Geophysical Abstracts 162 July-September 1955

GEOLOGICAL SURVEY BULLETIN 1033-C

ERRATA SLIP FOR BULLETIN 1033-C

Page 163, abstract 162--86, lines 3-4

Sentence should read: "It is assumed that the volumetric dilatation of the elastic medium is everywhere zero."

Geophysical Abstracts 162 July-September 1955

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

GEOLOGICAL SURVEY BULLETIN 1033-C

Abstracts of current literature pertaining to the physics of the solid earth and to geophysical exploration

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1955

UNITED STATES DEPARTMENT OF THE INTERIOR

Douglas McKay, *Secretary*

GEOLOGICAL SURVEY

W. E. Wrather, *Director*

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. - Price 25 cents (single copy). Subscription price: $1.00 a year; 35 cents additional for foreign mailing. The printing of this publication has been approved by the Director of the Bureau of the Budget, May 20, 1954.

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GEOPHYSICAL ABSTRACTS 162, JULY–SEPTEMBER 1955

By Mary C. Rabbitt, Dorothy B. Vitaliano, S. T. Vesselowsky, and others

GENERAL INFORMATION

Geophysical Abstracts provides 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 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 160 and 161. 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 Slavic names and titles. Translations of author's abstracts are indicated as "Author's abstract" followed by the initials of the translator.

ABSTRACTORS

Abstracts have been prepared by J. R. Balsley, P. E. Byerly, Henry Faul, R. G. Henderson, George V. Keller, D. R. Mabey, V. S. Neuschel, L. C. Pakiser, and Isidore Zietz as well as by the principal authors.

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

Abbreviation	*Publication*
Akad. Nauk SSSR Lab. Geologii Dokembriya Trudy.	Akademiya Nauk SSSR Trudy Laboratorii Geologii Dokembriya. Moskva.
Annales Géographie	Annales de Géographie. Bulletin de la Société de Géographie. Paris.
České Akad. věd a umění Rozpravy	České Akademie věd a umění Rozpravy. Praha.
Colliery Eng	Colliery Engineering. Tothill Press. London.
Denmark Geod. Inst. Meddel	Geodaetisk Instituts Meddelelser. København.
Engineers and Architects Sphere	Engineers and Architects Sphere, Engineers and Architects Association. Los Angeles.
Freiberger Forschungshefte	Freiberger Forschungshefte. Bergakademie, Freiberg. Akademie Verlag, Berlin.
Gulf Coast Assoc. Geol. Soc. Trans	Transactions of the Gulf Coast Association of Geological Societies. New Orleans.
Highway Research Board Bull	Bulletin of the Highway Research Board, National Research Council. Washington, D. C.
Japanese Jour. Geophysics	Japanese Journal of Geophysics. National Science Council of Japan. Tokyo.
L'Universo	L'Universo. Rivista dell'Istituto geografico militare. Firenze.
Madagascar Service géol. Rapport ann.	Rapport annuel de Service géologique. Haut Commissariat de Madagascar et Dependences, Direction des Mines et de la Géologie. Tananarive.
Milano Seminario Mat. e Fis. Rend	Rendiconti del Seminario Matematico e Fisico. Milan.
Mine and Quarry Eng	Mine and Quarry Engineering. Tothill Press. London.
Soc. Expt. Stress Analysis Proc	Proceedings of the Society of Experimental Stress Analysis. Cambridge, Mass.
Soc. vaudoise sci. nat. Bull	Bulletin de la Société vaudoise des Sciences naturelles. Lausanne, Switzerland.
Sveriges Geol. Undersökning Arsbok.	Sveriges Geologiska Undersökningen Årsbok. Stockholm.
Univ. Nac. Eva Peron Pub	Publicaçiones del Observatorio Astronomico de la Universidad de Eva Peron. La Plata, Argentina.
Victoria Inst. Jour. Trans	Journal of the Transactions of the Victoria Institute, or Philosophical Society of Great Britain. London.
Zeitschr. Metallkunde	Zeitschrift für Metallkunde. Deutsche Gesellschaft für Metallkunde e.v. Stuttgart.

GRAVITY

GENERAL AND THEORETICAL PAPERS INCLUDING THOSE ON ISOSTASY

162–1. Gaibar-Puertas, Constantino. Necesidad de la comprobación y el estudio de la variación secular a que, probablemente, esta sometido el campo gravifico terrestre [Necessity for the verification and the study of the secular variation to which the earth's gravitational field is probably subject]: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, fasc. 9, p. 115–121, 1954.

The close correlation between gravimetric and other geophysical phenomena (magnetic, seismic, and geothermal) suggests that the former ought likewise to exhibit two types of variations, not only regular short-period fluctuations, of exogene origin (exemplified by earth tides), but also much larger secular variations, of endogene origin. Comparison of data from gravity stations all over the world and over as long a period of time as possible seem to show a gradual decrease in the value of g. This subject should be investigated thoroughly; recognition of secular variation of gravity, if it exists, could furnish valuable information on the magnitude, velocity, and direction of displacements of matter below the earth's crust.—*D. B. V.*

162–2. Scheffer, V[iktor]. Isostasie [Isostasy]: Acta Tech. Acad. Sci. Hungaricae, tomus 9, fasc. 3–4, p. 253–276, 1954.

The isostatic equilibrium of the crust has been studied along two profiles, one across the Alps from Ajaccio to Livorno to München and the other across the Carpathian mountains from Hajduszoboslo to Tarnopol.

Seismic evidence indicates that the thickness of the granitic layer in the first profile decreases from the Ajaccio-München section toward the Ligurian Sea by 8–10 km. The thinning of the granitic layer, which is replaced by the more dense underlying strata, causes positive gravity anomalies of about 100 milligals. There are two regions in the München-Ajaccio section in which isostatic equilibrium has not yet been attained: one, the area of greatest isostatic anomaly—Solfernio-Peri-Ala—which must subside, and the other the area between the Appenines and the Po valley which must rise in order to restore the isostatic equilibrium. This conclusion is confirmed by precise geodetic measurements along the Genoa-Venice line. Similar relations are found along the profile through the northeastern Carpathians, where there is a positive anomaly in the region of Munkacs and the zone of depression in Podolia. The conditions in the Carpathians resemble closely those of the Ajaccio-München section. In neither section is isostatic equilibrium yet reached.—*S. T. V.*

162–3. Scheffer, V[iktor]. Der isostatische Charakter der ungarischen Niveauveranderungen und die Möglichkeit der zeitlichen Korrektion der Höhenwerte der Nivellementhöhenfestpunkte [Isostatic character of level changes in Hungary and the possibility of establishing a secular correction for the altitude of benchmarks]: Acta Tech. Acad. Sci. Hungaricae, tomus 10, fasc. 3–4, p. 247–260, 1955.

The changes in the altitude of benchmarks in different points of the great Hungarian lowland show a clear tendency towards isostatic equilibrium. This means that the areas of individual local gravitational maximums are sinking, and the zones of minimums are rising. A relationship exists between the rate

of the vertical displacement of a benchmark and the intensity of isostatic anomaly of the surrounding area, such that the sinking of the mark in millimeters per year is one-tenth of the anomaly expressed in milligals.—*S. T. V.*

162–4. Boaga, Giovanni. Map of the geoidal undulations in Italy and the cross section Como-Otranto: Geofisica Pura e Appl., v. 30, p. 8–12, 1955.

Astronomic and geodetic observations in Italy have been used to draw a map of the geoidal undulation; the map is based on differences between the geoid and the international ellipsoid referred to Monte Mario, Rome. There is a striking superelevation of the geoid south of Rome and a depression in northern Italy. Positive gravity anomalies are found in the area of geoidal superelevation and negative anomalies in the depression, indicating the undulations and anomalies have the same cause. The Como-Otranto section shows clearly both the depression and superelevation.—*M. C. R.*

162–5. Polak, E [dward] J[an]. Densities and porosities of rocks: Mine and Quarry Eng., v. 21, no. 6, p. 252–254, 1955.

Grain density, dry density, saturation density, and porosity were determined for 235 samples of rocks from the West Midlands coalfields of Great Britain. Close correlation between the saturation density and porosity was found. Regression factors, which give the change in saturation density with change of porosity by 1 percent, were calculated from the slope of the curves of saturation density against porosity. The curves may be used to calculate the saturation density of a buried rock from an outcrop sample or to find the bulk saturation density if the mean porosity is determined from electrical logs.—*M. C. R.*

INSTRUMENTS AND METHODS OF OBSERVATION

162–6. Borghi, D. C., and Medi, E[nrico]. Teoria del gravimetro a rotazione [Theory of the rotogravimeter]: Annali Geofisica, v. 8, no. 1, p. 1–8, 1955.

In a preceding work [see Geophys. Abs. 161–8], a new method was discussed for the determination of the absolute value of the constant of gravity: the method consists in measuring the focal distance of a paraboloid of revolution, obtained by rotating a liquid around a vertical axis, and measuring the angular velocity of the rotating system.

The surface tension of the liquid is a cause of error in the measurement. Introducing the expression for the perturbation into the equation for the paraboloid gives a differential equation which is solved in the present work. The exact solution allows, from the experimental point of view, a complete solution of the general problem.—*Authors' abstract*

162–7. Woollard, G. P., and Bonini, W. E. A review of the factors affecting the accuracy of long-distance and inter-continental gravimeter measurements: Am. Geophys. Union Trans., v. 36, no. 4, p. 575–583, 1955.

The sources of error in using gravimeters for long-range gravity connections are classified as those inherent in the instrument, those representing occasional or special conditions associated with the instrument, and those related to operational or reduction procedures. Despite these potential sources of error, results show very little spread between repeat observations. Uncertainties concerning the values obtained in terms of actual change in gravity are due to two factors, linearity of response of the instrument at points near the limit of its operating

range, and calibration of the instrument. It is hoped that the program of pendulum gravity measurements initiated by Woollard and Bonini in 1949 between Paso de Cortez, Mexico, and Fairbanks, Alaska, will provide a universal gravity standard against which an instrument can be checked for both these factors.—*D. B. V.*

162–8. Brein, Rudolf. Photographische Registrierung der Erdgezeiten mit einem Gravimeter [Photographic recording of earth tides with a gravimeter]: Deutshe Geod. Komm. Veroffentl., Reihe B, no. 21, p. 3–12, 1954.

A photographic method of registration developed for the North American gravimeter can be adapted for use with other gravimeters with optical reading devices with a scale. The curves are nearly drift free.—*M. C. R.*

162–9. Sand, Walter. Zur Ermittlung der Krümmung eines beliebigen Normalschnittes einer Niveaufläche der Schwerkraft [On the determination of the curvature of a given vertical section of an equipotential surface of gravity]: Geofisica Pura e Appl., v. 30, p. 13–16, 1955.

The curvature and radius of curvature of a vertical section of an equipotential surface of gravity can be determined by measuring with a precise levelling instrument the angle between two neighboring perpendiculars.—*M. C. R.*

METHODS OF ANALYSIS AND INTERPRETATION

162–10. Kukkamäki, T. J. Gravimetric reductions with electronic computers: Isostatic Inst. Pub. no. 30, 9 p., 1955; reprinted from Acad. Sci. Fenn. Annales Ser. A, 3: Geol.-Geog. 42.

