3, p. 587–604, 1953.

Laboratory reproducing equipment has made possible a record analysis service for seismic crews in areas of poor record. A signal representing a reflection is superimposed on actual field seismic noise to form a reproducible test record of known signal-to-noise ratios. The test record can then be subjected to various filtering and mixing arrangements and recorded. Noise- and signal-frequency spectra are measured by a mechanical Fourier analyzer to determine if separation is possible by filtering. This requires that the rejection of the filter must at least equal the rise of the noise level. Sharp filtering, peaked at the maximum signal-to-noise ratio, results in a usable record in an example shown.

Where filtering is inapplicable, two-channel or graded mixing may be employed. A signal can be brought out even where the noise spectrum is every-

where above the signal spectrum, as is shown in a second example. Graded mixing is superior where there is no step-out, but it has a detrimental effect where a substantial step-out exists. It is desirable to remove the step-out, elevation, and weathering effects before mixing. Extraneous picks are manufactured, but can often be detected because they are discontinuous from spread to spread.

Filtering may cause "filter ringing"; it is not a result of sharp filtering, but of rejecting a portion of the signal spectrum. The wave form may, therefore, have to be sacrificed to obtain time data.

Extreme filtering and mixing are justified if they result in usable records otherwise unobtainable and if the close control of reproducing equipment is available.—*L. C. P.*

14666. Alexander, Warren A. Detector for seismic exploration, U. S. patent 2,649,579, granted August 18, 1953. 4 claims. Assigned to Standard Oil Development Co.

A capacitator seismometer contained in a flexible tube.

14667. Piety, Raymond G. Seismometer, U. S. patent 2,653,306, granted September 22, 1953, 12 claims. Assigned to Phillips Petroleum Co.

A capacitive seismometer.

14668. Smith, Neal J., and Smith, Roberta I. Apparatus for detecting and recording measurements of seismic, gravity and other forces, U. S. patent 2,648,055, granted August 4, 1953. 15 claims.

A spring suspended electromagnetic seismograph which is power rotated about an axis normal to the spring, in which the output during rotation is measured.

14669. Stafford, John A. Seismic vibration detector, U. S. patent 2,651,769, granted September 8, 1953. 3 claims. Assigned to Century Geophysical Corp.

An inductive seismometer.

14670. De Shazo, Earl L., Jr. Method and apparatus for measuring the polarity of seismometers, U. S. patent 2,653,305, granted September 22, 1953. 6 claims. Assigned to Phillips Petroleum Co.

14671. McLoad, Kenneth W. Multiterminal seismic cable connector system, U. S. patent 2,654,077, granted September 29, 1953. 6 claims. Assigned to Socony-Vacuum Oil Co.

14672. Lash, Charles C. Marine seismometer spread, U. S. patent 2,652,550, granted September 15, 1953. 3 claims. Assigned to Stanolind Oil and Gas Co.

A marine seismometer spread adapted to be towed from a vessel through water.

14673. Vogel, Charles B. Well logging, U. S. patent 2,651,027, granted September 1, 1953. 4 claims. Assigned to Shell Development Co.

An electrical apparatus for generating acoustic waves in a borehole.

METHODS OF ANALYSIS OF SEISMIC SURVEY DATA

14674. Legge, John A., Jr. Problems of geophysical interpretation in Alberta: Canadian Min. Metall. Bull., v. 46, no. 489, p. 10–12, 1953.

Most geophysical failures in oil prospecting in Alberta are due either to insufficient seismic control or to velocity effects both near surface and at depth. The decision as to the amount of detail to be worked out in an area must be based on previous geophysical leads and geological clues; exploration of an area should be planned on the basis of the size of anomalies expected, otherwise small reefs might be missed.

Velocity variations in the sedimentary section may be due to the presence of the reefs sought, but may also be caused by variations in the weathered layer, including glacial drift, or in the Cretaceous sediments; by contrasts at the unconformity between Paleozoic and Lower Cretaceous strata; or by various combinations of these factors. The use of isopach or isochron maps eliminates some of the adverse velocity effects, but under some geological conditions a valid reef picture may give little or no isopach effect. In evaluating a particular anomaly, it is necessary to make all surface corrections as accurately as possible using the basic data, and then to evaluate the basic data in terms of the probable error contributed. If anomalies remain, they should be analyzed in the light of the regional geology so that at least the approximate magnitude of reef effects may be known. In this way some false "reefs" can be eliminated, but the borderline cases as yet remain a challenge to geologists and geophysicists.—*D. B. V.*

14675. Bediz, P. I. Interpretation of seismic data in locating reefs in Alberta: Oil in Canada, v. 5, no. 38, p. 52–54, 1953.

This is a reprint of the article in World Oil, abstracted as Geophys. Abs. 14297.—*D. B. V.*

14676. Wadsworth, G. P., Robinson, E. A., Bryan, J. G., and Hurley, P. M. Detection of reflections on seismic records by linear operators: Geophysics, v. 28, no. 3, p. 539–586, 1953.

A reflection seismogram is a statistical time series and is, therefore, amenable to analysis by a probabilistic approach. The application of linear operators was found to be the most satisfactory method and a multiple-prediction operator using several traces was preferred. A prediction error indicates dynamical change, such as the arrival of a reflection event. If the operator is chosen for a nonreflection interval and is applied to intervals during which reflections occur, the effectiveness of the operator is disturbed and large errors of prediction result. Reflections may be discriminated which are not evident by the standard visual method of "picking" reflection events. Several records furnished by the Magnolia Petroleum Co. were analyzed by the method. All company-marked reflections were detected, as well as several that were not visually observable.—*L. C. P.*

14677. Musgrave, Albert W. Wavefront charts and raypath plotters: Colorado School of Mines Quart., v. 47, no. 4, 60 p., 1952.

This paper covers the same ground in greater detail as the article abstracted as Geophys. Abs. 14298.—*L. C. P.*

OBSERVATIONS OF SEISMIC WAVES

14678. Wadati, Kiyoo, and Inouye, Win. On the *T* phase of seismic waves observed in Japan: Acad. Japan Proc., v. 29, no. 2, p. 47–54, 1953.

Observational data on the *T* phase as recorded in Japan are summarized. That recorded at Tori-shima from the Yoshino earthquake of July 18, 1952, was especially notable. The *T* phase is believed to be generated at the ocean bottom by the *SV* and *P* waves from the focus and transmitted through the water as a sound wave. A steep slope of the sea bottom is important to this mechanism of generation. Use of the *T* phase as a tidal wave warning is not regarded as valid.—*M. C. R.*

14679. Jolly, R. N. Deep-hole geophone study in Garvin County, Okla.: Geophysics, v. 28, no. 3, p. 662–670, 1953.

A deep-hole geophone study was made by The Carter Oil Co. in the Coleman Stephens No. 2 well in the Katie Pool of Garvin County, Okla. The deep-hole geophone was so constructed that it could be locked to the wall of the borehole, thus permitting reduced charges, reduced noise, reliable amplitude measurements, and the recording of reflections at depth. A surface geophone spread was recorded for purposes of comparison.

It was found that the pulse amplitude decays in proportion to the negative 2.6 power of travel time, as anticipated from theory and previous experiments. Several reflections were recorded from the deep-hole geophones, and they correlated quite well with the surface reflection traces. The corresponding reflection coefficients were determined from the amplitude and travel time data. The wave form of the pulse changed appreciably in the first 3,000 feet of path of travel—*L. C. P.*

14680. Mühlen, Walter v. zur. Über die seismische Wirkung tief verdämmter Sprengladungen [On the seismic effect of deeply set explosive charges]: Geol. Jahrb., Band 66, p. 425–432, 1952.

A drill hole on the west border of the Schneflingen salt stock provided an opportunity to study propagation of seismic waves undistorted by secondary reflected or refracted waves. Charges were detonated at depths of 15, 200, 280, and 340 m, and the resulting direct waves recorded by a series of mechanical seismographs. The nearest of these, at 2,700 m, gave quantitatively useful results. The first and only useful impulses in the seismograms showed a decrease in amplitude and increase in frequency with depth. An abrupt interruption in all but that of the 15 m shot indicated total absence of surface waves.

Vertical waves were measured with the seismograph at 340 m and the charge near the surface and with positions reversed. Though the waves traveled the same path, those from the surface shot showed twice the amplitude and correspondingly lower frequency than those from the deep shot. Ricker (Geophys. Abs. 13586) has shown that frequency depends on travel time or distance; his work does not indicate the dependence on depth of charge that is found in this study. This study is insufficient to throw light on the cause of such dependence, but Mühlen suggests as possible directions for theoretical study the fact that the surface shot took place in a semi-infinite body, the deep shot, in an infinite body; that propagation of elastic waves might be affected by degree of compression; and that absorption might be greater for higher frequencies.—*D. B. V.*

EARTHQUAKE OCCURRENCES AND EFFECTS

14681. Tams, Ernst. Materialen zur Geschichte der deutschen Erdbebenforschung bis zur Wende vom 19. zum 20. Jahrhundert [The history of German earthquake research up to the turn of the twentieth century]: Neues Jahrb. Geologie u. Paläontologie Abh., Band 95, Heft 1, p. 99–164; Heft 2, p. 165–292, 1952.

This is a very comprehensive history of the progress of knowledge of earthquakes and theories in Germany, from the time of von Humboldt through the first decade of the present century. The early investigations, necessarily from the macroscopic (and thus more purely geographic and geologic) point of view, formed the background for the development of modern geophysical methods which began in 1889 with von Rebeur-Paschwitz.—*D. B. V.*

14682. Tams, E[rnst]. Der gegenwärtige Stand in der Frage der Seismizität der Erde [The present state of the problem of the seismicity of the earth]: Neues Jahrb. Geologie u. Paläontologie Monatsh., Jahrg. 1952, Heft 11, p. 500–528; Heft 12, p. 529–544.

This is a review of the contributions to seismology made by various investigators during the first half of this century, beginning with Milne and de Montessus de Ballore.—*D. B. V.*

14683. Tams, E[rnst]. Über die regionale Verkoppelung der Erdbeben in Südwest-Europa und Nord-Afrika [Concerning the regional correlation of earthquakes in southwest Europe and northern Africa]: Neues Jahrb. Geologie u. Paläontologie Monatsh., Heft 4, p. 145–161, 1952.

Tams has studied the occurrence of approximately 2,100 earthquakes observed macroseismically or instrumentally in southern France, the Iberian Peninsula, Morocco, Algeria, and adjacent seas from 1909 to 1928, using simple statistical methods and the theory of probability. As previously noted in other areas, an endogenous, occasionally far reaching correlation is found to exist between individual earthquakes that seem to be completely independent in origin. The relationship is shown by numerous examples.—*D. B. V.*

14684. Stoyko, Nicolas. Sur les relations entre la variation de la rotation, l'oscillation libre et les tremblements de Terre [On the relation between the variation of rotation, free oscillation and earthquakes]: Acad. Sci. Paris Comptes Rendus, tome 234, no. 26, p. 2550–2552, 1952.

By the method of least squares, Stoyko derives the following equation from data for the period 1908–1942: $R=0.4335\ T+C_1=10.639\ A+C_2=21.954\ P+C_3$, where R=annual variation in earth's rotation in seconds, T=energy of deep-focus earthquakes in 10^{26} ergs, A=amplitude of Chandler period in seconds of arc, and P=duration of Chandler period in years. Plotted graphically, the results show very clear agreement, suggesting a common cause of the variations.

This could be the existence, above the zone of deep-focus earthquakes, of a layer in which matter is near the critical state. Relatively small changes in the interior would produce relatively large changes of volume in this layer and, consequently, displacement of the center of gravity and variation of the moment of inertia of the earth. If the energy produced by deep-focus earthquakes and acting on this layer increased, the amplitude of free movement and its period would increase and the earth's rotation decrease, while the geomagnetic field would likewise decrease.—*D. B. V.*

14685. Murphy, Leonard M., and Cloud, William K. United States earthquakes 1951: U. S. Coast and Geod. Survey Serial, no. 762, 49 p., 1953.