Use of electronic computers for determining topographic and isostatic reductions has been suggested by Heiskanen. The globe is divided into compartments bounded by meridians and parallels, and the elevations of these compartments are evaluated once and for all. In the reductions of different stations the elevations of the same compartments can be used. Integration over a compartment limited by meridians and parallels leads to formulas too complicated for practical calculations, so a method of numerical integration is necessary. For that purpose a formula is derived for the attraction of a vertical mass-line, which represents the mass in a frustum of a cone between elevations or depths in question and which has the apex in the center of the earth.—*M. C. R.*

162–11. Solaini, Luigi. Metodi moderni di studio delle anomalie gravitazionali e magnetiche [Modern methods of studying gravity and magnetic anomalies]: Milano Seminario Mat. e Fis. Rend., v. 24, p. 1–20, 1954

A critical discussion of the methods of interpreting gravity and magnetic anomalies based on calculation of first and second vertical derivatives and upward and downward analytic continuations.—*M. C. R.*

162–12. Bulashevich, Yu. P. Ob anomaliyakh v sluchaye plastoobraznykh vozmushchayushchikh tel [Anomalies produced by sheetlike disturbing bodies]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 3, p. 270–274, 1955.

Solutions of several special cases of gravitational and magnetic anomalies, using the method of direct determination, are given for anomalies produced on

the surface of the earth by a vertical plate of a given thickness buried at a given depth and of infinite extent in either direction, by a plate of variable density, and by a group of vertical plates of different magnetic intensity; and the magnetic anomaly produced by a vertical rectangular prism of finite dimensions.—*S. T. V.*

162–13. Kato, Motohiko. On the vertical gradients of gravity and their computing formulas [In Japanese with English summary]: Butsuri-Tanko (Geophys. Explor.), v. 7, no. 3, p. 128–139, 1954.

A discussion of the first vertical derivative in gravity interpretation and formulas for computing first and second vertical derivatives.—*M. C. R.*

162–14. Jung, Karl. Zur Dichtebestimmung nach dem Nettleton-Verfahren [On the determination of density by Nettleton's method]: Erdöl u. Kohle, Jahrg. 8, Heft 6, p. 401–402, 1955.

The procedure suggested by Jung for the determination of density [see Geophys. Abs. 159–10] and by Bortfeld [see Geophys. Abs. 159–11] can lead to erroneous results when the determinant formed from the coefficients of the normal equations introduced by Jung is equal to zero. In other words, the density of the ground varying from element to element of the terrain under consideration must not be a linear function of the coordinates of the corresponding element.—*S. T. V.*

162–15. Coron, Suzanne. Anomalies isostatiques négatives des bassins sédimentaires. Essai d'interprétation de la carte isostatique du Bassin Parisien [Negative isostatic anomalies of sedimentary basins. Attempt at interpretation of the isostatic map of the Paris Basin]: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, fasc. 9, p. 51–83, 1954.

Calculation of isostatic anomalies for sedimentary basins is discussed in some detail, particularly compensation (Airy) for light masses lying below the geoid. The resulting correction is applied to the isostatic map of the Paris Basin, using available geologic data. The residual anomalies then reveal the broad features of the deep structure—prolongation of the Hercynian arcs and their position relative to recent anticlines and irregularities in the basin floor. Recent sedimentary basins show weak anomalies, generally negative, and most older formations show positive anomalies. In the absence of exact density values, it is difficult to correlate anomalies with the various formations in any greater detail.—*D. B. V.*

162–16. Lejay, Pierre, and Cahierre, Loïc. Essai d'application du calcul de différences de potentiel de la pesanteur entre la Méditerranée et l'Océan Atlantique [First attempt at applying the calculation of differences of gravity potential between the Mediterranean and the Atlantic Ocean]: Acad. Sci. Paris Comptes Rendus, tome 240, no. 19, p. 1843–1846, 1955.

Following the recommendation of the International Association of Geodesy at the Rome general assembly that altitudes be expressed in terms of gravity potentials calculated with the use of true values of gravity, an attempt has been made to use the procedure in evaluating the potential differences between two stations, one on the Mediterranean and the other on the Atlantic, to determine the differ-

ence in level of the two seas. The stations selected were Marseille and La Pallice. $\int g\, dh$ is replaced by $\Sigma g\, \Delta h$ where Δh, the difference in level, is taken from the general levelling survey in France and g is obtained from the gravimetric map of France. In two routes which form a closed loop between Aix and La Rochelle, the closing error of the leveling survey was 0.0715 meter, but by the potential differences 0.0236 meter, the difference being the effect of influence of gravity values. The difference in level between the two stations (for 1885) is calculated as 0.12 meter, or within the limit of error. Considering variations in level since 1885, the present value is La Pallice-Marseille$=+0.30$ meter.—*M. C. R.*

162–17. Solaini, Luigi. Considerazioni interpretative sopra un rilievo gravimetrico [Interpretative considerations of a gravimetric survey]: Riv. Geofisica Appl., anno 15, no. 2, p. 93–104, 1954.

For interpretation of a gravity survey of the Pontine plain near Rome, several maps of vertical gradient, second derivatives, Bouguer anomalies extended downward 500 meters, and residual anomalies are compared. The local anomaly, vertical gradient, and downward extension methods mark important progress over earlier methods of interpretation, permitting greater objectivity.—*D. B. V.*

OBSERVATIONS OF GRAVITY AND GRAVITY SURVEYS

162–18. Innes, M. J. S., and Thompson, L. G. D. The establishment of primary gravimeter bases in Canada: Dominion Observatory Ottawa Pubs., v. 16, no. 8, p. 281–310, 1953.

In 1952 the Dominion Observatory initiated a program to establish throughout Canada a network of well-connected primary gravimeter base stations for the control and adjustment of existing and future gravimeter surveys. A total of two hundred and seventy bases occupied during the summer forms two separate networks, one in northern Canada and the other in southern Ontario and Quebec.

In the course of the survey gravimeter measurements were made at all available pendulum stations and the results show that the standard deviation of most pendulum determinations is about 1.2 mgals, and that the worst errors are in the measurements made before 1936 and in those throughout the unsettled regions of northern Canada. The comparisons provided the calibration factor for the North American gravimeter to an accuracy of one part in a thousand.

The principal facts for all the gravimeter bases and the descriptions of the sites for twenty-four principal bases in Ontario and Quebec are given. The adopted values of gravity for the bases have random errors estimated to be 0.08 mgal and 0.15 mgal for the southern and northern networks respectively. They may also contain systematic errors (0.5 mgal maximum) due to the unreliability of the calibration of the gravimeter.—*Authors' abstract*

162–19. Saxov, S[vend] E. The Danish gravity reference stations: Denmark Geod. Inst. Meddel., no. 25, 30 p., 1952.

The first pendulum observations in Denmark were made at Gyldensten in 1829, but regular observations did not begin until 1894. The first Danish reference station was established in the astronomical observatory at the university of København. A new reference station was established in 1920–21 in Den Danske Gradmaaling, now the Geodaetisk Institut. Since 1927, pillar no. 1 at the observatory of the Geodaetisk Institut in the outskirts of København has been the Danish National Reference Station. Other reference stations have been estab-

lished at pillar no. 2 and pillar no. 4 in the observatory; in the roadway at the observatory, at the Institut Proviantgaarden, at Kastrup airport, at the university, and at the Langelinie pier in København. The exact location and value of gravity (based on a Potsdam value of 981.2740 gal) for each station are given, as well as the gravity value for the National Reference Station determined through connections to the reference stations at Vienna, Teddington, Paris, Uccle, and Potsdam at various times and by different people.—*M. C. R.*

162–20. Worzel, J. Lamar, Shurbet, G. Lynn, and Ewing, Maurice. Gravity measurements at sea, 1950 and 1951: Am. Geophys. Union Trans., v. 36, no. 2, p. 335–338, 1955.

Continuing the long-range program initiated in 1947, 447 new gravity measurements were made at sea during 1950 and 1951, on cruises from San Diego, Calif. to Pearl Harbor, Hawaii to Japan and Guam by way of the Philippine Islands and return to Pearl Harbor; from Pearl Harbor to the Canal Zone and New London, Conn.; and from New London to Taranto, Italy and return to Norfolk, Va. The locations of stations occupied on each cruise are shown on maps.

Improvements in the pendulum apparatus include the installation of a more reliable and less expensive light source and the installation of fiducial markers to provide two reference lines on the photographic records.—*D. B. V.*

162–21. Worzel, J. Lamar, Shurbet, G. Lynn, and Ewing, Maurice. Gravity measurements at sea, 1952 and 1953: Am. Geophys. Union Trans., v. 36, no. 2, p. 326–334, 1955.

Continuing the long-range program initiated in 1947, 489 new gravity measurements were made at sea during 1952 and 1953, 209 in the Atlantic Ocean from the Gulf of Maine to the British West Indies and Puerto Rico, and 280 in the Pacific from San Diego to the Beaufort Sea with crossings to Hawaii. The locations of stations occupied in each cruise and of all stations occupied since 1947 are shown on maps.

Instrumental improvements include a clamping mechanism to insure positional control of the light trace indicating tilt of the main pendulum swinging plane and additional level bubbles for observing this tilt.—*D. B. V.*

162–22. Garland, G. D. Gravity measurements in the Maritime Provinces: Dominion Observatory Ottawa Pubs., v. 16, no. 7, 275 p., 1953.

Regional gravity measurements have been made by the Dominion Observatory in Nova Scotia, New Brunswick, and Prince Edward Island. Most of the Bouguer anomalies can be related to densities of known formations. Anomalies over the Devonian granites, which are found to be lighter than the average crustal rock, are used to estimate the form and depth of these intrusions. Similar investigations are made for certain basins of Carboniferous sediments. The depths estimated for the latter are reasonable but tend to be too small, presumably because of the increase in density of the sediments with depth. In Prince Edward Island, where the oldest exposed rocks are Carboniferous, the anomalies suggest a buried extension of rocks of Caledonian type.

The area of New Brunswick between Moncton and Sussex is treated in greater detail. The trend of several ridges and basins of Mississsippian beneath flat-lying Pennsylvanian strata is indicated. Certain small local anomalies are attributed to density variations within the Carboniferous, notably salt or gypsum concentrations. Gravity methods are of considerable use in tracing such concentrations.—*D. B. V.*

162–23. Domzalski, W. Gravity profile over the Hogs Back Fault: Mining Mag., v. 91, no. 2, p. 73–82, 1954.

A gravity profile over the Hogs Back ridge west of Guildford, Surrey illustrates the problem of reducing gravity data to the Bouguer anomaly when the surface layer is composed of materials of different densities. In the area of the gravity profile sufficient geologic information was available to permit the elevation correction to be computed by a method which effectively eliminated the gravity effect of the changes in density of surface materials. The observed gravity anomaly agrees well with the anomaly calculated from the known geology.—*D. R. M.*

162–24. Lejay, Pierre, and Coron, Suzanne. Étude gravimétrique de la Corse [Gravity study of Corsica]: Acad. Sci. Paris Comptes Rendus, tome 237, no. 7, p. 447–450, 1953.

Two maps show the Bouguer anomalies corrected for topographic influence and isostatic anomalies in the Airy system for a depth of compensation of 30 km. Cape Corse is strongly positive, the combined effect of overcompensation of an ancient depression and of greenstone; the east coast has negative anomalies coinciding with recent sedimentary deposits. Although the isostatic anomalies are pronounced, isostatic compensation is confirmed by the decrease of dispersion of values with respect to Bouguer anomalies. Strong gradients to the north and south of the central region suggest a lowering of the center or rise of northwest and southwest, which is confirmed by the seismicity south of the Gulf of Ajaccio.—*M. C. R.*

162–25. Harrison, John C., Cooper, Robert I. B., and Hey, Richard W. An interpretation of the gravity anomalies in the eastern Mediterranean: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, Sec. 9, fasc. 9, p. 39–42, 1954.

This is a preliminary interpretation of the results of the 1950 British Submarine Gravity Survey in the eastern and central Mediterranean. The islands of Kithera, Crete, Scarpanto, and Rhodes seem to form an island arc resembling those of the East and West Indies. The belt of negative isostatic anomalies outside of and parallel to the arc is interrupted by the large positive anomalies of Cyprus (+20 milligals Bouguer) which are interpreted as due to a large basic intrusion and whose position is regarded as significant; the original crustal depression must have been greater than at present and recovery have begun after the greater part of the intrusion had solidified.

The gravitational field suggests that light sediments border the Malta platform to the west and south to a depth of over 500 meters. The anomalies of the Nile delta indicate a crust not sufficiently depressed beneath an accumulating load of sediments.—*D. B. V.*

162–26. Salvioni, Guido. Rilievo gravimetrico della Toscana (1953) (anomalie di Faye e di Bouguer) [Gravimetric survey of Tuscany 1953. Faye and Bouguer anomalies]: Boll. Geodesia e Sci. aff., anno 13, no. 4, p. 299–360, 1954.

A regional gravimetric survey was made using Worden gravimeters; 271 stations were occupied at a spacing of 1 to about 85 km². Data are given in tables and as a map (scale 1 : 500,000) of Faye and generalized Bouguer anomalies contoured at 10-milligal intervals.—*M. C. R.*

162–27. Maino, Armando. Esperimento gravimetrico nell'isola di Capri e nella penisola Sorrentina [Gravimetric survey of the island of Capri and the Sorrento peninsula]: Servizio geol. Italia Boll., v. 76, fasc. 1, p. 325–342, 1954.

A gravimetric survey of the island of Capri and the peninsula of Sorrento was made during the summer of 1953 in connection with the electrical exploration of the area by Zaccara [see Geophys. Abs. 162–81]. Sixty-two stations were occupied in an area of 42 km^2, with Rome as base station. The results are given in a table showing for each station the geographic coordinates, elevations observed, gravity and the usual reductions, and Bouguer anomaly and residual anomaly maps. The agreement of geologic and gravimetric data confirms the hypothesis that the formations are in normal succession. The surveyed part of the Sorrento peninsula consists of a horst and graben.—*S. T. V.*

162–28. Marussi, Antonio. Con la spedizione italiana al K2. L'esplorazione geofisica del Karakorum [with the Italian expedition to K2. Geophysical exploration of the Karakorum range]: L'Universo, anno 35, no. 1, p. 1–12, 1955.

During the Italian expedition to K2 in 1954 gravity and magnetic observations were made. The airport at Karachi was used as base station and gravity observations there tied to those at Rome and at Rawalpindi. The Rawalpindi observation was tied to those at Skardu and Gilgit which became base stations for Tibet. About 150 observations were made along the traverse to the base of K2. Figures are not given.—*M. C. R.*

MAGNETISM

MAGNETIC FIELD OF THE EARTH

162–29. Slaucitajs, Leonidas. El origen fisico del campo geomagnetico [The physical origin of the geomagnetic field]: Univ. Nac. Eva Peron Pub., Special Ser. no. 19, 31 p., 1954.

A summary of modern ideas on the magnetic field of the earth. A bibliography of 45 items is included.—*M. C. R.*

162–30. Knapp, David G. The synthesis of external magnetic fields by means of radial internal dipoles: Annales Géophysique, tome 11, no. 1, p. 83–90, 1955.

Recent developments in geomagnetism have indicated that the main field, together with its secular change is probably generated by magnetohydrodynamic action in a highly conductive liquid core. It is therefore of interest to examine the field patterns that might arise from postulated simple combinations of radial dipoles at a depth chosen to simulate horizontal current systems at the surface of the core. This leads to conclusions regarding the critical separations of such dipoles that would give rise to observed features of the surface patterns, particularly in the polar regions.—*Author's abstract*

162–31. Vestine, E. H. Relations between fluctuations in the earth's rotation, the variation of latitude, and geomagnetism: Annales Géophysique, tome 11, no. 1, p. 103, 1955.

The experimental geomagnetic survey data of the past sixty years show that certain simple features of the geomagnetic field move westward at non-uniform

rates. The changes in westward motion appear to be antiparallel to those deduced for the earth's rate of rotation, as measured from astronomical sights on stars. This can be explained in terms of fluid motions of the core which carry the source of the magnetic field westward. As an independent check, other component motions associated with the magnetic field about an axis, transverse to the axis of rotation, can afford an unforced explanation of the variation of latitude.

These conclusions are supported mutually by related studies of the problem due to Munk and Revelle and to Runcorn.—*Arthor's abstract*

162–32. Elsasser, W. M., and Takeuchi, H[itoshi]. Nonuniform rotation of the earth and geomagnetic drift: Am. Geophys. Union Trans., v. 36, no. 4, p. 584–590, 1955.

The transmission of mechanical forces of the magnetic field through the top layers of the core and into the mantle is analyzed. It is shown that moderate fluctuations of the toroidal field near the boundary of the core are adequate to produce the observed variations in the earth's rate of rotation. A simple model of the boundary layer of the core is worked out and it is shown that the angular velocity, on going down from the boundary of the core, must first decrease and then increase again, in agreement with the observations of the westward drift and with the dynamo theory.—*Authors' abstract*

162–33. Chernosky, Edwin, J. Long-period variations in geomagnetic activity: Am. Geophys. Union Trans., v. 36, no. 4, p. 591–595, 1955.

The correlation shown by Bartels between annual means of the sunspot number and of the magnetic u figure is markedly improved when means of two longer periods are used. These are the fundamental solar periodicities—the 11-year sunspot-number and latitude cycle and the 22-year sunspot magnetism cycle. A plot of 11-year running means shows a 22-year variation not too evident in Bartels' annual means, and 22-year running means show a secular low at about 1900, with generally rising activity since then in both the objective u and the subjective C measures. Differences in u and C are ascribed more to evaluations of different regions of the magnetic time-variation spectrum than to inconsistencies of C.—*Author's abstract*

162–34. Coulomb, J[ean]. Variation seculaire par convergence ou divergence à la surface du noyau [Secular variation due to convergence or divergence at the surface of the core]: Annales Géophysique, tome 11, no. 1, p. 80–82, 1955.

A simplified calculation is made of the magnetic secular variation produced by a convergent or divergent flux at the surface of the earth's core. The nondipole and secular variation fields of this model are due to the motions in a thin surface layer in the core which crowd the field into regions of convergence of flow and disperse it in regions of divergence. A sinusoidal alternating fluid movement is considered as an approximation of the actual convection, which probably occurs in spurts. If it is assumed arbitrarily that the cross section of the ascending column is of the order of 100 km^2, a vertical velocity of the motion of the order of 5 meters per second is obtained.—*P. E. B.*

162-35. Lowes, F. J. Secular variation and the non-dipole field: Annales Géophysique, tome 11, no. 1, p. 91–94, 1955.

Bullard has shown that the foci of the nondipole field have, on the average, a westward drift of about 0.2° per year. In the study described herein, the nondipole field at one particular epoch was taken, and the variation field produced by a steady westward drift of 0.2° per year calculated. This was then subtracted from the observed secular variation. The remaining field should be due mainly to changes of the regional dipoles in magnitude and direction, and it should therefore be more likely to show positional correlation with the nondipole field than would the total secular variation field. No appreciable correlation could be found. It is concluded that the nondipole field employed was in error. A spherical harmonic analysis gives the total apparent central dipole, that is, the real primary dipole plus that given by the regional sources, and it is obvious that if one subtracts the spherical harmonic analysis dipole from the total field, what remains is not the field of the regional sources. It is thus likely that the nondipole fields which have so far been used have very little physical meaning.

It is important to realize the uncertainty which must be attached to the nondipole field as normally computed, and also to recognize that a large part of the secular variation is due to the westward drift of the nondipole field.—*P. E. B.*

162-36. Runcorn, S. K. Core motions and reversals of the geomagnetic field: Annales Géophysique, tome 11, no. 1, p. 73–79, 1955.

There is evidence that the mean magnetic field for long periods during Tertiary and Quaternary time was more closely that of an axial geocentric dipole than is the present field, and that the polarity of the field reverses at intervals of a few hundred thousand years to a few million years with only comparatively short periods of transition. Runcorn has emphasized that the only physical fact which seems likely to provide an account of the coincidence of the magnetic and geographic axes is the extraordinary dominance of the Coriolis forces on the motions in the core. In this paper an attempt is made to examine what type of change in the core motions would result in a reversal of polarity of the main field.

In order that a dipole field be generated with its axis along the axis of the earth's rotation, the motions and the field should be such that the harmonics from which they are derived should have the same order and degree and should depend upon the longitude. The sign of the axial dipole is found from an expression of form

$$P=4\pi\sigma/(2n+1)\int_{r=r_1}^{r=r_2} r^2\,F(r)f(r)dr,$$

where $F(r)$ and $f(r)$ are radial functions entering into the harmonics from which the motions and field are derived, and r_1 and r_2 are the radii of core and inner core respectively. If $F(r)$ has a number of nodes. that is, if the convection in the core consists of more than a single layer of vortexes, the above integral would involve the difference of two or more quantities. It is thus hard to believe that the polarity of the geomagnetic field can depend on any fundamental properties of the earth's core. Thus, the field may be reversed by changes, of otherwise little geophysical significance, in the radial function $F(r)$.—*P. E. B.*

162–37. Grenet, Gaston. Explication qualitative du début de certaines perturbations magnétiques polaires au moyen de la théorie de Chapman et Ferraro [Qualitative explanation of the beginning of certain polar magnetic disturbances according to the Chapman-Ferraro theory]: Acad. Sci. Paris Comptes Rendus, tome 240, no. 4, p. 448–450, 1955.

The progressive beginning of certain polar magnetic pulsations may be explained qualitatively but not quantitatively by the Chapman-Ferraro theory.—*M. C. R.*

162–38. Bryunelli, B. E. O vozmozhnoy prichine vozmushchennoy solnechnosutochnoy variatsii zemnogo magnitnogo polya [Possible cause of the diurnal solar disturbance of the geomagnetic field]: Akad. Nauk SSSR Doklady, tom 99, no. 5, p. 741–743, 1954.

At great distances the velocity of a corpuscular stream from the sun to the earth is nearly constant, but when it approaches the earth the geomagnetic field begins to produce a retarding effect and the frequency of gyromagnetic precession increases; as a result the stream receives a component parallel to the earth's surface. Near the earth the lines of force act as conductors in an insulating medium. An electric field, directed toward the noon side of the earth, is created over the polar region. If the current lines are closing in the southern latitudes, then a system similar to the system of S_D currents will result consisting of a vortex over the diurnal side of the earth, created by the approaching stream, and another vortex over the nocturnal side, produced by the receding stream. The shape of geomagnetic disturbance shows that the nocturnal vortex must be more intense. This is so in reality, because the forces of repulsion and of attraction disturb the initial symmetry of the stream. Thus, the system of currents is very similar to those producing the solar diurnal disturbance S_D.—*S. T. V.*

162–39. Rikitake, Tsuneji; Yokoyama, Izumi; and Hishiyama, Yonekó. A preliminary study on the anomalous behavior of geomagnetic variations of short periods in Japan and its relation to the subterranean structure: Tokyo Univ. Earthquake Research Inst. Bull., v. 30, pt. 3, p. 207–221, 1952.