This is a summary of earthquake activity in the United States and Alaska, Hawaii, Panama Canal Zone, and Puerto Rico during 1951. Earthquakes are reported from 19 States. The strongest were those of January 23, October 7, and December 5, (intensity 7 modified Mercalli scale), all in California. A shock of intensity 9 occured on August 21 in Hawaii.

Geodetic work in the vicinity of Monterey Bay shows a systematic creep of the area southwest of the San Andreas fault relative to the area northeast. Data on tidal disturbances, fluctuations in well water levels, a table of instrumental epicenters for 1950, and a summary of strong-motion seismograph observations are included.—*M. C. R.*

14686. Molard, P[ierre]. Tremblements de terre des Petites Antilles (1944–1951) [Earthquakes in the Lesser Antilles (1944–1951)]: Annales Géophysique, tome 8, fasc. 3, p. 309–310, 1952.

This is an analysis of available earthquake data for the Lesser Antilles for 1944–1951, based partly on instrumental, partly on macroseismic evidence. Comparison of the distribution of the epicenters with the gravimetric map of the region shows that zones of seismic activity coincide with zones of negative anomalies.—*D. B. V.*

14687. Meyer-Abich, Helmut. Das Erdbeben von Jucuapa in El Salvador (Zentralamerika) vom 6. und 7. Mai 1951 [The Jucuapa earthquake in El Salvador (Central America) on May 6 and 7, 1951]: Neues Jahrb. Geologie u. Paläontologie Abh., Band 95, Heft 3, p. 311–336, 1952.

This paper includes a review of the geology and history of previous earthquakes in El Salvador, as well as a detailed account of the effects of the Jucuapa earthquake. The May 6–7 earthquake was the culmination of a period of increased seismic activity in Central America that began in October 1950 and that in general is connected with epeirogenetic movement.

The felt area was relatively limited (about 30 x 50 km), and therefore the focal depth was probably small (20 km or less). The strongest shock reached an intensity of 8 (Mercalli-Cancani-Sieberg scale). The immediate cause was sinking in a graben that extends from Ilopango to San Miguel between the chain of volcanoes and the main fault paralleling it 15 km to the north. A geologic-tectonic and an isoseismal map are given.—*D. B. V.*

14688. Due Rojo, Antonio. Die südspanischen Erdbeben von März bis August 1951 [The earthquakes of southern Spain from March to August 1951]: Neues Jahrb. Geologie u. Paläontologie Monatsh., Heft. 1, p. 4–5, 1952.

Between March 10 and the end of August 1951, the Observatorio de Cartuja at Granada recorded 90 tremors, all from the same epicenter (lat. 38.1° N., long. 3.7° W.) in the province of Jaén. No records exist of any previous seismic activity in Jaén. The two most intense were rated 8 on the Mercalli scale.—*D. B. V.*

14689. Shalem, Nathan. La seismicité du Levant [The seismicity of the Levant]: Israel Research Council Bull., v. 2, no. 1, p. 5–16, 1952.

Although numerous and destructive earthquakes have been reported in Levant since Bibical times, at present the seismicity is moderate. During the last 500 years only 11 earthquakes reached intensity 9. Since instrumental seismologic

studies began in 1927 several earthquakes have occurred, but only of intensity 3. The epicenters of most of these earthquakes about 100 km offshore were under the Mediterranean Sea.—*S. T. V.*

14690. Pinar, Nuriye. Étude géologique et macrosismique du tremblement de terre de Kurşunlu (Anatolie septentrionale) du 13 août 1951 [Geologic and macroseismic study of the Kurşunlu (northern Anatolia) earthquake of August 13, 1951]; Istanbul Univ. Fakultesi Mecmuasi, ser. A, tome 18, fasc. 2, p. 131–142, 1953.

On August 13, 1951, a violent earthquake of intensity 7 or 8 (Mercalli-Sieberg) occurred in the region of Kurşunlu, north of Ankara, Turkey. The coordinates of the epicenter were computed, using the method of Labrouste and Gilbert, as lat. 41°12′ N.; long. 32°51′ E. Details of the geology of the region and a description of the effects of the earthquake are given.

In the appendix certain details are given on the earthquake of March 18, 1953, in the Yenice-Gönen region, The coordinates of the epicenter are lat. 40° N., long. 21°30′ E. Both earthquakes caused a deep fracture extending more than 50 km in a southwesterly direction.—*S. T. V.*

14691. Savarenskiy, Ye. F., Linden, N. A., and Masarskiy, S. I. Zemletryaseniya Turkmenii i Ashkhabadskoye Zemletryaseniye 1948 goda [The earthquakes of Turkmenistan, especially the Ashkhabad earthquake of 1948]: Akad. Nauk SSSR Izv., Ser. geofiz., no. 1, p. 3–16, 1953.

Turkmenistan is the most seismically active region of the U. S. S. R., 86 earthquakes of intensity greater than 6 having occurred there since 1912. From studies of the intensity, epicentral location, and seismotectonic characteristics of these earthquakes, all instrumentally recorded, 2 seismic lines can be indicated: one passing through Krasnovodsk on the Caspian Sea, another crossing the region of Ashkhabad. Several earthquakes occurred also outside of these zones.

The Ashkhabad earthquake of October 5–6, 1948, was notable for its great intensity. The geographic cordinates of its epicenter have been determined from the records of 113 seismograph stations, all over the world, at about 37.75°–38.10° N. lat., 58.20°–58.60° E. long.

The probable depth of focus was 25–30 km. The foci of these shocks changed, but no regularity in the variations of its position noticeable during numerous and very intense aftershocks could be established. This is attributed to the very great volume of the focus.—*S. T. V.*

14692. Hée, A[rlette]. Catalogue des séismes algériens de 1850 à 1911 [Catalog of Algerian earthquakes from 1850 to 1911]: Inst. Physique du Globe Strasbourg Annales, tome 6, 3e pt., p. 41–49, 1950.

Earthquakes occurring in Algeria from 1850 to 1911 are listed according to the regions (bounded by designated latitude and longitude) in which they were felt. Where known, hour and damage are given as well as place and date.—*D. B. V.*

14693. Rothé, J. P. Les seismes de Kerrata (1949) et la seismicité de l'Algérie [The earthquakes of Kerrata (1949) and the seismicity of Algeria]: Inst. Physique du Globe Strasbourg Annales, tome 6, 3e pt., p. 3–49, 1950.

This paper originally appeared as a bulletin of the Carte Géologique d'Algérie (Geophys. Abs. 12565).—*D. B. V.*

14694. de Miranda, Rauhl. A seismicidade de Angola no ano de 1945 [The seismicity of Angola in 1945]: Univ. Coimbra Mus. Mineralog. Geol. Mem. e Noticias, no. 21, p. 1–9, 1948.

Four earthquakes were recorded in southwestern Angola in 1945, with epicenters at Humpata, Lóla, and two at Ganda. Three seismic lines are traced, and macroseismic characteristics of each earthquake are given. Intensity and noise are rated according to the Rothé and Davison scales, respectively.—*D. B. V.*

14695. de Miranda, Raul. A sismicidade de Moçambique no ano de 1945 [The seismicity of Mozambique in 1945]: Univ. Coimbra Mus. Mineralog. Geol. Mem. e Noticias, no. 21, p. 11–19, 1948.

The 4 earthquakes recorded in 1945 were in central and southern Mozambique, unlike those of 1943 and 1944, which occurred mainly in the north. Epicenters were at Vila Paiva de Andrada, Mavita, Lourenço Marques, and Namaacha. Characteristics of each are presented as for those of Angola (Geophys. Abs. 14694).—*D. B. V.*

SEISMIC SURVEYS

14696. Joset, A., and Holtzscherer, J. J. Seismische Eisdickenmessungen in Grönland und Island [Seismic measurements of the thickness of ice in Greenland and Iceland]: Phys. Verhandlungen, Jahrg. 3, no. 6, p. 152, 1952.

This is a summary of the paper presented at the meeting of the Deutsche Geophysikalische Gesellschaft and Meteorologische Gesellschaft in Hamburg in August 1952. More than 315 stations were occupied in Greenland alone, forming about 7.350 km of profiles. The seismic reflection method was found to be well adapted to the purpose; most of the arrivals of reflected waves were very clear, and in some instances as many as 3 reflections were observed. The wave velocity in the ice mass was estimated to range from 3,800 to 3,950 m per sec, according to the altitude of the region and the temperature of the ice, which was as low as —30 C. The thickness of the ice was found to be greater than 900 m at some points.

In Iceland similar determinations gave values ranging from 360 to 1,040 m. The refraction method at some stations gave values 50 to 100 m lower; the difference is attributed to the lower velocity in the ground moraine.—*S. T. V.*

14697. Förtsch, O[tto]. Analyse der seismischen Registrierungen der Grosssprengung bei Haslach im Schwarzwald am 28. April 1948 [Analysis of the seismic records of the big explosion near Haslach in the Black Forest on April 28, 1948]: Geol. Jahrb., Band 66, p. 65–80, 1952.

By analysing the seismic records of the 1948 explosion near Haslach, Förtsch traces 5 distinct waves from station to station. The longitudinal and transverse waves are both double waves, whose second parts follow the first at a definite time-interval with the same velocity; the fifth is a Rayleigh-wave. These waves travel through 4 layers, granite, diorite, gabbro, and peridotite, whose thickness at any station can be derived from the measured travel times. These calculations reinforced by magnetic and gravimetric data allow construction of a geologic profile from Haslach to Füssen, on the basis of geophysical measurements alone.—*D. B. V.*

14698. Lackenschweiger, H. Seismiche Aufnahmen in der Weststeiermark [Seismic surveys in western Steiermark]: Berg- und Hüttenmänn. Montash., Jahrg. 97, Heft 6, p. 111–113, 1952.

Details are given of a seismic survey in western Steiermark, made as the first step in exploration for new coal seams. Velocities measured in various formations were 2,100–2,800 m per sec in Tertiary, 3,200–3,800 m per sec in Cretaceous, 4,200–5,000 m per sec in Paleozoic, and 5,500 m per sec in crystalline rocks. Data were compiled in isochron maps with related profiles. Favorable structures were then drilled, but all proved barren.—*D. B. V.*

14699. Gamburtsev, G. A. Glubinnoye seysmicheskoye zondirovaniye zemmoy kory [Deep seismic sounding of the earth's crust]: Akad. Nauk SSSR Doklady, tom. 87, no. 6, p. 943–945, 1952.

During 1949–50 extensive seismic surveys were made in the northern part of the Tien Shan to explore the deep structure of the region, and determine its seismic properties. The reflection method was used at first but later the method of correlated refracted waves was used almost exclusively. To increase the depth of sounding, the length of profiles was increased to 400 km. Simultaneously the sensitivity of the seismographs was improved, greater amplification was introduced, and the geophones were distributed with optimum distance between them (see Geophys. Abs. 14285), suppressing the effect of background noise. It was found advantageous to use lower frequencies, down to 10 cycles per second for longitudinal waves and still lower frequency for transverse ones. Explosive charges were not increased, but the shots were usually made in holes covered with water and 20 to 25 m deep.

Two groups of waves were found to be typical for the region, one with the velocity of 6–7 kmps another with higher velocity 8–8.5 kmps. The former presumably the P^* wave propagating along the basalt layer, the latter is the P wave propagating along subcrustal surface. By constructing the corresponding travel time curves for these waves, the thickness of granite was determined to be 10–15 km, that of basalt 30–40 km.—*S. T. V.*

14700. Tvaltvadze, Guri. Stroyeniye zemnoy kory v verkhney Kartli [Structure of terrestrial crust in upper Kartalinia]: Akad. Nauk Gruzinskoy SSR Soobshcheniya, tom 11, no. 8, p. 479–482, 1952.

Four artificial explosions during 1941–45 in Borzhomi canyon (Caucasus), consisting of explosive charges ranging from 38 to 220 tons buried in drill holes 12 to 18 m deep, were observed at 3 permanent seismograph stations (Abastumani, Borzhomi and Tbilisi), a temporary station installed for the purpose, and on numerous geophones in the vicinity of the shot point and along the valley. Analysis of the seismograms indicates that the seismic velocities of longitudinal and transverse waves in the upper layer are 4.4 and 2.6 kmps respectively. The thickness of this layer ranges from 3.5 to 4.0 km. In the next layer the velocities are 5.6 and 3.2 kmps and its thickness is about 20 km. A still deeper formation was of equal thickness, but the seismic velocities were 6.7 and 4.0 kmps. A surface wave was also observed of a wave length of 3,390 m and velocity of 2.2 kmps.—*S. T. V.*

14701. Imbert, Bertrand. Sondages séismiques en Terre Adélie [Seismic sounding in Adélie Land]: Annales Géophysique, tome 9, no. 1, p. 85–92, 1953.

Seismic measurements were made at 4 points, 30, 80. 185, and 290 km from the coast on the meridian of the French base at Port-Martin. Near Port-Martin the

thickness of the ice was found to be 84 m, and the longitudinal velocity 3,100 m per sec. Ground roll was observed with velocity of 1,030 m per sec and period of 0.025 sec. The maximum velocity in the ice was 3,900 m per sec. Poisson's ratio was determinable at only 1 point where it was found to be 0.32. A velocity of 4,920 m per sec below the ice, presumably in granite gneiss, was observed at 1 point. The thickness of the ice at this point was found to be 190 feet. The thickness computed from the data on reflections at the same point was 205 feet.—*M. C. R.*

MICROSEISMS

14702. Lynch, J. Joseph. The Great Lakes—a source of 2-second period microseisms: Earthquake Notes, v. 24, no. 2, p. 17–18, 1953.

By means of tripartite stations set up east and west of the Hudson River and at Hot Springs, N. C., Lynch has identified Lake Erie as one source of certain 2-second microseisms observed at Fordham University. Apparently, when a cold front moves over the Great Lakes it causes waves in the water, which reflected from shore, give rise to standing waves on interfering with the approaching direct waves. The standing waves, pounding on the lake bed, give rise to ground waves having a velocity of ½ mps. Thus the passage of a cold front over the lakes is announced by seismographs in New York in a matter of minutes. Later, when the cold front itself arrives over New York, it gives rise to more pronounced microseisms caused by standing waves produced in the Atlantic.—*D. B. V.*

14703. Båth, Markus. Comparison of microseisms in Greenland, Iceland, and Scandinavia: Tellus, v. 5, no. 2, p. 109–134, 1953.

Microseismic amplitudes and periods recorded at Scoresby-Sund, Reykjavik, Bergen, and Uppsala in seven different cases from the years 1949–1950 are studied. At all stations the polar air is of essential importance for the generation of microseisms, whereas there is in general no close connection with the cyclone centers themselves. A coast effect is of importance for Scandinavia, whereas the source for microseisms recorded at Scoresby-Sund is located over the open ocean within the polar air. Standing ocean waves may be of importance at the Norwegian coast but in many cases not on the open ocean. The microseismic waves propagate much farther over the continent than along the ocean bottom. The microseismic periods in Scandinavia vary generally in parallelism with the amplitudes, in Iceland and Greenland generally not. Period minima and rapid amplitude increases are observed in Scandinavia when cold fronts cross the Norwegian coast. There is no sign of microseismic barriers in the Atlantic outside Scandinavia. The microseisms at Scoresby-Sund have a regular, group character; at the other stations they are generally continuous.—*Author's Abstract.*

RADIOACTIVITY

INSTRUMENTS AND METHODS OF OBSERVATION

14704. Wack, Monique. Dosage du potassium à l'aide de son reyonnement β dans les sels naturels de potasse [Determination of the proportion of potassium by means of its beta radiation in the natural potash salts]: Annales Géophysique, tome 8, no. 3, p. 337–341, 1952.

The beta radiation of the K^{40} isotope can be used to determine the KCl content of a sample, instead of the long and delicate chemical separation now used in

potash mines. The beta radiation is more suitable than gamma radiation for the small samples involved in laboratory measurements. From absorption curves, the law J Imp/min$=4.36X+11.2$ (J Imp/min=measured intensity, X=percentage of KCl) is found for artificial mixtures of NaCl-KCl, and J Imp/min$=3.6X+11.2$ for natural mixtures of potash salts. Comparison of values calculated from radioactivity with values obtained by chemical analysis shows that an accuracy of ± 2 percent is possible in the former method; the error is due to heterogeneity of the salt rather than to instrumental limitations.—*D. B. V.*

14705. Hée, A[rlette], and Lecolazet, R[ené]. Interprétation et utilisation de la mesure du rayonnement pénétrant des roches sur le terrain [Interpretation and utilization of the measurement of penetrating radiation of the rocks on the terrain]: Annales Géophysique, tome 8, no. 3, p. 316–319, 1952.

Measurements made in drill holes give the total penetrating radiation of a rock (Geophys. Abs. 14141), from which the concentration of radioactive substances can be calculated. The uranium equivalent is calculated by means of Eve's formula. If the K_2O and actual uranium content have previously been determined by other methods (chemical analysis and radon method, for instance), the thorium content can be determined with the same order of accuracy as in the very difficult thoron method. An advantage of this method is that it measures the radiation of approximately two tons of rock rather than of a small sample.—*D. B. V.*

14706. Lundberg, Hans. An attempt to interpret radioactive patterns obtained from airborne recordings: Geol. Assoc. Canada Proc., v. 5, p. 117–125, 1952.

The use of airborne gamma scintillation detectors in prospecting for oil and the author's theories relating radioactivity anomalies to the occurrence of oil and gas are summarized. *See also* Geophy. Abs. 13743, 13960, 13961.—*F. W. S.*

14707. Kirchheimer, Franz. Weitere Untersuchungen über das Vorkommen von Uran im Schwarzwald [Further investigations on the occurrence of uranium in the Black Forest]: Geol. Landesamt Baden-Württemberg Abh., Heft 1, p. 1–60, 1953.

The first chapter of this paper is concerned with methods of exploration for radioactive materials. The superiority of the scintillometer over the Geiger counter and its application to investigations of ore deposits, geologic mapping, and the potash industry are discussed. The remainder of the paper is devoted to description of occurrences of uranium ore and uranium-bearing manganese in the Black Forest.—*D. B. V.*

14708. Rothé, J[ean]- P[ierre], and Peterschmitt, É[lie]. Quelques mesures radiogéologiques dans les Vosges hercyniennes—Comparison des appareils Kolhörster, gammaphone et gammamètre [Some radiogeologic measurements in the Hercynian Vosges—Comparison of the Kolhörster, gammaphone, and gammameter instruments]; Inst. Physique du Globe Strasbourg Annales, tome 6, 3e pt., p. 77–90, 1950.

In order to compare instruments, 35 stations previously surveyed by E. Rothé (Geophys. Abs. 9058) were restudied. At 21 stations, measurements were made with gammaphone and Kolhörster electrometer; at 19, with gammameter (A. V.

P. 300) and ionization chamber. Procedure and results are presented in detail. In the first instance, agreement was found to be adequate, and the values obtained could be correlated by means of the formula $N=1.4K+6$ (N=gamma-phone reading, K=electrometer reading). In the second, the results were directly comparable ($X=1.25$ K, where X=gammameter reading). The gammameter is considered the most satisfactory for radioactive prospecting, the Kolhörster instrument the least.

This survey further served to confirm previous measurements absolutely and to indicate that different types of rocks exhibit characteristic degrees of radioactivity. A table gives the measurements for 27 different rocks.—*D. B. V.*

14709. Rothé, Jean-Pierre, and Peterschmitt, Élie. La radioactivité des Vosges hercyniennes [The radioactivity of the Hercynian Vosges]: Acad. Sci. Paris Comptes Rendus, tome 234, no. 16, p. 1610–1612, 1951.

This paper overlaps to some extent with the preceding, but is not merely a condensed version. The Kolhörster ionization chamber and A. V. P. gammameter are compared. Results obtained with the 2 instruments agreed; the empirical formula $X=1.31-0.65$ was established for correlation (X=gammameter reading, impulses per sec, I=ionization chamber reading, pairs of ions per cm^3 per sec). An altitude correction of 2.2—2.7 ions per cm^3 per sec was applied to account for cosmic radiation.

The radioactivity of the different formations observed is discussed briefly and a table gives I and the K_2O content of 14 characteristic rocks. On the whole, the correlation between K_2O content and content of radioactive elements noted by Evans (Geophys. Abs. 2648) is confirmed.—*D. B. V.*

14710. Chaminade, Robert. Ionizing radiation movable detecting device, U. S. patent, 2,645,722, granted July 14, 1953. 6 claims. Assigned to Commissariat a l'Energie Atomique (France).

A modified Geiger meter counter.

14711. Greenfield, Alexander, and Clayton, Joseph F. System for measuring radioactivity, U. S. patent 2,648,015, granted August 4, 1953. 9 claims. Assigned to Bendix Aviation Corp.

A means for measuring the intensity of radioactivity based on an ionization chamber and a balanced electronic circuit.

14712. Herzog, Gerhard, and Mazzagatti, Roy P. Detection and measurement of radiation, U. S. patent 2,648,781, granted August 11, 1953. 15 claims. Assigned to The Texas Co.

A radiation detector.

14713. Argabrite, George A. Alpha radiation detector, U. S. patent 2,652,499, granted September 15, 1953. 3 claims. Assigned to Pacific Transducer Corp.

A device for optically detecting alpha radiation from a radioactive sample.

14714. Froman, Darol K., Hinch, William H., and Watts, Richard J. Ionization chamber circuit, U. S. patent 2,651,726, granted September 8, 1953. 1 claim. Assigned to United States of America as represented by the U. S. Atomic Energy Commission.

A radiation-measuring apparatus of the ionization chamber type.

14715. Herzog, Gerhard. Combination induced and scattered gamma ray borehole logging, U. S. patent 2,648,780, granted August 11, 1953. 1 claim. Assigned to The Texas Co.

14716. Scherbatskoy, Serge A. Nuclear well logging, U. S. patent 2,648,012, granted August 4, 1953. 11 claims. Assigned to Perforating Guns Atlas Corp.

An apparatus for measuring the frequency of incoming particles and the magnitude of pulses.

14717. Herzog, Gerhard. Method of neutron borehole logging, U. S. patent 2,644,891, granted July 7, 1953. 6 claims. Assigned to The Texas Co.

14718. Herzog, Gerhard, and McKay, Alexander. Radioactivity method and apparatus for borehole logging, U. S. patent 2,652,496, granted September 15, 1953. 4 claims. Assigned to The Texas Co.

A neutron-logging device.

14719. Fearon, Robert Earl. Method and apparatus for increasing speed of well logging, U. S. patent 2,645,723, granted July 14, 1953. 2 claims. Assigned to Well Surveys, Inc.

An ionization-chamber circuit in which the potential across the chamber is maintained at a constant level by balancing the potential across primary and secondary resistors in series.

14720. Silverman, Daniel, Newton, George R., and Skinner, Jimmie. Automatic diameter compensation in radiation well logging, U. S. patent 2,648,778, granted August 11, 1953. 15 claims. Assigned to Stanolind Oil and Gas Co.

A method of measuring and compensating for intensity variations caused by changes in the diameter of the wells when stratigraphic formations in the wells are irradiated with penetrating radiations, permitting a log free of such variations.

ISOTOPE STUDIES AND AGE DETERMINATIONS

14721. Fleming, W. H., and Thode, H. G. Argon 38 in pitchblende minerals and nuclear processes in nature: Phys. Rev. v. 90, no. 5, p. 857–858, 1953.