Anomalously large amplitudes of ΔZ and parallelism between ΔH and ΔZ observed at Aburatsubo are also found at other observatories in central Japan but are less noticeable in the northern and southern parts of Japan. The anomalous distribution may be due to electric currents at depths of less than 100 km in the earth. The electric currents are seemingly induced electromagnetically by changes in the magnetic field of external origin, and their special distribution is the effect of a heterogeneous distribution of electrical conductivity.—*M. C. R.*

162–40. Rikitake, Tsuneji; Yokoyama, Izumi; and Hishiyama, Yoneko. The anomalous behavior of geomagnetic variations of short period in Japan and its relation to the subterranean structure. The 2d report: Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 1, p. 19–31, 1953.

The sudden commencement at $9^h\ 41^m$ G. M. T. on June 18, 1936 was studied on magnetograms from all parts of the earth. The distribution of magnetic po-

tential was determined using a method of graphical integration and found to be nearly zonal. The potential was separated into parts of external and internal origin by Vestine's surface integral method and the part of internal origin shown to be anomalous near Japan.—*M. C. R.*

162–41. Rikitake, Tsuneji; Yokoyama, Izumi; and Hishiyama, Yoneko. The anomalous behavior of geomagnetic variations of short period in Japan and its relation to the subterranean structure. The 3d report: Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 2, p. 89–100, 1953.

Geomagnetic records at Maze, Niigata-ken, do not always show parallelism between short-period changes in horizontal components, and in general ΔZ is small. The distribution of $\Delta Z/\Delta H$ for short-period variations has been determined on the basis of continuous observations and magnetic surveys. Large values are expressed as roughly circular contours centered at Shimoda; contours of smaller values are roughly parallel to the length of the islands.—*M. C. R.*

162–42. Rikitake, Tsuneji; Yokoyama, Izumi; and Hishiyama, Yoneko. The anomalous behavior of geomagnetic variations of short period in Japan and its relation to the subterranean structure. The 4th report: Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 2, p. 101–118, 1953.

The geomagnetic change at $5^h\ 50^m$ G. M. T. June 19, 1936 was analyzed from magnetograms of 44 observatories in all parts of the earth. The magnetic potential was calculated and the external and internal parts determined, and an anomalous distribution for the part of internal origin was again noted in southern Honshu. Local characteristics of geomagnetic changes are of two types: sensitive to rapid changes but not observable in bays or polar magnetic storms, as in western Europe; and observable in all changes, as in Japan. The former may be due to some superficial effects such as the influence of the sea, and the second related to subsurface structure.—*M. C. R.*

162–43. Rikitake, Tsuneji; Yokoyama, Izumi; and Hishiyama, Yoneko. The anomalous behavior of geomagnetic variations of short period in Japan and its relation to the subterranean structure. The 5th report: Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 2, p. 119–127, 1953.

The anomalous distribution of magnetic changes in central Japan may be interpreted by assuming a hypothetical dipole at a depth of 150 km under the central part of Japan.—*M. C. R.*

MAGNETIC PROPERTIES OF ROCKS AND MINERALS

162–44. Thellier, Émile, and Rimbert, Francine. Sur l'utilisation, en paléomagnétisme, de la désaimantation par champs alternatifs [On the use in paleomagnetism of demagnetization by alternating fields]. Acad. Sci. Paris Comptes Rendus, tome 240, no. 13, p. 1404–1406, 1955.

A cylinder of synthetic rock containing 1 percent magnetite, with thermoremanent and isothermal remanent magnetization induced separately or superposed, was subjected to alternating fields of increasing intensity. With isothermal magnetization alone, the curve of demagnetization slopes steeply

from the origin and is zero when the applied intensity reaches the intensity of the initial magnetization, but for thermoremanent magnetization the curve is steplike, with the length of the step depending on the intensity. When the two types of magnetization are superposed, and the magnetizations are weak, the curve is the addition of the two curves of separate magnetization, and the two can be distinguished. With increased isothermal magnetization, however, the curve becomes simple, and the two cannot be distinguished. The effect of the alternating field is greatest if it is applied parallel to the direction of the initial magnetization.—*M. C. R.*

162–45. Kumagai, Naoiti; Kawai, Naoto; and Kume, Shoichi. On the method of sample-sealing in thermo-magnetic analysis: Kyōto Univ. Coll. Sci. Mem., Ser. B., v. 21, no. 2, p. 287–292, 1954.

In a thermomagnetic analysis of an open sample of titanomagnetite, there is oxidation or reduction depending on the pressures and temperatures to which the sample is exposed, and the magnetization and Curie point so determined are not those of the original sample. If the sample is sealed in a quartz tube evacuated to as little as 10^{-4} mm Hg, no chemical change takes place. With samples of single-phased titanomagnetites so sealed it has been found that the Curie point decreases linearly as the lattice constant increases, and in general the Curie point increases linearly as the intensity of magnetization increases.—*M. C. R.*

162–46. Akimoto, Syun-iti. Magnetic properties of ferromagnetic minerals contained in igneous rocks: Japanese Jour. Geophysics, v. 1, no. 2, 31 p., 1955.

Changes of saturation magnetization with temperature, Curie points, and intensity of saturation magnetization at atmospheric temperature, in relation to chemical compositions and crystallographic parameters have been systematically studied in ferromagnetic minerals magnetically separated from typical igneous rocks in Japan. Most of the ferromagnetic minerals are titanomagnetites, that is, solid solutions between magnetite (Fe_3O_4) and ulvöspinel ($TiFe_2O_4$). The ulvöspinel content in the titanomagnetite ranges from 0 to 65 percent resulting in changes in the intensity of saturation magnetization from 93 emu per gram to 14 emu per gram and Curie point from 580° to 120°C. Linear relations hold approximately between either pair of the four parameters, saturation magnetization, Curie point, chemical composition, and lattice parameter.

Of another series of iron-titanium oxides of rhombohedral crystal structure that are limited solid solutions between ilmenite ($FeTiO_3$) and hematite (Fe_2O_3), the most magnetic shows saturation magnetization of 29 emu per gram at the atmospheric temperature. These minerals seem to play an important role in rock magnetism, although their amount is only about 1 percent that of titanomagnetites in natural igneous rocks.—*M. C. R.*

162–47. Langenheim, R. L., Jr. Magnetite in redbeds and associated rocks: Am. Assoc. Petroleum Geologists Bull., v. 39, no. 7, p. 1404–1405, 1955.

Magnetite and ilmenite occur in appreciable quantities in samples of predominantly red sediments of the Maroon formation in the Crested Butte Quadrangle, Colorado, and also in nonred terrestrial rocks of the Gothic formation. The highest concentration of magnetite, 2.4 percent by volume, occurred in a very coarse buff arkose of the Maroon formation.—*L. C. P.*

162–48. Einarsson, T[raüsti], and Sigurgeirsson, T[horbjörn]. Rock magnetism in Iceland: Nature, v. 175, no. 4464, p. 892, 1955.

Investigations of Hospers on Icelandic basalts and Roche on French basalts of Quaternary and Tertiary age indicate that the direction of remanent magnetization is either the same as or opposite to the direction of the present geomagnetic field. Einarsson and Sigurgeirsson have found an ordinary field compass convenient, in an extensive survey, for rapidly distinguishing between the two groups. The amount of inversely magnetized basalt in Iceland was about equal to the amount of normally magnetized basalt. They assume that the magnetic field of the earth has been opposite to its present direction and believe that there were at least three periods during which there was a reversion affecting the Icelandic basalts.—*R. G. H.*

162–49. Roche, Alexandre, and Leprêtre, Bernard. Sur l'aimantation de roches volcaniques de l'Ahaggar [The magnetization of volcanic rocks of the Ahaggar]: Acad. Sci. Paris Comptes Rendus, tome 240, no. 20, p. 2002–2004, 1955.

Of 64 oriented samples of trachyte, phonolite, and basalt from the Ahaggar, 20 had measurable but unstable magnetization, and 18 had magnetization too weak to be measured. The magnetization of two series of Quaternary basalts was fairly uniform in magnitude and direction—apparently thermoremanent magnetization in a field about the same as the present field. The magnetization of Tertiary samples was exceedingly variable in magnitude and direction.—*M. C. R.*

162–50. Yokoyama, Izumi. Geomagnetic anomaly on Mt. Haruna and its relation to the reverse thermo-remanent magnetism of the pumice covering the place: Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 1, p. 33–34, 1953.

The anomalous distribution of magnetic dip angles at the foot of Mt. Futatsudake is attributed to the presence of a considerable thickness of hornblende dacite with inverse remanent magnetism.—*M. C. R.*

INSTRUMENTS AND METHODS OF OBSERVATION

162–51. Beisswenger, Heinrich, and Wachtel, Ernst. Magnetische Waage zur Messung der Suszeptibilität [Magnetic balance for the measurement of susceptibility]: Zeitschr. Metallkunde, Band 46, Helt 7, p. 504–507, 1955.

A description is given of a magnetic balance for para-, dia- and ferromagnetic measurements on metals and alloys. The operation of the balance is based on the measurement of the force produced by a heterogeneous magnetic field on the specimen under investigation. The main part of the measuring system is a vertically erected pendulum, supported on knife edges. Its sensitivity can be adjusted within wide limits by the variation of its center of gravity. The electromagnet producing the magnetic field can attain the greatest intensity of 6,000 oersteds with a rate of field variation equal to 1,000 oersteds per cm. With this balance, magnetic susceptibility of 1×10^{-7} can be measured on a specimen of only 1.5 grams with an error not exceeding 1 percent. Also, the ferromagnetic effect of impurities of only 10^{-8} cm^3 can be established at saturation of 1,700 gauss.—*Authors' summary, S. T. V.*

162–52. Yokoyama, Izumi. A new method for regulating electric currents and its application to measurements of geomagnetic field: Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 3, p. 211–217, 1953.

The regulation of electric currents through the Helmholtz-Gaugain coil in the GSI magnetometer is accomplished by adjusting rheostats to nullify the current in the circuit of the standard cell. By converting the direct current to alternating current of 1,000 cycles per second and amplifying it, an audible signal may be obtained except when the circuit is balanced.—*M. C. R.*

162–53. Roux, A. T. The airborne magnetometer and its application in prospecting: Inst. Mining Metallurgy London Bull., no. 562, p. 529–538, 1953.

A review of the development, techniques, and applications of the airborne magnetic method.—*M. C. R.*

162–54. Rankin, P. A. Prospecting by airborne magnetometer: Mine and Quarry Eng., v. 21, no. 2, p. 64–70, 1955.

A review of the development, techniques, and applications of the airborne magnetic method with illustrations drawn from the experience of Hunting Geophysics Ltd. Early work in the United States is not mentioned.—*M. C. R.*

METHODS OF ANALYSIS AND INTERPRETATION

162–55. Werner, Sture. Interpretation of magnetic anomalies at sheet-like bodies: Sveriges Geol. Undersökning Årsbok 43 (1949), no. 6, p. 1–130, 1953.

Well-defined magnetic anomalies frequently arise from bodies which approach sheetlike configurations, as for example, dikes composed of basic rocks. Previously the parameters for infinite sheets were calculated directly from magnetic profiles at right angles to the strike. However, only specific points on the profile could be selected, such as the maximum, minimum, and inflection points. The method described here is also an analytical one, but the parameters of the sheetlike structures are determined using arbitrary points on an observed profile. Also with this method, the thickness and depth extent of the sheet may be determined. Either the horizontal or vertical field anomalies may be used for analysis. Formulas for anomalies of thin sheets of infinite and finite lengths are derived. Numerical tables of these formulas are given and numerous illustrations presented.—*I. Z.*

162–56. Matschinski, M[atthias]. Some methods of interpretation of the magnetic fields: Geofisica Pura e Appl., v. 30, p. 68–85, 1955.

The use of magnetic time fluctuations has been shown to be suitable for studying the structure of the earth's crust. In this paper, the method of direct comparison of telluric and magnetic time fluctuations as well as the method of representing telluric current and conductivity in the form of characteristic ellipses is considered to involve objectionable features. A method is proposed which uses ellipse representations for the magnetic field, H, and the conductivity, λ. The method is illustrated in a 3-layer case involving the following ellipses: an ionosphere layer (H_i-ellipse), a nonconducting atmosphere layer (H_a-ellipse), and a conducting upper layer of the earth's crust (H_t-ellipse). Starting with the angle β between H_t and H_a, known from measurements, conclusions are

drawn about the angle δ between H_a and H_i. From β and δ the λ-ellipse representing the conductivity can be determined. The method can be extended to the multilayer case. A rigorous mathematical treatment is given in which formulas for quantitative use are developed.—*R. G. H.*

Bulashevich, Yu. P. Anomalies produced by sheetlike disturbing bodies. See Geophys. Abs. 162–12.

Solaini, Luigi. Modern methods of studying gravity and magnetic anomalies. See Geophys. Abs. 162–11.

MAGNETIC OBSERVATIONS AND SURVEYS

162–57. Budding, A. J. Aeromagnetic survey in Lac La Ronge district: Precambrian, v. 27, no. 7, p. 22, 24, 1954.

Comparison between geologic and aeromagnetic maps of the region shows the magnetic contours closely reflect the geologic boundaries. In general closely spaced contours are associated with volcanic rocks, and a more open magnetic pattern with granites and gneisses, and intrusive bodies of gabbroic rock show rather sharp local anomalies.—*M. C. R.*

162–58. Vincenz, S. A. Magnetic prospecting for iron ores in Jamaica: Geophysics, v. 20, no. 3, p. 593–614, 1955.

Ground magnetic surveys have been made in two areas in Jamaica where iron ores have been formed as the result of thermal or hydrothermal alteration or replacement in sediments by acid intrusions. Anomalies ranging from −5,500 to +5,500 gammas were observed in the Glade-Orchard area and exceeding the range of −15,000 to +15,000 in the Rock Hall area. Mean susceptibility of the Glade-Orchard ore was determined as 0.096 ± 0.042 and of the Rock Hall ore as 0.15 ± 0.086; the ratio of remanent to induced magnetization was 0.92 ± 0.84 in the Glade-Orchard ore, and 10.23 ± 12.74 in the Rock Hall ore. Approximate sizes and positions of the main ore bodies were determined from the magnetic profiles. The usefulness of ground magnetic surveys rather than airborne, in areas such as Jamaica, is emphasized.—*M. C. R.*

162–59. Murphy, Thomas. A vertical force magnetic survey of the counties Roscommon, Longford, Westmeath, and Meath: Dublin Inst. for Advanced Studies, Geophys. Bull. 11, 14 p., 1955.

A vertical force magnetic survey covering a rectangular area of central Ireland, 108 miles from west to east and 36 miles from north to south with a density of one station per 5 square miles, was completed in 1952–53. The following major positive anomalies were mapped: a large anomaly over most of the area interpreted as representing the Precambrian basement; a well-marked anomaly in the east outlining the Ordovician volcanic series and tracing its extension under cover of Carboniferous rocks; and a remarkable positive anomaly in the west of no obvious explanation but probably marking a major structural line.—*V. S. N.*

162–60. Gaibar Puertas, Constantino, and Hoge, Edmond L. L. Estudio geológico y geomagnético del macizo cámbrico de Serpont (Ardena Belga) [Geological and geomagnetic study of the Cambrian massif of Serpont (Belgian Ardennes)]: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, fasc. 9, p. 131–134, 1954.

This presents results of simultaneous geologic and geomagnetic surveys of the region comprising the Paleozoic massif of the Serpont in the Belgian Ardennes, carried on in 1951. A new geologic map has been prepared, and borings in progress are expected to permit correlation of the strong magnetic anomalies with the geology.

A particularly marked local anomaly was found to be caused by an auriferous pyrrhotite having an extraordinarily high magnetic susceptibility. This mineral seems to have become magnetically oriented when the uppermost Cambrian formations, in which it occurs, were involved in a horizontal translational movement of overlying conglomerates. The resulting anomaly is identical with that produced by a theoretical subhorizontal dipole.—*D. B. V.*

162–61. Spinicci, Gian Luigi. Sul campo geomagnetico regionale per la Sicilia [Regional geomagnetic field for Sicily]: Riv. Geofisica Appl., anno 15, no. 2, p. 105–123, 1954.

The geomagnetic normal field for Sicily has been determined on the basis of 447 measurements made in 1930 by Petrucci with a Schmidt balance. Normal fields for Z and H were obtained analytically using a square grid of 52 values obtained by equal-weight averaging of the data and graphically by repeated averaging along parallels and meridians alternately. Comparison of these with each other and with the field derived by Giorgi and Molina [see Geophys. Abs. 161–26] indicates analytical methods are not superior for Sicily.—*M. C. R.*

162–62. Giorgi, M[aurizio], Medi, E[nrico], and Molina, F. Rilievo magnetico della Sicilia centro-settentrionale [Magnetic survey of the north-central portion of Sicily]: Annali Geofisica, v. 8, no. 1, p. 23–58, 1955.

A magnetic survey was made of about 3,000 km^2 in Sicily, with 124 stations occupied. The area was chosen to obtain more knowledge of the magnetic characteristics of the area in which the observatory at Gibilmanna will be built.

The results of the survey are presented in tables and as maps showing isodynamic curves and regional anomalies of horizontal and vertical intensity contoured at 10-gamma intervals. The outstanding magnetic anomalies within the surveyed area were a positive anomaly of vertical intensity of 90 gammas between Petralia and Gangi and a negative anomaly of horizontal intensity of −42 gammas near Nicosia.—*S. T. V.*

162–63. Alldredge, L. R., Keller, Fred, Jr., and Dichtel, W. J. Magnetic structure of Bikini Atoll: U. S. Geol. Survey Prof. Paper 260–L, p. 529–535, 1954.

The magnetic total field intensity was surveyed, at an altitude of 1,500 feet above Bikini and the adjacent guyot. The resulting contour map shows a broad negative anomaly of 750 gammas over Bikini Atoll, with several superimposed more localized anomalies. Study based on a magnetic model indicates that basement material rises to within 5,000 feet of sea level approximately 1 mile to the northeast of Bikini island. The model assumes uniform susceptibility and zero

permanent magnetization and conforms to known seismic profiles of the basement.—*Authors' abstract*

162–64. Yoda, Wasiro. On the magnetic anomalies and their secular variations around Maeyama on Simabara peninsula: Kyōto Univ. Coll. Sci. Mem., Ser. A, 1. 27, no. 21, p. 101–123, 1954.

A three-component magnetic survey in 1952 of an area around the volcanic hill, Maeyama, in Simabara peninsula covered about the same area as a similar survey in 1923. The anomalies in the two surveys were similar. They are attributed to an oblate spheroid with center at sea level and at nearly the geographic center of Maeyama, with a minor axis of 1.4 km in the vertical direction, and major axis of 2.8 km in the horizontal direction and magnetic susceptibility of 0.0057 cgs units. The absolute values of the anomalies are larger by about 1/13 in 1952, indicating the magnetization of the mountain block has increased slightly.—*M. C. R.*

ELECTRICITY

GENERAL AND THEORETICAL STUDIES

162–65. Chetaev, D. N. O tochechnom istochnike postoyannogo toka v neodnorodnom poluprostranstve [On the point source of direct current in heterogeneous half-space]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 3, p. 265–266, 1955.

The problem discussed is the determination of the pattern of the electrical field generated in the ground by a dipole fed by a continuous source. The ground with respect to its electric properties is considered as a sectionally differentiable semispace. By following the procedure suggested by Tikhonov [see Geophys. Abs. 12047, 12271], differential equations are derived representing the physical conditions of the problem and by use of the theory of complex variables after a solution is found in finite form.—*S. T. V.*

162–66. Belluigi, Arnaldo. L'eccitazione transitoria e. m. d'un terreno stratigrafico con dipolo magnetico pulsante verticale [The transient electromagnetic field produced in a stratified terrain by a pulsating vertical magnetic dipole]: Servizio geol. Italia Boll., v. 75, (1953), fasc. 2, p. 913–926, 1954.

Determination of the pattern of the electromagnetic field produced in a horizontally stratified terrain by a pulsating vertical dipole (a horizontal circular loop) is closely related to the problem of the transient electromagnetic field produced by a horizontal electrical dipole, previously solved by Belluigi, and the solution is given as a simple corollary. Wait has also solved the problem by a different method [see Geophys. Abs. 14095].—*S. T. V.*

162–67. Wait, James R. Mutual electromagnetic coupling of loops over a homogeneous ground: Geophysics, v. 20, no. 3, p. 630–637, 1955.

The equations for the mutual coupling between two loops near the surface of the earth are reviewed. In addition, two cases with the loops above the ground are considered, as they may be of interest in airborne methods of electromagnetic exploration. These two cases are coplanar loops, both above the ground surface, and perpendicular loops, both above the ground surface. Curves are presented for each of these cases for the mutual impedance as a function of loop separation, height above the ground, and the electrical character of the ground.—*G. V. K.*

ELECTRICAL PROPERTIES OF ROCKS AND MINERALS

162–68. Volarovich, M. P., and Parkhomenko, Ye. I. P'yezoelektricheskiy effekt gornykh porod [Piezoelectric effect in rocks] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 3, p. 215–222, 1955.

Specimens of rocks, 25 × 25 × 25 mm in size, were subjected to impulses from an ultrasonic seismoscope and tested for the generation of electromotive forces due to these impulses. A piezoelectric effect was found in granite, quartzite, sandstone, and gneiss, but not in dolomite, marble, syenite, diabase, gabbro, and jasper, at least, not within the limits of sensitivity of the instruments used. The electromotive force produced was due to the piezoelectric effect, changing its polarity with rotation of the position of the specimen tested, and is different from the electroseismological phenomenon discovered by Ivanov—produced by an eletrokinetic effect—being conditioned by the presence of a certain amount of moisture in the ground. It is suggested that the observed piezoelectric effect is to be attributed to the presence of quartz grains in the rocks.—*S. T. V.*

162–69. Němec, Dušan. Piezoelektrische Texturen in der Natur [Piezoelectric textures in nature] : Geologie, Jahrg. 4, no. 3, p. 280–284, 1955.

"Piezoelectric textures" are crystalline aggregates composed of oriented crystals of minerals that show piezoelectric properties. Measurements were made on such aggregates, both artificial and natural, and the most pronounced effect was found in aggregates composed of quartz, granulite, mylonite, and tourmaline. This phenomenon can be important in many tectonic and seismic studies.—*S. T. V.*

Runcorn, S. K., and Tozer, D. C. The electrical conductivity of olivine at high temperatures and pressures. See Geophys. Abs. 162–240.

INSTRUMENTS AND METHODS OF OBSERVATION

162–70. Palmer, L. S. Location of subterranean cavities by geoelectrical methods : Mining Mag., v. 91, no. 3, p. 137–141, 1954.