The isotopic constitution of argon extracted from four pitchblende samples of different age and uranium concentration had been determined. The A^{36}/A^{38} ratio was found to vary by over three hundred percent with the greatest deviations from normal occurring in the ores with high uranium content. It is suggested that A^{38} has been produced in considerable quantities in these ores by nuclear reactions involving α-particles and/or the spontaneous fission neutrons.—*Authors' Abstract*

14722. Dansgaard, Willi. Comparative measurements of standards for carbon isotopes: Geochimica et Cosmochimica Acta, v. 3, no. 5, p. 253–256, 1953.

To provide a direct comparison between American and Scandinavian measurements on carbon isotopes, 2 American (Nier's and Urey's), 1 Swedish, and 1 Danish standard were measured, using a Consolidated-Nier Isotope-Ratio Mass Spectrometer in which CO_2 samples are admitted. It is shown that differences in O^{17} abundance may cause measurable errors.—*M. C. R.*

14723. Wickman, Frans E. Wird das Haufigkeitsverhaltnis der Kohlenstoff-isotopen bei der Inkohlung verandert? [Would the carbon isotope ratio be changed by carbonization?]: Geochimica et Cosmochimica Acta, v. 3, no. 5, p. 244–252, 1953.

C^{12}/C^{13} ratios were measured in three series of coal samples of Pliocene, Cretaceous, and Carboniferous ages, all of which had been thermally metamorphosed. The ratios do not seem to have been influenced by the metamorphism.—*M. C. R.*

14724. Reynolds, John H. and Verhoogen, J[ean]. Natural variations in the isotopic constitution of silicon: Geochimica et Cosmochimica Acta, v. 3, no. 5, p. 224–234, 1953.

The isotopic constitution of silicon in minerals and rocks has been examined. In general the Si^{30} content decreases as one goes from a high-temperature mineral (olivine) to a low-temperature pegmatite quartz to vein quartz to geyserite; the greatest isotope separation occurring in the last two steps which involve deposition from an aqueous phase rather than crystallization from a silicate melt. Organic silica deposited from sea-water (chert, marine diatomite) shows an increase in Si^{30} over olivine, whereas a fresh-water diatomite has an isotopic composition consistent with that of silicon from hot springs (geyserite). The isotopic composition of silicon in a stony meteorite is surprising, as it shows a lower Si^{30}/Si^{28} ratio than olivine or even plagioclase from a pegmatite. In general the distribution of the silicon isotopes is similar to that of oxygen isotopes reported by Silverman; some exceptions are noted. The variation in isotopic constitution of silicon is small (the maximum difference encountered in the ratio Si^{30}/Si^{28} being 3 per mil) indicating presumably a relatively simple geochemical history involving few opportunities for exchange with gas phases or aqueous solutions.—*Authors' Abstract*

14725. Thode, H. G., Macnamara, J., and Fleming, W. H. Sulphur isotope fractionation in nature and geological and biological time scales: Geochimica et Cosmochimica Acta, v. 3, no. 5, p. 235–243, 1953.

The S^{32}/S^{34} ratio in marine sulfide deposits, ranging from 22.08 in the oldest to 23.05 in the most recent, shows a striking correlation with geologic age. A greater scatter exists in the ratios in marine sulfates, but the results are in general parallel to those in sulfides. Older samples have about the same S^{34} concentration as in sulfides, and indicate there was little or no fractionation before 700–800 million years ago. Since that time the sulfides have been depleted and the sulfates enriched in the heavy isotopes of sulfur. The maximum spread in the present-day ratio is about 7 percent, or the fractionation expected if thermodynamic equilibrium of S^{34} were established between $SO^{=}_{4}$ and H_2S. The biologic sulfur cycle in nature provides a mechanism for exchange of sulfur isotopes between $SO^{=}_{4}$ and H_2S. It is likely that autotrophic organisms which oxidize H_2S were insignificant before 700–800 million years ago.—*M. C. R.*

14726. Noggle, G. R. The use of isotopes in soil research: Sci. Monthly, v. 72, no. 1, p. 50–56, 1951.

Both stable and radioactive isotopes provide a means for studying soil problems in place. This paper describes how isotopes of phosphorus, nitrogen, potassium, calcium, and sulfur are being used in soil fertility studies. The radioisotopes have several advantages over the stable isotopes, in that they require simpler apparatus, can be used in greater dilution, and can be followed over a period

of time because the organism does not have to be killed for study. They are used most commonly in spite of the risk in handling, and the greater difficulty in obtaining quantitative results. Of the minerals essential for plant growth, satisfactory isotopes are available for all except magnesium and boron.— *D. B. V.*

14727. Hosticka, Harold E. Radiosotopes and nuclear reactions applied to soil mechanics problems: Am. Soc. Testing Materials Special Tech. Pub. 134, p. 3–9, 1953.

This is the introduction to the symposium on the use of radioisotopes in soil mechanics held at a meeting of the Committee on Soils for Engineering Purposes at Cleveland, Ohio, March 1952. The general aspects of tracer techniques and techniques depending on the interaction of radiation with matter are discussed.—*F. W. S.*

14728. Belcher, Donald J., Herner, Raymond C., Cuykendall, T. R., and Sack, H. S. Use of radioactive material to measure soil moisture and density: Am. Soc. Testing Materials Special Tech. Pub. 134, p. 10–22, 1953.

Quick reliable measurements of soil moisture and density in place, needed for engineering purposes, can be made by determining the scattering of neutrons and gamma rays from suitable radiation sources. A radium D-beryllium or cobalt 60 source is contained in a cylindrical probe of less than 1-inch diameter along with a detector of slow neutrons or of gamma rays, respectively; the amount and character of the radiation scattered back toward the detector by the soil at various depths determines soil moisture to ± 1 lb of water per cu ft and soil density to ± 5 lb per cu ft. Measurements at the surface (using similar source, detector, and suitable shielding) are in the experimental stage and are less accurate than measurements at depths greater than 1 ft.—*F. W. S.*

14729. Lane, D. A., Torchinsky, B. B., and Spinks, J. W. T. Determining soil moisture and density by nuclear radiations: Am. Soc. Testing Materials Special Tech. Pub. 134, p. 23–34, 1953.

To determine rapidly soil moisture at depth and in place, a Ra–Be neutron source and detector foil (indium) are mounted in a probe designed for 2-inch-diameter holes. Fast neutron bombardment of soil results in reflection of slow neutrons which activate the detector foil, the activity of which after given exposure is related to water content of soil. To determine soil density, a gamma-ray source and detector are mounted in the probe. The gamma-ray absorption in soil is proportional to density, and the measured activity is related to soil density. Results to date are promising and further development is necessary.—*F. W. S.*

14730. Starik, I. Ye. Sovremennoye sostoyaniye radioaktivnykh metodov opredeleniya vozrasta drevnikh i molodykh obrazovaniy [Present status of radioactive methods employed for the determination of the age of ancient and recent formations]: Akad. Nauk SSSR Izv., Ser. geol., no. 6, p. 11–19, 1952.

In many practical problems it is important to determine the geologic age of formations. There are several methods available. Starik distinguishes between primary methods, in which the degree of radioactive disintegration of a known substance is used as indicator, and secondary methods in which phenomena produced by radioactive disintegration in surrounding bodies such as pleochroism in mica are used as determining factors. In chronologic determinations it is important to know the exact isotopic composition of the

primary substance as well as that of final products, if they are stable. Disintegration is assumed to be going on at a constant rate and must not be disturbed by other processes, such as leaching out of some of the products.

Of the several possible methods of radioactive disintegration the lead method and the helium method are recommended as the best. Other methods considered are the argon method and the strontium method. The carbon-14 method can be recommended, only for geologically short time intervals of not more than several thousand years.—*S. T. V.*

14731. Cahen, L. État actuel des recherches géochronologiques en Afrique Sud-Saharienne [Present state of geochronological research in south Saharan Africa]: Soc. belge géologie Bull., tome 61, fasc. 3, p. 272, 1952.

Ages are known for the Shinkolobwe pitchblende (600 million years), the Kibarian orogeny (1,000–1,100 million), and an ante-Kibarian orogeny (1,500 million) in central Africa. The two last are "chemical" ages, subject to correction when the results of isotype analysis are known. In general the ages date a diastrophism and constitute only an upper limit for the terrain involved, so that although over 15 determinations, mostly provisional, are known for the whole south Saharan region, correlation is still impossible. At least six successive pre-Cambrian diastrophisms are indicated.—*D. B. V.*

14732. Larsen, E. S. Jr., Keevil, N. B., and Harrison, H. C. Method for determining the age of igneous rocks using the accessory minerals: Geol. Soc. America Bull., v. 63, no. 10, p. 1045–1052, 1952.

The age of igneous rocks is determinable by a method based on the included accessory minerals. In the common igneous rocks, most of the lead is concentrated in the potassium minerals, and most of the radioactivity is in the zircon and other accessory minerals. The lead in the potassium minerals is believed to be mostly primary lead; that in zircon is probably chiefly radiogenic lead. By separating the zircon of fresh igneous rocks, determining the amount of lead with the spectrograph and the radioactivity by alpha counters, the age of Paleozoic and Precambrian rocks can be determined with an accuracy of approximately 90 percent. Basalts and gabbros may contain too few accessory minerals for satisfactory age determination by this method. Zircon is the most satisfactory mineral for this kind of determination. Apatite and sphene give high results and therefore must contain primary lead. Sphene gives erratic results.—*Authors' Abstract.*

14733. Collins, C. B., Lang, A. H., Robinson, S. C., and Farquhar, R. M. Age determinations for some uranium deposits in the Canadian Shield: Geol. Assoc. Canada Proc., v. 5, p. 15–41, 1952.

Fifty-two new age determinations, calculated from analyses of radiogenic leads, are given for as many radioactive samples from several localities, and the geologic setting and some mineralogical information are described. Most samples are from pitchblende deposits of hydrothermal origin; some are uraninites from pegmatites. The presence of radiogenic lead in galena from pitchblende deposits and the mineralogical evidence of replacement and reworking of pitchblende show that younger pitchblende deposits were probably formed by dissolution and redeposition of older deposits. The most reliable data on age are obtained by a combination of chemical and isotopic analysis of radiogenic lead extracted from uranium samples, and from an isotopic analysis of the lead extracted from galena found with the uranium.—*F. W. S.*

14734. Antevs, Ernst. Geochronology of the Deglacial and Neothermal ages: Jour. Geology, v. 61, no. 3, p. 195–230, 1953.

The major portion of this paper is devoted to a review of chronologies based on varved sediments and a revision of the estimates of the gaps in varve data.

The age of the Valders determined by this method is 19,000 years; the radiocarbon date of 11,400 years determined for the underlying Two Creeks forest bed is obviously erroneous. Errors in radiocarbon dating can result from change of proportions of C^{12} and C^{14} by contamination with younger organic matter and old carbonates, and by decomposition. Most contamination is promoted by ground moisture, but it can take place in dry caves visited by burrowing animals. Decomposition, performed mainly by aerobic bacteria, requires moisture. Under wet conditions, decay is believed to release relatively fewer C^{14} atoms than C^{12} atoms during its early stages, so that the samples give too low dates. However, occasional wetting does not seem to affect the radiocarbon content. The main tasks and problems are to determine which kinds of materials are usable and to find and recognize such materials. An extensive bibliography is included.—*D. B. V.*

14735. Wormington, H. M. Der urgeschichtliche Mensch in Nordamerika [Prehistoric Man in North America]: Quartär, Band 6, Halbband 1, p. 1–18, 1953.

This paper includes a short discussion of radiocarbon dating. The age of the Two Creeks forest bed underlying Valders drift in Wisconsin, which has been determined as 11,442 ±350 years, is too young for the latest Wisconsin ice advance. To account for such discrepancy, it has been suggested that under damp conditions of deposition, the C^{14} content may be higher than normal.—*D. B. V.*

RADIOACTIVITY OF ROCKS, WATER, AND AIR

14736. Festa, C[amilla], and Santangelo, M. Sulla fissione spontanea dell' uranio terrestre [On the spontaneous fission of terrestrial uranium]: Annali Geofisica, v. 5, no. 4, p. 551–560, 1952.