Using Maxwell's method of images and assuming a constant ratio of potential- and current-electrode separations, equations are developed for the effect of a spherical cavity and a tunnel in a homogeneous medium. If h and r are the depth to the center and radius of the cavity, $a=b/a$ (b and a being one-half the potential- and current-electrode separations), and a_o, a for the position of maximum apparent resistivity, then the depth for both sphere and tunnel is given by $h=a_{ao}$, and the magnitude of the anomaly on the high-resistance side by $[(1-a)/(1+a)^2]\ [r/h]^3$ for the sphere and $[2a/(1+a)^2 \log_e (1+a)/(1-a)]\ [r/h]^2$ for the tunnel. Experimental observations over caves in the Mendip Hills and the Drewton tunnel confirm the usefulness of the method in locating cavities; details of size and shape cannot be reliably determined, however.—*M. C. R.*

162–71. Fritsch, Volker. Geoelektrische Verfestigung von Böden bei gleichzeitig wirksamen mechanischem Druck [Geoelectric consolidation of the ground with simultaneous effective mechanical pressure] : Geofisica Pura e Appl., v. 30, p. 86–92, 1955.

New experimental data are presented on the problem of soil consolidation by simultaneous application of geoelectrical and mechanical means of consolidation. Experiments were made with intermittent and continuous mechanical methods of

consolidation. The experiments show that the methods of consolidation must be correctly chosen with regard to both their quantitative and temporal succession if they are to support each other. The experiments show further that close by the anode through the so-called effect of coherence the conductivity of the soil is essentially higher. The problem is by no means completely cleared. With regard to the great practical importance of this question further series of investigation will be necessary.—*Author's summary*

162–72. Flathe, H. Possibilities and limitations in applying geoelectrical methods to hydrogeological problems in the coastal areas of North West Germany: Geophys. Prosp., v. 3, no. 2, p. 95–110, 1955.

In the coastal areas of Germany, along the southern part of the North Sea, electrical resistivity investigations have been conducted in the search for fresh ground water in permeable beds. These resistivity studies have proved to be useful in locating permeable beds, as well as the contact between fresh water and salt water. The task is difficult, however, because of thickness and facies changes in the Lauenburg clay, and the presence of impervious Tertiary layers which often divide a permeable bed into several storage levels.—*L. C. P.*

162–73. Volker, A., and Dijkstra, J. Détermination des salinités des eaux dans le sous-sol du Zuiderzee par prospection géophysique [Determination of the salinity of ground water beneath the Zuiderzee by geophysical exploration]: Geophys. Prosp., v. 3, no. 2, p. 111–125, 1955.

Experiments indicate chlorine content of ground water may be estimated by the direct resistivity method with the Wenner electrode configuration. In water samples from boreholes, the chlorine content and the resistivity of pore water were closely related. The resistivity of the saturated sand was 4.5 times resistivity of the pore water. In an area near the Zuiderzee, the measured resistivities of 1 to 200 ohm-meters correspond to chlorine contents of 12,000 to 15 mg per liter.—*M. C. R.*

162–74. Rowland, Elmer F., Stolzy, Lewis H., and Crabb, George A., Jr. Frost determined by electrical resistance: Highway Research Board Bull. 100, p. 17–21, 1955.

Field and laboratory studies indicate there is a 200-ohm increase in resistance at the beginning of the freezing process; that a period of stable temperature and resistance conditions precedes freezing; and that after thawing, resistances are similar to those observed before freezing. Increases in resistance at temperatures below 32°F are caused by dehydration of soil moisture. Freezing of mineral soils within the available moisture range begins at temperatures between 31.00° and 31.75°F. Soil moisture measurements by variations in the electrical resistance of porous units buried in the soil profile, a method developed at the Michigan Hydrologic Research Station, may therefore be used for frost determinations.—*M. C. R.*

METHODS OF ANALYSIS AND INTERPRETATION

162–75. Bondarenko, A. P. Analiticheskiy sposob obrabotki polevykh nablyudeniy pri razvedke metodom zemnykh tokov [Analytic method of treating field data in surveys made by the telluric current method]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 3, p. 267–269, 1955.

In this method of exploration, ellipses are graphically constructed representing the variations of the vectors measuring the intensity of the electrical

field. An analytical method of this determination is suggested, similar to a Fourier harmonic analysis, and is explained by an example. It takes less time to perform the computations than to construct the necessary ellipses. The method can be applied also when the field vector is linearly polarized.—*S. T. V.*

162–76. Belluigi, Arnaldo. Prospection géophysique à l'aide d'émetteurs alternatifs et champs au sol pour différents types de ces émetteurs [Geophysical prospecting by the use of alternating emitters and fields in the ground for different kinds of these emitters]: Acad. Sci. Paris Comptes Rendus, tome 240, no. 16, p. 1657–1659, 1955.

In this note a few characteristic properties of the electromagnetic fields of different emitters are indicated, and a solution is given for the problem of the single-electrode emitter. For this, $E_x=E_y$ (ω) and $E_y=E_y$ (ω), ω being $2\pi f$ and E_x andE_y, the vectors in the x and y (horizontal) directions.—*M. C. R.*

162–77. Guyod, Hubert. Electric analogue of resistivity logging: Geophysics, v. 20, no. 3, p. 615–629, 1955.

A model consisting of a resistor network was built to investigate the relation between the apparent resistivity measured in electric logging and the true resistivity of rocks about a borehole. Such a model is justified mathematically if Laplace's differential equation is replaced by difference equations at a series of mesh points in a continuous medium. These nodal points may then be connected together with appropriate values of resistance, and, when current flows through the network, the voltages at these nodal points will be essentially the same as those in a uniform medium. The model was constructed to represent axial symmetry about a borehole. Provisions were made to represent horizontal beds of various thicknesses, various degrees of mud infiltration, and various hole diameters.—*G. V. K.*

162–78. Kiyono, Takeshi; Kimura, Koichi; and Kabayashi, Keiichi. Theoretical study on the electromagnetic induction method [In Japanese with English summary]: Butsuri-Tanko (Geophys. Explor.), v. 7, no. 3, p. 121–127, 1954.

Solutions are obtained for the magnetic field due to spheroidal conductors of infinite conductivity in a uniform alternating field, and the formulas for computing the vertical and horizontal components of the magnetic field are deduced. The results of calculations of the magnetic fields of prolate spheroid, oblate spheroid, and circular disc are shown.—*M. C. R.*

162–79. Ohashi, Shuji. On the figures of SP distribution. (Part I) At the Tsuchihata mine area [In Japanese with English summary]. Butsuri-Tanko (Geophys. Explor.), v. 7, no. 3, p. 140–149, 1954.

An outline of studies of the distribution of self-potential with relation to the location, grade, and type of ore body, effect of topography, change of potential with time, mineral paragenesis, and similar factors.—*M. C. R.*

ELECTRICAL SURVEYS

162–80. Vincenz, S. A. A resistivity survey in Scotland: Colliery Eng., v. 31, no. 362, p. 157–163, 1954.

An experimental resistivity survey was made in the River Devon valley in the Alva area of Scotland, using Gish-Rooney equipment. Thirteen expanding-

electrode depth probes were made followed by twelve traverses with constant electrode separation. In the western part of the area, the survey indicated presence of a deep, wide, U-shaped channel. In the eastern part of the area, resistivities of unconsolidated materials vary considerably, and surveys with constant electrode separation could not supply the required information. A few depth probes confirm the persistence of the channel in the easterly direction. In only a few places, however, were the results susceptible to mathematical analysis to yield depths to bedrock comparable with those from boreholes nearby.—*M. C. R.*

162–81. Zaccara, Gaetano. Esperimenti geofisici nell'isola di Capri e nella penisola Sorrentina [Geophysical experiments on the island of Capri and on the Sorrento peninsula]: Servizio geol. Italia Boll., v. 76, fasc. 1, p. 315–321, 1954.

An electrical resistivity survey was made on the island of Capri in search for sources of drinking water. Two aquifers were discovered, a rather meager one near the surface, and another with abundant, but unpalatable, water. The second layer continues beneath the sea to the continent and is evidently separated from the sea by permeable formations. The results of the survey were confirmed by exploratory drilling.—*S. T. V.*

162–82. Aynard, Cl., Arnaud, M., and Société Chériflenne des Pétroles. Études par sondages éléctriques du bassin Miocène du nord du Gharb [Electrical depth profiling studies of the Miocene basin of northern Gharb]: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, fasc. 9, p. 217–229, 1954.

Electrical resistivity methods proved more efficient than seismic ones in exploration of the closed structures of the basal Miocene horizons of the northern Gharb of Morocco. The base of the upper Miocene could be traced to depths of the order of 800 meters. In preliminary reconnaissance, the area was surveyed with one sounding for each 4 km^2, which permitted coverage of 200 km^2 per month with a very active crew. Interesting zones were resurveyed in detail. A series of borings proved the efficacy of the method—where the contact between marly and sandy Miocene was sharp, agreement was quantitative, and where transitional, qualititative with exaggeration of dips.—*D. B. V.*

162–83. Breusse, J. J. Cinq années de prospection électrique en Afrique du Nord pour des recherches hydrologiques [Five years of electrical exploration in North Africa for hydrologic research]: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, Sec. 9, fasc. 9, p. 191–209, 1954.

This is a rather detailed summary, by region, of the results of 5 years of electrical exploration for ground water in Algeria, Morocco, and Tunis.—*D. B. V.*

162–84. Murakami, Masatuga. Étude sur l'évolution d'une ancienne lagune selon la mesure de la résistance électrique spécifique du terrain [Study of the evolution of an old lagoon by the measurement of the specific electric resistance of the terrain]: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, Sec. 9, fasc. 9, p. 211–216, 1954.

The evolution of the area near the mouth of the Hino River in Japan from lagoonal conditions to the present alluvial plain can be rather precisely worked

out by means of resistivity depth profiles through the various deposits of gravel, sand, clay, and volcanic material underlying the area.—*D. B. V.*

SEISMOLOGY

GENERAL

162–85. Lynch, [J.] Joseph. Recent developments in seismology: New York Acad. Sci. Trans., ser. 2, v. 17, no. 8, p. 579–583, 1955.

Brief review. Recent developments mentioned are the studies of the *T* phase, low-velocity channels in the crust, and the origin of microseisms.—*M. C. R.*

ELASTIC WAVES

162–86. Hostinský, Bohuslav. Vlastnosti vln v pružných prostředích obdobné vlastnostem vln elektromagnetických [Properties of the waves propagating in elastic media analogous to those of electromagnetic waves]: České Akad. věd a umění Rozpravy, Třída 2, ročnik 61, čast 2, čisclo 25, 14 p., 1951 (1953).

Mathematical analogies are established between the properties of spherical waves propagating in a homogeneous isotropic perfectly elastic medium and electromagnetic waves in a perfect insulator free of electric charges. It is assumed that the volumetric dilatation of the elastic medium is everywhere. The fundamental Maxwell's equations are used as the basis of comparison, and it is shown that both waves can be represented by the same equation if the components of magnetic induction are replaced by components of elastic strain, the components of the electric force are replaced by the time integrals of the components of the curl of the deformation, and the product of the dielectric constant and the magnetic permeability is replaced by the ratio of the density over the shear modulus. The velocity of the electromagnetic waves has the same meaning as the velocity of the propagation of the elastic waves.—*S. T. V.*

162–87. Satō, Yasuo. Velocity of elastic waves propagated in media with small holes: Tokyo Univ. Earthquake Research Inst. Bull., v. 30, pt. 3, p. 179–190, 1952.

Elastic constants and velocity of propagation in media with small holes have been calculated following the method developed by Mackenzie [Phys. Soc. London Proc., Section B, v. 63, 1950]. Convenient expressions for practical use are developed for both empty holes and for holes filled with liquid. The velocity of propagation in a heterogeneous medium cannot be determined from the weighted harmonic means of the velocity of two component substances, one an elastic medium and the other a liquid.—*M. C. R.*

162–88. Satō, Yasuo. Velocity of elastic waves propagated in media with small obstacles: Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 1, p. 1–18, 1953.