A rough determination of the Kr and Xe generated by the spontaneous fission of terrestrial uranium during the last 3.3 billion years (the assumed age of the earth) is made on the basis of recent data on the half life of U^{238}. It is concluded that the amount of Kr and Xe attributable to the fission of U^{238} and entering the atmosphere is negligible; and the amount of these elements retained in the earth's crust is more important. A determination of the amount of these elements in the rocks and in natural gas is said to be a very promising method for use in geophysical prospecting.—*S. T. V.*

14737. Földvari, A. The geochemistry of radioactive substances in the Mecsek Mountains: Acta Geol. Acad. Sci. Hungaricae, tomus 1, fasc. 1–4, p. 37–48, 1952.

Based on measurements of the relative radioactivity of sedimentary rocks with particular emphasis on coals, the accumulation of uranium in coal seams and coal shales is greater than in other rock types. Uranium in ionic condition forms an adsorptive or more probably an organic bond with certain organic compounds contained in coal and, under favorable circumstances, concentrates to a higher degree in coals than in its primary condition in magmatic rocks. In coal shales, the high radioactivity is attributed not only to uranium forming organic bonds with carbon compounds but also to uranium adsorbed on inorganic

substances, mainly clayey minerals. Data on the relative radioactivity of all rock types in the Mecsek Mountains [Mecsek Hegység] show Mesozoic limestones the lowest in activity, igneous rocks as intermediate, and Liassic coaly shales the highest.—*F. W. S.*

14738. Payot, Roger, and Jaquerod, Adrien. Distribution de la radio activité en Suisse [Distribution of radioactivity in Switzerland]: Soc. physique et histoire nat. Génève Mem., v. 42, fasc. 3, p. 253–320, 1953.

This paper gives the results of a general survey of the radioactivity of Switzerland. Payot and Jaquerod measured the radioactivity of 570 spring waters and 12 gases by means of an electrometer (±10 percent accuracy) and of approximately 100 rocks by means of a Geiger-Müller counter (±20 percent accuracy). Extensive tables present their data, with 167 additional spring-water measurements made by others in Switzerland and neighboring countries.

In general, radioactivity is found to be weak, and no uranium deposits are believed to exist. Radioactivity is associated with granites, gneisses, pegmatites, and Triassic and Liassic bituminous schists. If exploitation of rocks with low uranium content should ever be envisaged, possible regions would be the center of the Hercynian massif or the upper valleys of the Rhône and the Aare, the Tessin [Ticino] with its bituminous schists, and perhaps the Grisons [Graubünden]. Radioactive springs of undetermined origin are alined between the Jura and the Molasse basin, but they do not seem to originate in the bituminous beds.—*D. B. V.*

14739. Simpson, D. J. Correlation by means of radioactivity logging in the Witwatersrand system in the Klerksdorp area: Geol. Soc. South Africa Trans., v. 55, p. 33–52, 1952.

The method of correlation in the Witwatersrand system, using radioactivity logging equipment in narrow bore holes, has been applied to problems in the Klerksdorp area.

As in the goldfields of the Orange Free State [see Geophys. Abs. 13769], remarkable continuity of markers characterised by specific degrees of radioactivity was found, and extensive use has been made of these in the development of a classification covering the Upper Division of the Witwatersrand system and based entirely on the radioactive content of the sediments.

The Vaal reef is readily recognized on the radioactivity logs and extensive use was made of this in determining the position when core recoveries were incomplete, or the gold values too low to permit of positive identification.

Some aspects of variation in normal of the Ventersdorp lavas and the Dolomite are recorded and suggestions made as to the future use of such variations.—*Author's abstract*

HEAT

INSTRUMENTS AND METHODS OF OBSERVATION

14740. Jacobsen, Bent Bulow; Daly, Charles Trevor; Thomas, David Lane; Wolfson, Henry; Shepard, Stanley Carden; and Green, David. Thermosensitive resistance element, U. S. patent 2,651,699, granted September 8, 1953. 1 claim. Assigned to International Standard Electric Corp.

An indirectly heated thermistor enclosed in an evacuated envelope.

OBSERVED TEMPERATURES IN THE CRUST

14741. Kashpur, Ya. N. Geotermicheskiye usloviya kamennougol'nykh otlozheniy yugo-zapadnoy chasti Donetskogo basseyna [Geothermal conditions of coal deposits in southwestern part of the Donets Basin]: Akad. Nauk SSSR Doklady, tom. 86, no. 4, p. 809–812, 1952.

During 1949–1951, measurements of temperature were made in more than 200 drill holes in the southwestern part of the Donets Basin. The depths of the holes ranged from 400 to 1,500 m; and measurements, using electric thermometers, were made at 20 m intervals.

The geothermal gradients thus determined varied from 14.2 C to 36.8 C per km. It is suggested that a better thermal characteristic of geologic formations would be the temperature measured not at a certain depth below the surface of the earth, but at a definite plane with reference to sea level.

Kashpur finds that the temperature generally rises from synclines towards anticlines, reaching a maximum at the apex; the temperature rises from stratigraphically higher formations towards the older lower layers.—S. T. V.

VOLCANOLOGY

14742. Matschinski, Matthias. Sur la distribution des volcans á la surface de la Terre [On the distribution of volcanoes at the surface of the Earth]: Acad. Sci. Paris Comptes Rendus, tome 233, no. 12, p. 669–671, 1951.

Matschinski proposes the term "arch effect" to designate his concept of the origin of volcanoes. He does not intend the term "arch" to be taken in the structural sense, but rather as the transmission of the weight of heavy masses to relatively small surfaces of pressure (the "beginning of arch") which causes the superpressures necessary to explain the phenomenon of eruption. Volcanic arcs, particularly the Pacific "ring of fire," are treated briefly and mathematically.—*D. B. V.*

14743. Matschinski, Matthias. Distribution des volcans sur la surface de la terre [Distribution of volcanoes on the surface of the earth]: Soc. Géol. France Comptes Rendus, no. 12, p. 218–220, 1952.

Matschinski analyses the correlation between the physical characteristics of a volcanic arc and the activity of its volcanoes. A table of data for 17 arcs indicates that for the same radius of curvature, the more active volcanoes are more densely distributed. Moreover, more nearly straight arcs show feebler activity. This supports his general theory that the radius of curvature constitutes a volcanogenetic factor.—*D. B. V.*

14744. Neumann van Padang, M. Catalog of the active volcanoes of Indonesia (Pt. 1 *of* Catalog of the active volcanoes of the world, including solfatara fields.): International Volcanological Association 1951, 271 p.

Detailed data for each of the 128 Indonesian eruption centers (78 active volcanoes, 29 dying volcanoes, 21 solfatara and fumarole fields) are compiled under 5 headings: name and location, form and structure, activity, petrography, and bibliography.—*D. B. V.*

14745. Rade, J. Tectonics and associated volcanic activity in the central part of Australian New Guinea: Australian Jour. Sci., v. 15, no. 4, p. 115–117, 1953.

The geotectonic forces responsible for the New Guinea volcanoes are analogous to those causing the salt uplifts of northern Germany. Both are associated with

deep fissuring of the earth's crust which takes the form of two sets of faults. The volcanoes are alined along these two directions, reflecting the dominating trend lines of the central highlands of New Guinea and the mountain belt of Queensland.—*D. B. V.*

14746. Matschinski, M[atthias]. Quelques remarques sur les causes des éruptions volcaniques [Some remarks on the causes of volcanic eruptions]: Cashiers géol. Thoiry, no. 9, p. 77–79, 1951.

In Hawaiian-type eruptions the energy reserve is great and the forces necessary for extrusion relatively weak, so that the eruptions are maintained over a long period. The enormous forces manifested in more explosive types of eruptions cannot be constant, or the eruptions would not be intermittent. Rather, such eruptions are caused by the gradual building up of great pressures from relatively weak forces. The "arch hypothesis" explains how this can be accomplished, whereas the pressures invoked in theories involving isostasy, continental drift, or gases are inadequate.—*D. B. V.*

14747. Matschinski, Matthias. Sur les eruptions peléennes, pliniennes et hawaiiennes: [On Peleean, Plinian and Hawaiian eruptions]: Soc. géol. France Comptes Rendus, no. 16, p. 341–343, 1952.

In former papers Matschinski has advanced the "arch hypothesis" for the origin of volcanic eruptions, which is based on the fact that, on a small scale, isostatic equilibrium is never perfectly realized because of resistance to shearing. At depths of 10–15 km the forces resulting from this resistance may become concentrated at points analogous to the imposts of arches, thus producing the "superpressure" necessary to explain eruptions. Pressures much greater than the necessary minimum are easily obtainable. The theory is explained by means of a diagram and mathematical calculations, and a table gives values of altitude (calculated as "h probable" and "h possible" on the basis of two different values for the depth of compensation, R) for different horizontal distances, (radii of arcs or distance between "imposts") with geographic examples of each. The range in types from Hawaiian to Peleean is mentioned briefly as being caused by resistance to shearing, but at the point of eruption rather than above the impost.—*D. B. V.*

147948. Macdonald, Gordon A. The 1952 eruption of Kilauea: Volcano Letter no. 518, p. 1–10, 1952.

After being quiescent since 1934, Kilauea resumed activity on June 27, 1952. This is a detailed account of the eruption, which lasted until November 10, 1952.—*D. B. V.*

14749. Sicardi, L. Stromboli, Panarea e Vulcano (Eolie) nell'agostosettembre 1951 [Stromboli, Panarea and Vulcano (Isole Eolie) in August and September 1951]: Soc. italiana scienze nat. Atti, v. 91, fasc. 3–4, p. 212–219, 1952.

In August and September of 1951 Stromboli tended toward a state of solfataric quiescence punctuated by periods of normal vigor. On Isola Panaria, fumaroles constituted the most important manifestation of volcanism in the Isole Eolie between Isola Stromboli and Isola Vulcano. The activity of Vulcano was exclusively solfataric. Sicardi's measurements indicate an increase in temperature northwest of the crater, suggesting that future volcanic activity may possibly develop at this weak point.—*D. B. V.*

14750. Pitts, Forrest R. Morphology and historical eruptions of Mount Fuji: Michigan Acad. Sci. Papers, v. 36, p. 183–188, 1950.

This is a review of current knowledge of Fuji-san, based on Japanese sources. Tsuya's cross section is reproduced, showing that the present mountain is formed by 2 stratovolcanoes of different ages and composition, having individual cores, and separated by a series of mud flows. Two series of parasitic cones have been formed along lines of weakness, subsequent to the formation of the main body of the mountain. Fifteen eruptions have been recorded since writing was introduced into Japan, the earliest of which was in 781 A. D. Four have occurred since 1500, after 4 centuries of inactivity; Fuji-san therefore should not be considered totally inactive at present.—*D. B. V.*

14751. Mason, Arnold C., and Foster, Helen L. Diversion of lava flows at O Shima, Japan: Am. Jour. Sci., v. 251, no. 4, p. 249–258, 1953.

Lava flows during the 1951 eruption of Mihara Yama on O Shima, Japan, were partly blocked by a concrete building on the crater rim. Highly fluid lava filled the interior and poured out through the doors and windows on the opposite side. Observations made on the characteristics of the flows and the effect of this obstruction indicate that it is feasible to construct walls of sufficient strength to divert lava streams from inhabited areas. The pressure from hydrostatic head of the flow in most cases is small, as it consists of the vertical height of the lava column up to a point of relief which usually is nearby. The impact from momentum may be large, but it can be decreased by locating the wall where it does not face a steep slope, and where there are obstructions above it. Diversion walls should be diagonal to the slope and located topographically to direct the flow to a safe channel.—*Authors' Abstract*

14752. Alcaraz, Arturo, Abad, Leopoldo F., and Quema, Jose C. Hibok-Hibok volcano, Philippine Islands, and its activity since 1948: Volcano Letter No. 516, p. 1–6, and No. 517, p. 1–4, 1952.

The present activity of Hibok Hibok began in August, 1948. A discernible cycle of behavior consists of a short period of emission of smoke from the crater and slides of volcanic materials, with or without accompanying tremors; explosions, or steam blasts, with emission of heavy clouds of steam, ashes, and fragmentary materials, with possible nuées ardentes (main eruptive phase); disgorging of incandescent materials, emission of much ash and smoke, formation of agglomeratic flows, and occasional minor outbursts in the crater; decrease in amount of smoke and ejecta, possibly because of engulfment of the lava column. Eruptions took place in September 1948, June 1949, September 1950, and December 1951. The various manifestations of the activity, particularly their effect on lives and property, are described in some detail.—*D. B. V.*

TECTONOPHYSICS

14753. Jardetzky, W. S. Convection and zonal rotation in celestial bodies: New York Acad. Sci. Trans., ser. 2, v. 14, no. 7, p. 273–276, 1952.

Jardetzky believes that zonal rotation can be maintained by convection currents produced either by gravitational instability, lack of thermal equilibrium, or viscosity of radiation. Thus the hypothesis of convection currents in the Earth is related to the hypothesis of zonal rotation. The latter uses only the existence of such deviation from the rotation of a rigid body which is directed along parallels; the former provides a physical explanation for this deviation.

During the formation of continents, the Earth's crust became a solid shell (covering first only a part of the surface) under which currents of magma produced stresses resulting in horizontal displacements of the parts which formed ocean basins as well as those which became continents. This theory eliminates the need for the concept of continental drift. Folding occurred at places determined by distribution of forces. The existence of thicker portions of the shell, that is, shields, was a factor determining the number, position, and shape of existing continents.—*D. B. V.*

14754. Cailleux, André. Sur les théories orogéniques [On theories of orogeny]: Rev. géomorphologie dynamique, 4e année, no. 1, p. 37–38, 1953.

A theory of orogeny should account for the energy involved, the amount of contraction known, and the distribution of mountains in space and time. None of the current theories fully meets these requirements. Although reserving support of Matschinski's hypothesis, Cailleux gives him credit for having broken the narrow circle of theories based on convection or gravity, and thus stimulated new thinking on the problem.—*D. B. V.*

14755. Matschinski, M[atthias]. Refroidissement de l'écorce terrestre et orogénèse [Cooling of the earth's crust and orogenesis]: Rev. geomorphologie dynamique, 4e année, no. 3, p. 121–133, 1953.

Matschinski first answers some general objections to his theory and then answers specific objections raised by Cailleux and Fardin in great detail. In conclusion, he sums up his work as follows: The two basic postulates for the theory are that the local system Earth-immediate environment has been irreversible from the time the earth was entirely liquid till today, and that the energy reserve is finite and spontaneously depleting itself through radiation. As a consequence of this cooling, the crust formed over 80–100 percent of the surface, and cooled faster than the core. The crust therefore contracted more than the core, and cracked. Mountains were formed under the influence of this unequal contraction as well as of gravity. He stresses that the crust has never been more extensive than the core, and might even never have completely enveloped it.—*D. B. V.*

14756. Dive, Pierre. La derive des continents et les mouvements intra-tellurique [Continental drift and the movements in the earths' interior]: 90 p., Paris, Dunod, 1950.

Considerations favoring Wegener's hypothesis of continental drift, taken from geologic evidence, from the distribution of gravitational anomalies, and from paleontologic data are presented. Of main interest to the geophysicist is the analysis of the mechanical conditions and forces which, assuming sufficient plasticity of the terrestrial mass, would bring about horizontal displacements of continental blocks. The importance of this analysis is emphasized by E. Picard, permanent Secretary of the French Academy of Sciences, in his preface to the book.—*S. T. V.*

14757. Trechmann, C. T. Une nouvelle théorie orogénique [A new orogenic theory]: Cahiers géol. Thoiry, no. 8, p. 65–70, 1951.

This is a French summary of a theory which appeared in England in papers privately printed in 1945, 1948, and 1950. Mountains are attributed to lunar attraction, aided by pressure of sea water against ocean floors and the conti-

nental slopes, which helps force material inward and upward. Chemical changes, crystallization, metamorphism, and magmatization are caused by penetration of sea water; the exothermic heat produced renders the mass plastic and facilitates response to the forces of uplift.—*D. B. V.*

14758. Matschinski, Matthias. Sur l'origine des forces géodynamiques [On the origin of geodynamic forces]; Cahiers géol. Thoiry, no. 7, p. 59–64, 1951.

The basis of Matschinski's theory [Geophys. Abs. 12223, 13419] is the assumption that at a certain moment during cooling the crust of the earth had a smaller radius of curvature than the core and cracked into segments that became the continents; because of their smaller radius, these segments were subjected to horizontal forces of extension and contraction that can account for all fundamental geologic structures. The development of various types of mountain systems and the distribution of continents and oceans are explained by means of diagrams.—*D. B. V.*

14759. Hales, A. L. The thermal contraction theory of mountain building: Royal Astron. Soc. Monthly Notices, Geophys. supp., v. 6, no. 7, p. 458–466, 1953.

On the basis of temperature distribution given by Jeffreys the depth of the level of no strain is 59 km, the stress difference in the crust increase at the rate of 0.6 dyn per cm^2 per year, and the decrease in radius in 200 million years is 0.6 km. From relations between the decrease in radius and the heat loss per unit area, it is shown that the possible changes in the parameters will not bring agreement with geologic estimates of contraction. As stress differences increase much more rapidly in relation to strength at depths of 250 to 600 km, failure should begin there. On this basis the cross-sectional area of an ocean deep is 1400 km^2.

Compression of the lower mantle and the core, as a result of cooling between the surface and 700 km, is relieved by deep-focus earthquakes. Increases of about 3½ sec in the length of the day occur in a period of failure of the mantle. The heating effect associated with the compression of the core is of the order of 10^{17} erg per sec; during failure of the mantle the cooling effect is probably much greater. At present, energy dissipated in earthquakes is very much greater than strain energy generated by cooling.—*D. B. V.*

14760. Matschinski, M[atthias]. Le critérium eulerien de la stabilité des blocs continentaux, critérium d'orogénèse [The Eulerian criterion for the stability of continental blocks, criterion for orogenesis]: K. Nederland Akad. Wetensch. Proc., ser. B, v. 55, no. 4, p. 411–435, 1952.

Applying the Eulerian criterion to segments of the earth's crust, Matschinski has calculated the cases of bilaterial stress and of stress acting on all sides of a round block. Each of these is considered from the point of view of the compression theory (block whose radius of curvature coincides with that of the globe) and from Matschinski's own theory (blocks whose radius of curvature is smaller than that of the earth) [Geophys. Abs. 12223, 13419.]. The results are summarized in one table, and another gives relevant geographic and geologic data for the different continents. Comparison of the two tables shows that the latter hypothesis is more plausible. The compression hypothesis requires unlikely assumptions (for example, a crust made up of thin parallel beds without friction between themselves).—*D. B. V.*

14761. Matschinski, Matthias. Plissement d'un continent de forme approximativement triangulaire [Folding of an approximately triangular continent]: Acad. Sci. Paris Comptes Rendus, tome 234, no. 25, p. 2473–2476, 1951.

Continuing with the development of his geodynamic theory Matschinski calculates the case of folding in a roughly triangular continent, and finds that his theoretical results are confirmed by actual geographic data.—*D. B. V.*

14762. Matschinski, Matthias. Les limites des blocs continentaux [The limits of the continental blocks]: Soc. géol. France Comptes Rendus, no. 7, p. 105–108, 1952.

Matschinski proposes a precise definition for the term "block", which has heretofore been used in different senses for different hypotheses. According to his "law of altitudes" the true limits of continents lie between the —200- and —100-m isobaths.—*D. B. V.*

14763. Matschinski, Matthias. Stades de l'évolution du plissement sur un continent isolé [Stages in the evolution of folding on an isolated continent]: Cahiers géol. Thoiry, no. 10, p. 84–88, 1952.

The development of folding in an isolated continent is explained according to Matschinski's geodynamic theory by means of diagrams and calculations.—*D. B. V.*

14764. Matschinski, Matthias. Ressemblance des côtes atlantiques africaine et sud-americaine et developpement du plissement d'un continent isolé, comme corollaires de la théorie de continents en moyenne immobiles [Resemblance of the Atlantic coasts of Africa and South America and development of folding in an isolated continent, as corollaries of the theory of continents in an immobile medium]: Acad. Sci. Paris Comptes Rendus, tome 233, no. 25, p. 1653–1655, 1951.

Matschinski shows how the resemblance between the coasts of Africa and South America, imperfect at best, can be derived from his theory assuming immobile continents. He calculates the case of displacement of folding from the centers of continents toward their margins in the course of geologic time.—*D. B. V.*

14765. Cizancourt, H[enri] de. Deep tectonics and isostasy: Jour. Geology, v. 59, no. 1, p. 39–59, 1951.

A satisfactory geological interpretation of many gravity anomalies based on Airy's hypothesis of a floating crust seems impossible. The author therefore postulates a plastic deformation of a much thicker layer, in alternate anticlinal and synclinal undations, separated by surfaces dipping at approximately 45°. Such deformation, by the displacement of surfaces of equal density, causes gravity anomalies and disturbances of isostatic equilibrium. Examples are given, showing that the gravity anomalies observed in various regions (Hawaiian Islands, Mid-Atlantic Ridge, the Alps, the Mediterranean Basin) correspond in a satisfactory manner with those required by the hypothesis of plastic deformation.

The usual methods of calculation of the isostatic anomalies of certain regions indicate a large isostatic unbalance for which there is no adequate geological interpretation. The author's hypothesis shows that these same regions are in isostatic equilibrium. Although vertical adjustments tend to restore the isostatic equilibrium, there still remain pressure differentials which cannot be entirely suppressed by these vertical adjustments. They produce deep currents, the ef-

fect of which is to modify the previous isostatic equilibrium and, consequently, to provoke downward and upward movements in the mountain chains, as well as in the basins. The final result is a tendency to restore a stable equilibrium, in which the equal-density surfaces coincide with the equipotential surfaces, as before the deformation.—*Author's Abstract*

14766. de Sitter, L. U. Pliocene uplift of Tertiary mountain chains: Am. Jour. Sci., v. 250, no. 4, p. 297–307, 1952.

Modern tectonic theory, strongly influenced by the Alps, attempts to establish a causal connection between tangential compression (as expressed by folds, faults, and nappes) on the one hand and a succeeding uplift on the other. But Pliocene uplifts of virtually equal magnitude have taken place not only in the Alps, which were tremendously compressed from the Cretaceous to the Miocene, but also in the Pyrenees, strongly compressed but mainly without nappes in the Cretaceous and Eocene, the High Atlas, moderately compressed in the Eocene and Miocene, and the Anti-Atlas, not compressed since the Precambrian. Vertical uplifts of this sort are better considered causally connected with contemporary phases of tangential compression than with preceding phases.—*Author's Abstract*

14767. Longwell, Chester R. Tectonic theory viewed from the Basin Ranges: Geol. Soc. America Bull., v. 61, no. 5, p. 413–434, 1950.

After a review of the sedimentary, tectonic, and igneous record of the Great Basin, Longwell examines the evidence in the light of various tectonic theories. Weaknesses and inadequacies are found in the island-arc theory, the "blister hypothesis" and the similar oscillation theory, and in the theory of unaided isostatic compensation, either as a result of slow transfer of low-density material at depth or in response to erosion. More information is needed about the Basin Ranges to recognize the primary agent of deformation.—*D. B. V.*

14768. Kober, Leopold. Gastein. Geologie, Tektonik, Lagerstätten und Radioaktivität [Gastein—Geology, tectonics, ore deposits and radioactivity]: Berg- und Hüttenmänn. Monatsh., Jahrg. 98, Heft 6, p. 106–111, 1953.