A solution is obtained for the velocity of elastic waves in a medium with small solid obstacles (for example, gravel), assuming that the obstacles are spherical and of the same size, small in volume compared to the whole medium, that the displacement and stress components are continuous at the boundary surfaces, and that the wavelength is larger than the diameter of the obstacles. Conclusions

regarding bulk modulus and rigidity are similar to those for the medium with small holes.—*M. C. R.*

162–89. Jobert, N. Effet de la courbure de la terre sur les ondes de Love [Effect of the curvature of the earth on Love waves]: Annales Géophysique, tome 11, no. 1, p. 1–48, 1955.

The motion due to Love waves on the surface of an elastic spherical layer underlain by an elastic homogeneous sphere of different properties is considered. The source of the energy is a sudden displacement at a point within the layer. The calculated motion is compared with the motion at the surface of a plane layer covering an elastic half-space. The initial development involves the determination of the form of the Love waves due to a displacement which is a sinusoidal function of time. The case of an abrupt displacement is treated by means of a Fourier integral, which is evaluated approximately by the method of stationary phase.

Owing to the curvature of the surface, the long-period waves are more dispersed, and the beginning of the train of waves is stretched forward; the first long-period waves arrive with a velocity greater than that of *SH* waves in the underlying medium, and the amplitude of the subsequent motion grows more slowly with time.—*P. E. B.*

162–90. Das Gupta, Sushil Chandra. Propagation of Rayleigh waves in transversely isotropic medium in three dimensions: Am. Geophys. Union Trans., v. 36, no. 4, p. 675–678, 1955.

The propagation of Rayleigh waves in a transversely isotropic medium has been considered as a three-dimensional problem, with the axis of elastic symmetry taken along the vertical line as in crystals of the hexagonal system. The frequency equation then reduces to the same expression as that found by Stoneley [see Geophys. Abs. 11546] and Satō for the two-dimensional case, and by suitable modification of elastic constants to the results obtained by Lamb for an isotropic medium.—*M. C. R.*

INSTRUMENTS AND METHODS OF OBSERVATION

162–91. Benioff, Hugo. Seismographs: Engineers and Architects Sphere, v. 1, no. 3, p. 9–11, 1953.

Brief description of instruments, with emphasis on those at the California Institute of Technology stations.—*M. C. R.*

162–92. Kirnos, D. P. Nekotoryye voprosy instrumental 'noy seysmologii [Some questions of instrumental seismology]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 27 (154), p. 1–169, 1955.

This is a treatise on seismic instruments, principally seismographs. A detailed analysis of the operation of the instrument is given, with special attention to the effect of galvanometric recording on the vibrations of the main system. Seismographs adapted to universal use are discussed, as well as special instruments for the measurement and recording of violent and destructive earthquakes, and a detailed description is given of two typical instruments designed and manufactured in the U. S. S. R. as standard equipment for seismic stations.—*S. T. V.*

162–93. Gerrard, J. A. F. VLF refraction method with less explosives gives excellent results: World Oil, v. 141, no. 4, p. 79–83, 1955.

The seismic refraction method has been little used for oil exploration since the introduction of the reflection seismograph in 1930. A new "very low frequency" or VLF seismic system recently introduced by Houston Technical Laboratories permits the use of very long refraction spreads with relatively small charges of dynamite. The VLF system is portable and is designed to record frequencies as low as 2 cycles per second.—*L. C. P.*

162–94. Jones, W. M., and Dennison, A. T. A low frequency refraction geophone: Geophys. Prosp., v. 3, no. 2, p. 168–176, 1955.

Certain seismic problems may be most readily solved by large-scale refraction surveys. A low-frequency geophone with a natural frequency of 1.85 cycles per second, output of 0.7 volt per cm per second into a 500 ohm load, and 0.7 critical damping satisfies the requirements of recording the low frequencies expected when the detectors are at great distances from the shot point. Such a geophone, weighing 14 pounds and with dimensions of $7 \times 5\frac{1}{2} \times 4\frac{1}{2}$ inches, has been designed and constructed. It uses a single spring which is equally stressed at all points on its surface.—*L. C. P.*

162–95. Loper, George B. Seismic recorder for monitoring magnetic tape: Geophysics, v. 20, no. 3, p. 585–592, 1955.

A new recorder utilizing Polaroid "picture-in-a-minute" film has been developed to monitor seismic data recorded on magnetic tape. Signals from 12 magnetic recording heads are applied through appropriate networks to conventional galvanometers in the monitor as the magnetic record is made. The optical system is arranged to make a miniature seismogram of conventional appearance on a standard 3×4 inch Polaroid print. The record is a satisfactory guide for the operator to evaluate the quality of the record on the magnetic tape without the need for playing it back.—*Author's abstract*

162–96. Richard, Henri, and Rimbaut, Marcel. Mesure du bruit et sismos multiples (étude expérimentale dans les Landes) [Evaluation of noise and multiple geophones (experimental study in the Landes)]: Geophys. Prosp., v. 3, no. 2, p. 177–194, 1955.

To improve the ratio of signal to noise in seismic recording, the number of geophones in a spread and the length of spread have been increased. An experimental study in the Landes of the effectiveness of these measures indicated that when a 12-geophone line is long enough the noise is reduced by a factor of 0.36 and with two 12-geophone lines, each 55 meters long, the reduction is 0.29. Noise is reduced by a factor of $KN^{-1/2}$ where N is the number of geophones per trace and K a constant near unity.—*M. C. R.*

162–97. Oil and Gas Journal. Star patterns: Oil and Gas Jour., v. 54, no. 13, p. 82–83, 1955.

By using geophones laid out in a star pattern and multiple shotholes, it has been possible to conduct successful seismograph operations in many problem areas of the world which had previously proved unsuitable for seismic exploration. A typical star pattern setup consists of twelve 6-pointed stars laid out along lines extended in two directions from the shothole area. Each point of the star contains 36 geophones. The output of all 36 phones is recorded on a

single seismograph trace. A typical shothole pattern consists of 36 holes in 3 concentric circles.—*D. R. M.*

162–98. Parr, J. O., Jr., and Mayne, W. H. A new method of pattern shooting: Geophysics, v. 20, no. 3, p. 539–564, 1955.

In areas where reflection shooting is difficult, it is often necessary to attenuate the energy in a broad continuous band of disturbing wavelengths to less than a few hundredths of what would be recorded if all units were bunched together. The wavelength band of the attenuated energy should be adjacent to the band of reflection wavelengths received. Attenuation of the undesired energy is best accomplished with multiple detectors or charges. In many areas the pattern should attenuate energy horizontally propagated in all directions, not just in the direction of the detector line. Neither a finite number of uniformly effective, uniformly spaced units in line nor a uniformly effective sheet of finite length will accomplish this result. A system for gradation of the effectiveness of units described in this paper does produce this result (not only for in-line disturbances but also for disturbances coming in from the side of the line). The attenuation band can be made broad with good attenuation or narrower with still better attenuation, as desired. The variation of effectiveness can be applied to detectors or charges arranged in a horizontal line, over a horizontal area, in a vertical line, or over a vertical area. The principle of varying effectiveness can also be applied to reversed-polarity detectors in order to accentuate certain apparent wavelengths.—*Authors' abstract*

162–99. Kupalov-Yaropolk, I. Metodicheskoye soveshchaniye po seysmorazvedke na russkoy platforme [Conference on methods of seismic exploration of the Russian platform]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 3, p. 290–293, 1955.

A conference was organized in Saratov, U. S. S. R. in January 1955 on the problems in exploration for oil in the Russian platform. Devonian oil-bearing strata are found at depths of 1,600–2,000 meters covered by Carboniferous formations that may be as much as 1,500 meters thick. Salt domes have very sloping contours, so that the time differences in the arrival of the waves reflected from the roof of the dome and from its flanks are less than 0.001 second, or much less than the differences in time of arrival caused by slight variations of the relief and by accidental heterogeneities of upper layers.

The following were recommended as the best measures for improvement of results: use of seismic waves with higher frequencies than usual; multiple geophones in spreads of 75 meters long; and use of filters. Numerous individual problems in individual surveys are also described.—*S. T. V.*

162–100. Selem, A. M., and Merlini, E. Electrical hazards in seismic prospecting: Geophys. Prosp., v. 3, no. 2, p. 163–167, 1955.

The highest safe continuous current and voltage that can be applied to electrical seismic detonators of European manufacture are, respectively, 20 milliamperes and 200 volts. The electrical hazards involved in seismic field work vary over wide limits. The usual hazards due to powerlines, low-power radio transmitters, and self-potentials are within the permissible safety limits by a factor of at least 2½. However, changes in conditions (such as large metal masses near the shot point) may cause these limits to be exceeded. Strict adherence to safety rules during seismic operations minimizes these electrical hazards.—*L. C. P.*

METHODS OF ANALYSIS AND INTERPRETATION

162–101. Peterson, R. A.; Fillippone, W. R.; and Coker, F[rank] B. The synthesis of seismograms from well-log data: Geophysics, v. 20, no. 3, p. 516–538, 1955.

The amplitude of a reflected pulse is determined by the change in the product of density and velocity between two layers, or the change in acoustic impedance. As an approximation, the amplitude of the wave reflected by each incremental change in acoustic impedance is proportional to the corresponding incremental change in the value of the logarithm of acoustic impedance. Numerical methods may be used to determine the reflections but an analog computer, such as the Seisyn computer of United Geophysical Corp. for the synthesis of reflection seismograms from basic well log data, is more efficient. Examples of the synthesis of seismograms are given.—*M. C. R.*

162–102. Horton, C. W. The structure of the noise background of a seismogram: Geophysics, v. 20, no. 3, p. 565–584, 1955.

It is postulated that the noise background of a typical seismogram is the result of the arrival at random times of a large number of small reflections which are reflected from small scatterers distributed throughout the earth. It is shown on the basis of this assumption that if one knows the shape of a typical reflection, one can calculate the statistical parameters of the seismogram trace. Conversely, if one has the experimental autocorrelation function, the shape of the individual reflections can be determined. This analysis has been applied to a vertical spread of three geophones located 10, 75, and 125 feet below the surface. The shapes of the individual reflections were determined for the two deeper geophones. These curves show that the disturbances detected by the deeper geophone have a significantly smaller dominant frequency.—*Author's abstract*

162–103. Weber, Max. Zur Interpretation von seismischen Refraktionsmessungen [The interpretation of seismic refraction measurements]: Geofisica Pura e Appl., v. 30, p. 27–32, 1955.

Based on a recorded travel time curve $\psi_2(\eta)$, a simple direct method is developed for calculating the function $Z = Z(c)$, under the assumption that the wave velocity c is a regularly monotone increasing function of the depth Z. A numerical example is given.—*Author's abstract*

162–104. Baumgarte, J. Konstruktive Darstellung von seismischen Horizonten unter Berücksichtigung der Strahlenbrechung im Raum [Graphical determination of seismic horizons with consideration of refraction in the medium]: Geophys. Prosp., v. 3, no. 2, p. 126–162, 1955.

The paper describes a geometrical construction which allows the reflecting or refracting boundaries to be derived from seismic time observations.

In reflection work the construction makes use of the ray reflected from the boundary at normal incidence. For constant velocities of the beds, or for a linear increase of velocity with depth, the method leads to the construction of successible envelopes from which the reflecting interface and the rays are obtained. By using the idea of "stretching fictitious rays," the construction requires ruler and compasses only and is applicable to both plane and curved boundaries with any strike direction and in any number.