Kober offers a "cosmo-geo-logical" theory to explain the geology of the region around Gastein [Badgastein]. He believes that nuclear reactions occurring when a granitic magma rose from the earth's core during Alpine orogeny gave rise to "atom gas", which brought in the ore deposits, mingled with vadose water to produce the hot springs, and still is emanated in tunnels. It dissolved rocks at depth and formed "migmas" (magma plus rock), of which the Reisenferner, Adamello, and Bergell rocks are examples. The central gneiss is declared to be older than Alpine, probably Variscan. The enrichment of the gneiss by soda at the expense of potash is attributed to atomic decomposition of K^{40} into Na+O under high pressure resulting from tectonic movement. Although physicists have rejected his theory as impossible, Kober believes it should be left to the test of time.—*D. B. V.*

14769. Knetsch, Georg. Diskussionsbemerkung zur Frage der Entstehung der mittelatlantischen Schwelle [Comments on the question of the origin of the mid-Atlantic swell]: Neues Jahrb. Geologie und Paläontologie Monatsh., Jahrg. 1950, Heft 4, p. 113–115.

It is suggested that ridges and basins of the earth's crust are analogous in origin to the pressure ridges and depressions formed in a salt crust as its subcrust shrinks by evaporation.—*D. B. V.*

14770. Chevallier, Jean-Maurice, and Cailleux, André. Durée du jour et forme de la Terre [Length of the day and shape of the earth]: Rév. gén. sciences pures et appl., tome 59, no. 9–10, p. 300–305, 1952.

The slow decrease in velocity of the earth's rotation is believed to have had a significant influence on the shape of the earth. The deceleration was greater in the past when the braking effect of lunar tides was stronger. The results of mathematical calculations (not given here) are compiled in a table which shows, for various points in geologic time, the length of the day, difference between equatorial and polar radii, distance between earth and moon, and period of lunar revolution. According to this table, since the beginning of geologic time the day has increased from 4.3 to 24 hours, the difference between radii has decreased from 460 to 21 km, the distance to the moon has increased from 2.8 to 60.3 times the earth's radius, and the lunar cycle has increased from 0.22 to 27.3 days. Chevallier and Cailleux believe that the resulting decrease in centrifugal force has caused the deformation of the earth's crust.

The fact that folding seems to decrease in magnitude from pre-Cambrian time to the present is cited to support this theory.—*D. B. V.*

14771. Melchior, P. J. Sur les fluctuations à longue periode de la vitesse de rotation de la terre et les characteristiques du mouvement chandlerien du pole, [On the long-period fluctuations of the rotational velocity of rotation of the earth and the parameters of Chandlerian movements of the pole]: Acad. Royle Belgique Bull., Cl. Sci., 5° ser. tome 38, p. 1044–1050, 1952.

From an analysis of the investigations of Kimura and Hittori, Melchior concludes that no correlation can exist between the Chandlerian movement of the pole and the fluctuation of the rotational velocity of the earth.—*S. T. V.*

14772. Matschinski, Matthias. Relation entre l'altitude moyenne et la superficie des continents [Relation between average altitude and area of continents]: Acad. Sci. Paris Comptes Rendus, tome 233, no. 6, p. 492–495, 1951.

This is a condensed version of the paper which has been abstracted in Geophys. Abs. 13419.—*D. B. V.*

14773. Young, Andrew. Glacial eustasy and the rotation of the Earth: Royal Astron. Soc. Monthly Notices, Geophys. supp., v. 6, no. 7, p. 453–457, 1953.

A rise in sea-level at the rate of 1 cm per century following a reduction in the extent of ice in glaciated regions results in an increase of the moment of inertia of the Earth about its axis of rotation sufficient to lengthen the day by 10^{-4} second per century provided there is no isostatic compensation. The consequent apparent secular acceleration of the Moon is 2 seconds of arc per century per century. The changes however are negligible if immediate and complete isostatic compensation occurs. A tentative discussion of climatic and glaciological evidence indicates that fluctuations of sea-level do occur and that their effect on the Moon's apparent acceleration may be appreciable. This re-opens the question of the cause of the Moon's apparent acceleration which is usually attributed to the deceleration of the Earth by tidal friction. The change in tidal friction due to a rise in sea-level is very small and has not been sufficient to produce the observed change in the Moon's acceleration.—*Author's summary*

14774. Lilly, J. E. Crustal tilting in the Great Lakes area: Bull. géod., no. 27, p. 61–70, 1953.

Examples of the tilting of the Great Lakes area are cited; both a progressive change of about 0.5 ft per 100 mi per century, and a seasonal oscillation of about 0.1 ft per 100 mi are noted. There are three possible explanations: the water surface is not always level; the crust is tilting; the level surface does not remain stable. It is concluded that the seasonal variations are due to the departure from level of the water surface resulting from meteorological causes. The progressive change, usually attributed to tilting of the crust after removal of the Pleistocene ice cap, could also be explained by a change in the direction of gravity, implying a change in the form of the geoid. There is some support for the latter suggestion in reports of the International Latitude Service, but it is not conclusive.—*D. B. V.*

14775. Corkan, R. H. A determination of the earth tide from tilt observations at two places: Royal Astron. Soc. Monthly Notices, Geophys. supp., v. 6, no. 7, p. 431–441, 1953.

This paper, which was almost completed by Dr. Corkan just before his death in 1952 [and revised slightly and completed by A. T. Doodson], gives a method of analysing observations of the tilting of the Earth's surface. The method combines observations from two places and assumes only that the body tilt due to the direct yielding to the attractive forces is simply related to the equilibrium form, but with a constant phase lag, and that the semidiurnal constituents in the load tilt have the same ratios as in the loading tide. It is shown that these ratios are very stable over large parts of the oceans, and a useful table is given for the main seas and oceans. This method avoids the uncertainties of computation of the loading tide which have caused many difficulties in previous investigations, and it automatically eliminates the greater part of the secondary effects of the more distant oceanic tides.—*Author's summary*

INTERNAL CONSTITUTION OF THE EARTH

14776. Ramirez, J. E. La sismologia investiga el interior de la tierra [Seismology explores the interior of the earth]: Acad. Colombiana Cienc. exactas fis. y nat. Rev. v. 9, no. 33–34, p. 32–36, 1953.

Basic conclusions on the earth's structure derived from observations of seismic phenomena, are presented.—*S. T. V.*

14777. Tyrell, G. W. Major earth problems and tectonics: Science Progress, v. 41, no. 161, p. 101–110, 1953.

This is a review of current theories on the internal constitution of the earth, isostasy, orogenesis, and submarine geology.—*D. B. V.*

14778. Gamow, G[eorge]. Expanding universe and the origin of galaxies: K. Danske Vidensk. Selsk. Mat.-fys. Meddel., bind 27, nr. 10, 15 p., 1953.

The energy density in an expanding thermal radiation changes as the inverse fourth power of linear dimensions, whereas matter density changes as the inverse third power. (Until one hundredth of the present age of the universe, gravity is a negligible factor.) The density functions of matter and radiation, plotted graphically, intersect at a point where $t=2.2\times10^{16}$ sec (7×10^{7} years),

$\rho=1\times10^{-25}$g/cm^3, and $T=320°$ K. It is concluded that during the first two hundredths of its history, expansion of the universe was ruled by radiation; particles of matter were uniformly distributed through space, knocked about by light quanta. After that, it was ruled by matter and the protogalaxies were formed.

Substituting these values in Jeans' formula for gravitational instability, the minimum diameter of gravitational condensation is calculated to be 5×10^{21}cm, or 5,000 light years, and the minimum mass of condensation, 10^{40}g, or 5×10^6 sun masses. A correction for turbulence in the primordial gas brings the calculated minimum mass value to the observed value. Without turbulence gravitational condensation would not have developed within the time period allowed by the age of the universe. Holmberg's curve for the distribution of galactic masses suggests, not only by numerical agreement but by its very shape, that there existed a lower threshold for the existence of protogalaxies.

In the first half hour of the universe, thermonuclear reactions caused the originally dissociated neutrons, protons, and electrons to form the atomic species. The density value which must be assumed in order to arrive at the observed distribution of the elements agrees with that obtained by Gamow's theoretical calculations.—*D. B. V.*

14779. Bullen, K. E. Theories on the evolution of the planets: Australian Jour. Sci., v. 15, no. 1, p. 1–5, 1952.

Theories of the evolution of the planets are "surveyed with a view to providing a background to a short discussion of the somewhat radical ideas recently put forward by Harold C. Urey." The theories range from those of Kant, Buffon, and Laplace to those of von Weizsäcker and Kuiper. Two points raised by Urey in rejecting Ramsey and Bullen's suggestion that the material between 2,900 and 5,000 km is silicate in a high-density modification are considered. Bullen's calculations have shown that Elsasser's argument based on an interpolation between Bridgman's high-pressure experimental data and calculations of Feynman and others on a Thomas-Fermi-Dirac model is invalid. The supposed incompatibility of observational data on Mars and Mercury with such a constitution is explained. Bullen observes that Urey's theory may need some reinvestigation on a number of geophysical questions, but "geophysicists themselves will need to re-examine various aspects of their own theories in the light of many questions raised by Urey."—*M. C. R.*

14780. Brewer, Leo. The equilibrium distribution of the elements in the earth's gravitational field: Jour. Geology, v. 59, no. 5, p. 490–497, 1951.

The Gibbs equation for equilibrium in a multicomponent system has been applied to the equilibrium distribution of elements in the earth's gravitational field. In contrast to the conclusions reached by use of the commonly used binary equation, one finds that atomic weight and partial molal volume alone do not determine whether an element should concentrate up or down. The chemical interactions are very important and can reverse the trend expected from the density. Although accurate data are not available, reasonable estimates of the necessary thermodynamic data can be obtained for prediction of expected trends. Thus in the case of uranium one can show that it should concentrate toward the surface of the earth in an equilibrium system. However, it was not possible to use these conclusions to test the various theories for the formation of the earth, since it is possible to explain such a distribution using either of the commonly advanced theories.—*Author's Abstract*

14781. Daly, Reginald A. Origin of "land hemispheres" and continents: Am. Jour. Sci., v. 249, no. 12, p. 903–924, 1951.

Daly presents a hypothesis for the distribution of ocean basins and continents that emphasizes the influence of lunar tides when the moon was close to the earth and the day only a few hours long. Differentiation of the originally peridotitic earth shell into sial and sima occurred by vertical gravitative separation of the products of fractional crystallization under the influence of the strong positive and negative tidal tensions occurring every few hours. These tensions caused the young crust to be cracked into separate floelike pieces, each liable to upending, foundering, and differential melting in depth, with the ultimate result that a stable sialic layer was formed at the surface. Juvenile gases helped the process by speeding convection and by promoting crystallization at the surface as they escaped into space. Horizontal segregation into Pangaea may have been the result of the gravity pull of the moon on the moon-made tidal bulges of the molten earth, which caused the free-floating sial floes to collect into a single mass about 10 km thick covering about half the globe. The surface of the exposed basic liquid crystallized into a permanent sialsimatic crust. Subsequent continental drift would account for the present distribution of land and sea.—*D. B. V.*

14782. Bullen, K. E. The rigidity of the Earth's inner core: Annali Geofisica, v. 6, no. 1, p. 1–10, 1953.

The evidence for the existence of significant rigidity in the Earth's inner core is summarized and discussed in the light of recent work. Quantum-mechanical calculations, based on a Thomas-Fermi-Dirac model, suggest that an earlier estimate of 3.6×10^{12} dyn/cm^2 for this rigidity may need to be reduced by 0.5×10^{12} dyn/cm^2. The theoretical travel-times of the phase *PKJKP* would then need to be increased by amounts ranging from zero to 40 seconds. It is shown that the use of Gutenberg's seismic data in place of that of Jeffreys would reduce the estimated rigidity of the inner core by a further 1.6×10^{12} dyn/cm^2, approximately. It is suggested that Gutenberg's data lead to the lowest likely value for the rigidity of the inner core, namely 1.5×10^{12} dyn/cm^2, so that, on all present evidence, it is improbable that the inner core is less than about twice as rigid as steel is at zero pressure.—*Author's Abstract*

14783. Bondi, H., and Lyttleton, R. A. On the dynamical theory of the rotation of the earth. Pt. 2: The effect of precession on the motion of the liquid core: Cambridge Philos. Soc. Proc., v. 49, pt. 3, p. 498–514, 1953.

An account is given of an investigation of the effect of precession on the motion of the earth's core. It is assumed that the core is a spherical liquid mass of uniform density and that its motion is coupled to that of the external shell through the effects of viscosity. The shell has uniform angular velocity about its own polar axis while the latter precesses with uniform angular velocity about the polar axis of the ecliptic.

The equations for steady-state motion are derived for the interior and boundary layer. A solution is obtained for the latter, but no solution in terms of analytic functions consistent with the boundary conditions was possible for the interior. It is concluded that the precessional motion imposes a motion on the fluid interior which cannot remain permanently steady unless the viscosity is extremely high and that the onset of turbulence occurs mainly near the surface of the core and in latitudes 30° N and 30° S.—*R. G. H.*

14784. Cagniard, Louis. Sur la nature des ondes séismiques capables de traverser le noyau terrestre [On the nature of seismic waves capable of traversing the core of the earth]: Acad. Sci. Paris Comptes Rendus, tome 234, no. 17, p. 1705–1706, 1952.

Cagniard advances the opinion that the abrupt change in velocity of seismic waves on passing from mantle to core is not due to differences in elasticity and density but to differences in electrical conductivity, which is very high in the core. The geomagnetic field causes the circulation of electric currents in the core, currents induced shortly after formation of the Earth. The conductivity of the core must be several hundred times greater than that of copper, otherwise the currents would have died out by now. The only seismic wave capable of traversing the core is the transverse wave whose elongation is in the same plane as the magnetic field and the normal to the wave plane.—*D. B. V.*

GENERAL GEOPHYSICAL EXPLORATION

14785. Haalck, H[ans]. Lehrbuch der angewandten Geophysik, Teil I [Textbook of applied geophysics, Part 1]: 259 p., Berlin Gebrüder Borntträger, 1953.

This is the first volume of the much enlarged and completely revised textbook of applied geophysics, first published 20 years ago. The introductory section contains a general discussion of geophysical methods used in exploration of the crust and data on the physical properties of different parts of the lithosphere. Gravity and magnetic exploration methods are discussed in detail.—*S. T. V.*

14786. Melchiori, Jorge. Geofísica minera [Mining geophysics]: Minería, año 1, no. 3, p. 37–46, 1953.

This is a review of geophysical methods useful in mining, particularly those which are practical for smaller scale operations. The electrical, magnetic, and radioactive methods of prospecting for or defining ore bodies are considered.—*D. B. V.*

14787. Cortes, Henry C. Geophysical progress: Geophysics, v. 18, no. 3, p. 510–524, 1953.

This is a discussion of advances in geophysics since 1940. Emphasized are the improvements in instrumentation, field operations, and interpretation methods in magnetic, seismic, and gravity exploration, and the increased geologic-geophysical coordination.—*M. C. R.*

14788. Closs, H[ans]. Die Geophysik im Amt für Bodenforschung [Geophysics in the Amt für Bodenforschung]: Erdöl u. Kohle, Jahrg. 6, Heft 2, p. 60–63, 1953.

This is the address presented at the opening ceremonies for the new building of the Amt für Bodenforschung by the chief of its geophysics section. The great scientific and economic value of geophysical methods of exploration are cited with examples of important work in Germany in search for oil, primarily by seismic methods, in prospecting for water by electric methods, and in search for potassium deposits by the radioactive method.—*S. T. V.*

14789. Gussow, William Carruthers. Carboniferous stratigraphy and structural geology of New Brunswick, Canada: Am. Assoc. Petroleum Geologists Bull., v. 37, no. 7, p. 1712–1816, 1953.

The Carboniferous stratigraphy of New Brunswick is described in some detail and the structure is discussed and illustrated by geological maps and cross sections. An attempt is made to record many of the data accumulated by geological surface mapping and by seismic, gravimeter, and magnetometer surveys, and to interpret them in the light of recent wildcat drilling and other subsequent geological information. Particular emphasis is placed on the use of seismic surveying in rationalizing the complex structure of the area and in interpreting the attitude of faults in depth. It is felt that sufficient information is now at hand to provide a clearer geological picture of the area.

A new subdivision of the Pennsylvanian strata of New Brunswick is presented. The time break between the Mississippian and Pennsylvanian is pre-Enrage, coinciding with a major period of deformation. A still older period of deformation is now recognized within the Moncton group; this marks the close of Horton time. Due to lack of subsurface control in the greater part of the Moncton basin and the absence of lithological or paleontological horizon markers generally, it is usually impossible to subdivide the Upper Red Bed series which is mapped as the Moncton group. Accordingly, although the Hillsborough formation is still shown as belonging to the Moncton group, it is definitely recognized as being post-Horton in age and as such is more closely related to the Windsor in time.

Abundant evidences of oil exist and large structures in which oil could accumulate are known to occur; however, wildcat drilling to date has failed to find suitable permeability.—*Author's Abstract*

14790. Eckhardt, E. A. Geophysical activity in 1952: Geophysics, v. 13, no. 3, p. 501–509, 1953.

Geophysical activity during 1952 reached an all-time high. The rapid rise in seismograph operations which began early in 1950 culminated in October 1952 and has since declined about 10 percent. The increased volume of seismograph operations was largely concentrated in the Williston basin. More than half the gravity operations were in Texas and Louisiana. Between $350 million and $400 million was spent for geophysical work by the oil industry; the mining industry reports spending well over $5 million for its field operations, geophysical research and development.—*M. C. R.*

14791. Link, W. K. Oil exploration in Surinam: Geologie en Mijnbouw, jaarg. 15, no. 6, p. 249–250, 1953.

Geophysical exploration of Surinam for oil was begun in 1939, when 15 refraction profiles were shot. In an exploratory well the basement complex was found at 1,500 m just 100 m deeper than predicted on the basis of seismic work. No indication of oil or gas was found. A fluorescent survey following the seismic exploration gave very discouraging results, which were confirmed by drilling.—*S. T. V.*

14792. Mason, John F., Von Estorff, F. E., Hedberg, Hollis D., Heater, W. E., and Barnwell, George F. 1952 developments in foreign petroleum fields (South American and Caribbean, Europe, Africa, Middle East and Far East): Am. Assoc. Petroleum Geologists Bull., v. 37, no. 7, p. 1586–1712, 1953.

In 5 reports by individual authors summaries of the petroleum exploration, drilling and production for 1952 are presented for South America and the Caribbean area, Europe, Africa, the Middle East and the Far East. Both geologic and geophysical exploration activities are summarized for each area.—*L. C. P.*

14793. Schultz, P. R. Oil-discovery trends: Am. Assoc. Petroleum Geologists Bull., v. 37, no. 7, p. 1572–1585, 1953.

Oil-discovery trends are needed in forecasting long-term availability of oil; a knowledge of anticipated discovery costs is useful in evaluating the economic feasibility of synthetic fuels. An analysis of oil-discovery trends based on several different criteria, such as new discoveries, exploratory wells drilled, reserves added, and dry hole percentage, reveals that the composite picture of exploration activities is satisfactory. The discovery rate is still upward, and there is no indication that the country is running out of oil or should turn to extensive importation or synthetic fuels. One reason for the continued high success is that sound geologic and geophysical advice, along with better drilling and completion techniques, is the basis for drilling wells. Many geologists and geophysicists believe that major new fields will be found in the future as a result of a more adequate integration of geology and geophysics.—*L. C. P.*

14794. Pickett, G. R. The relation of the physical properties of reefs to geophysical exploration: Mines Mag., v. 43, no. 7, p. 23–29, 1953.

There are four types of modern reefs, composed principally of corals and calcareous algae. Presumably ancient reefs are similar to modern ones, although the conditions of deposition may have been quite different. Ancient reefs of economic importance occur in the Silurian, Devonian, and Permian periods. Reefs typically have blocky, irregular, almost vertical lateral boundaries and relatively flat tops. The density of reef material is variable, but may be less than that of pure limestone; reef-material velocity may be less than that of pure limestone, but is often greater than that of the surrounding rock material.

Magnetic methods will not be useful in the direct location of reefs, but may help to determine the relationships of reefs with basement uplifts. Extremely detailed gravity surveys may occasionally locate reefs but are not generally applicable. Seismic-reflection surveys remain the most reliable geophysical method of locating reefs. Discoveries may result from direct structural mapping of the reef surface, evidence of compaction in the surrounding materials, or velocity anomalies in reef areas. Great detail is required for success.—*L. C. P.*

14795. Oil in Canada. Seismic crew at work: Oil in Canada, v. 5, no. 38, p. 34–44, 1953.

The annual exploration issue of Oil in Canada includes this review of geophysical activity in Canada for the first half of 1953, which shows a decrease compared with 1952. Number and location of crews in the field and comparative costs are given for the various types of operations. New methods and instruments, particularly the "muskeg crawler" and light weight seismograph equipment, are mentioned. Photographs show a seismic crew in action.—*D. B. V.*

14796. Oil in Canada. Unique crawler walks on muskeg: Oil in Canada, v. 5, no. 38, p. 56–60, 1953.

This is a description of the new amphibious vehicle developed for muskeg and snow that is expected to permit year-round geophysical exploration in thousands of square miles hitherto inaccessible for 7½ months a year.—*D. B. V.*

MISCELLANEOUS PATENTS

14797. Morrow, Marvin E. Galvanometer having balanced coil assembly, U. S. patent 2,646,546, granted July 21, 1953. 3 claims.

14798. Hawkins, James E., and Finn, Robert S. Rectifier balancing circuit, U. S. patent 2,647,205, granted July 28, 1953. 3 claims. Assigned to Seismograph Service Corp.

14799. Johnson, Ford Lawrence, and Mayes, Fred M. Elevation meter, U. S. patent 2,647,323, granted August 4, 1953. 30 claims. Assigned to Sun Oil Co.

A means of determining elevation differences by recording the displacement of a pendulum from a predetermined position in a moving vehicle.

14800. Jakosky, John Jay. Well logging method and apparatus, U. S. patent 2,648,056, granted August 4, 1953. 15 claims. Assigned to Union Oil Co. of California.

A method for measuring the dimensions of fluid-filled subsurface openings by sonic impulse emitter and sound-sensitive receiver, together with a reflector at a known distance for velocity determination.

14801. Cornett, Jesse R. Transducer testing apparatus, U. S. patent 2,648,979, granted August 18, 1953. 27 claims. Assigned to Seismograph Service Corp.

14802. Clewell, Dayton H. Automatic mapping device, U. S. patent 2,649,781, granted August 25, 1953. 5 claims. Assigned to Socony-Vacuum Oil Co.

A system for obtaining the relative movement between a stylus and a map support in a vehicle to indicate its position and trace its course, using an azimuth-sensitive detector.

14803. Morrow, Marvin E. Oscillograph galvanometer, U. S. patent 2,651,756, granted September 8, 1953. 3 claims. Assigned to Midwestern Geophysical Laboratory.

14804. Hawkins, James E. Radio location system, U. S. patent 2,652,558, granted September 15, 1953. 49 claims. Assigned to Seismograph Service Corp. Other U. S. patents granted: 2,652,559 (24 claims), 2,652,560 (35 claims), 2,652,561 (11 claims) and 2,652,562 (18 claims).

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