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The same principles can be applied to refraction problems and again the construction of successive envelopes allows the indirect or Mintrop wave to be defined. The position of the refracting boundary and the velocity can be derived immediately. As in the reflection method any number of plane boundaries with any strike can be dealt with.

An appendix discusses the use of the method in reflection work with any type of velocity distribution.—*Author's abstract*

162–105. Linsser, Helmut. Verfahren zur Auswertung von Untertage-seismogrammen [Method of evaluation of subsurface seismograms]: Geofisica Pura e Appl., v. 30, p. 33–67, 1955.

This paper presents geometrical and statistical approaches to interpretation of recent seismic reflection surveys of the Sieger iron-ore deposits in Germany. In the geometrical method, each reflection is treated individually, resulting in a series of ellipsoids whose grouping indicates the position of the reflecting plane [see also Geophys. Abs. 158–130]. How this method can take into account the angle of dip is illustrated for different cases. Applicable statistical methods include correlation arithmetic in which the reflection ellipsoids are resolved into series of points or lines, or calculation of error by various methods, particularly least squares. The greater the number of ellipsoids involved, the more cumbersome the arithmetical method becomes, but the amount of work involved in the least-squares method can be reduced to reasonable proportions by use of approximation formulas. Practical examples are described and illustrated.—*D. B. V.*

162–106. Kurihara, Shigetoshi. The determination of mean velocity by reflection travel times [In Japanese with English summary]: Butsuri-Tanko (Geophys. Explor.), v. 7, no. 3, p. 107–120, 1954.

A method of calculating mean velocity from surface to reflector directly from reflection data instead of assuming $v=v_0+ah$.—*M. C. R.*

162–107. Paterson, N. R. A theoretical approach to the calculation of seismic wave-velocity in sedimentary formations: Royal Soc. Canada Trans., 3d ser., v. 48, sec. 4, p. 59–64, 1954.

Development of interest in seismic wave velocities as a tool for studying the nature of the earth's crust and the development of a theoretical model of structure close to that of sedimentary rocks to determine elastic constants for anisotropic media in order to test the conclusions of the classical wave theory are reviewed. The present work is concerned with testing the theory for different packings of glass spheres in the laboratory as a further development of the work of Graton and Fraser, Iida [see Geophys. Abs. 103–5784], Gassmann [see Geophys. Abs. 147–13147], and others. Preliminary results agree with the experimental error with the law of increase of velocity with depth, that is, for entire geological sections velocity seems to increase as the one-sixth power of the depth (Z) and the one-sixth power of another parameter (R_t) involving chiefly porosity and cementation.—*V. S. N.*

162–108. Zapol'skiy, K. K. O dinamicheskikh godografakh seysmicheskikh voln [On the dynamic hodographs of seismic waves]: Akad. Nauk. SSSR Izv. Ser. geofiz., no. 3, p. 198–206, 1955.

When using the seismic correlation method over a large area, there are often difficulties in following the selected wave on the records from different instru-

ments. By analysis of the dynamic characteristics of the wave, such as the variation of the amplitude, it is possible to discover reflections producing a variation of the phase angle. To simplify the procedure, Zapol'skiy suggests use of a special curve, called the "dynamic hodograph," which is constructed by adding at every point of the wave path the ordinate of the traveltime curve and the amplitude of the wave at this point, thus forming a sum composed of units of time and length.—*S. T. V.*

162–109. Linsser, Helmut. Possibilités d'utilisation d'ondes transversales dans la sismique appliquée [Possibilities of use of transverse waves in applied seismology]: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, fasc. 9, p. 245–247, 1954.

Linsser's paper on the possible use of *S* waves in seismic surveying here appears in summary only; the rest consists of an addendum in which Rothé presents and briefly discusses a montage of seismograms, obtained in a reflection survey of the Greenland icecap, in which the *S* waves are clearly shown.—*D. B. V.*

162–110. Akima, Tetsuo. A new mechanical low-pass filter for seismogram analyses: Tokyo Univ. Earthquake Research Inst. Bull., v. 30, pt. 1, p. 53–58, 1952.

Design, construction, and operation of a pendulum with electromagnetic damper that can be used to filter seismograms are given.—*M. C. R.*

162–111. Kogan, S. D. O primenenii principa fasovoy korrelyatsii k udalennym zemletryaseniyam [The application of phase correlation to distant earthquakes]: Akad. Nauk SSSR Doklady, tom 101, no. 4, p. 653–655, 1955.

In the application of the method of phase correlation is the study of distant earthquakes. There is possibility of serious error when it is assumed that the first arrivals on seismograms at different stations represent the same phase. Because of errors in the determination of epicentral distance and errors in measurements of time, one or even two peaks of the arriving wave can be lost, thus making the analysis of dynamic conditions in the focus impossible. Kogan recommends tracing the phase sequence in each component separately. It is also important to have instruments of the same type at different stations. There are sometimes difficulties in determining the phase of the incoming wave because of disturbances in the immediate vicinity of the station as the result of structural heterogeneity. Conditions are more favorable in studying distant earthquakes because the waves are propagated through deeper and more homogeneous strata.—*S. T. V.*

OBSERVATIONS OF SEISMIC WAVES

162–112. Riznichenko, Yu. V., and Silayeva, O. I. Opredeleniye zavisimosti skorostey rasprostraneniya uprugikh voln v obraztsakh gornykh porod ot odnostoronnego davleniya [The determination of the relationship between the velocity of propagation of elastic waves in specimens of rocks and unilateral pressure applied to them]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 3, p. 193–197, 1955.

Specimens of granite, marble, sandstone, and concrete, mostly about $5 \times 5 \times 12$ cm in size, were placed under pressures as great as 1000 kg per cm^2, and elastic

oscillations were excited in them both parallel and perpendicular to the direction of applied pressure by an ultrasonic seismoscope supplied with piezoelectric transducer. Measurements of time were made with an error not exceeding 0.2–0.5 microsecond. The error in the measured velocity did not exceed 1 percent. Increase of the pressure produced an increase in seismic velocity in all specimens except some building materials—such as gypsum concrete. In some the increase was as much as 35 percent. The increase of seismic velocity in the direction parallel to the direction of the applied pressure differed from that in the perpendicular direction.

A detailed description of the setup of the experiments is given, and results are shown graphically.—*S. T. V.*

162–113. Akima, Tetsuo. On dispersion curves of surface waves from the great Assam earthquake of September [sic] 15, 1950: Tokyo Univ. Earthquake Research Inst. Bull., v. 30, pt. 3, p. 237–257, 1952.

Both Love and Rayleigh waves of the earthquake of Assam were studied on the records of Japanese stations, which were almost due east of the epicenter. Three types of dispersion curves were observed with a systematic distribution. The differences are attributed to differences in crustal structure of the East China and Japan Seas, the former structure being a double-layered medium, the latter a single layer (the intermediate) or having a thin upper layer.—*M. C. R.*

162–114. Caloi, P[ietro], Filippo, D[omenico] Di, and Spadea, M. C. Onde sismiche guidate dagli strati sedimentari [Seismic waves guided by sedimentary layers]: Annali Geofisica, v. 8, no. 1, p. 9–21, 1955.

On the seismograms of the earthquake of May 15–16, 1951 (epicenter at 45° 18.3′ N., 9° 36.8′ E; depth of focus 6 km), waves propagating in the sedimentary layers have been identified. These waves are strongest in the Val Padana or near its boundaries and consist of a series of pulses with gradually decreasing velocities. The mean velocity of the longitudinal (P_s) waves was found to be 3.8 kmps, and of the transverse waves (S_s), 2.5 kmps. The waves continue beyond the boundaries of the Val Padana, but the number of impulses decreases. Clear examples recorded in Switzerland and also in Spain are taken as evidence that the "granite" is covered throughout the European continent by consolidated sedimentary rocks in which the velocity is 3.8–4.0 kmps.—*S. T. V.*

EARTHQUAKE OCCURRENCES AND EFFECTS

162–115. Sternberg, Hilgard O'Reilly. Séismicité et morphologie en Amazonie brésilienne [Seismicity and morphology of the Brazilian Amazon region]: Annales Géographie, 64e année, no. 342, p. 97–105, 1955.

Study of aerial photographs and 1:1,000,000 maps had lead to the hypothesis that the hydrographic network is related to tectonics, with rivers trending in two general directions—northeast-southwest, and northwest-southeast—following a proposed conjugate system of faults and fractures, perhaps related to subsidence of the crust accompanying the sedimentation in the Amazon basin. Earthquakes are less rare than supposed in the area—at least 35, and possibly more, have occurred since 1690—and many other localized ones undoubtedly occurred. The centers of the shocks are consistent with the proposed system of faults.—*M. C. R.*

162–116. Rothé, Jean-Pierre Edmond. La séismicité de l'Algérie [The seismicity of Algeria]: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, fasc. 9, p. 267–274, 1954.

A map of epicenters of 72 earthquakes in Algeria shows that they are distributed along the principal anticlinal axes of the littoral ranges, the interior Tell, and the Saharan Atlas. The more recent the folding, the more frequent are the earthquakes. The region averages five shocks a year, with a stronger one every 2 years. An earthquake of magnitude greater than 6 (more than 10^{23} ergs of energy) occurs every 30 or 40 years. The attention of administrators and architects of the cities of Oran, Ténès, Cavaignac, Mascara, Miliana, Constantine, and Guelma is drawn to their location in or near the active axes.

The earthquake at Kerrata on Feb. 17, 1949, the strongest in 30 years, was accompanied by about 60 preliminary or aftershocks. The classic hypothesis of tension accumulating to the point of rupture seems hardly justified; an important shock may follow shortly after a great number of weaker shocks.—*D. B. V.*

162–117. Termier, Henri, and Termier, Geneviève. Sur la séismicité de l'Afrique du Nord [The seismicity of northern Africa]: Acad. Sci. Paris Comptes Rendus, tome 240, no. 7, p. 797–799, 1955.

There is a clear relation between the seismicity and the structure and geologic history of northern Africa. The old stable zones are aseismic, and zones of recent folding are strongly seismic, particularly where two mountain chains join, or in sinking areas. The Mediterranean has the seismic characteristics of an inland sea like the Sea of Japan or of a composite basin formed by several fault troughs.—*M. C. R.*

162–118. Aubrat, J., and Molard, P[ierre]. Secousses séismiques provoquées par des éruptions volcaniques sousmarines [Earthquakes caused by submarine volcanic eruptions]. Annales Géophysique, tome 11, no. 1, p. 109–113, 1955.

Earthquakes due to submarine eruptions or probable eruptions north of Grenada have been recorded at Guadeloupe and Martinique. Records were available also from Puerto Rico and Dominica. In addition to the *T* phase, an earlier short-period (maximum 0.2 second) *C* phase was recorded. The *C* phase seems to be propagated in the sea with the speed of sound. The periods are of the order of magnitude of those possible for sofar transmission. The abnormally slow propagation indicated by some of the later maximums in the *T* phase may be due to reflections from submarine topographic highs. The regularity of period of the *T*'s throughout the phase and from one record to another makes it difficult to imagine the phase is the result of multiple reflections. *C* waves, very probably comparable to sofar waves, and the *T* waves recorded by seismographs seem to be two distinct phenomena and are propagated independently of one another.—*P. E. B.*

162–119. Mukherjee, S. M. Lisbon earthquake of 1 November 1755: Indian Jour. Meteorology and Geophysics, v. 6, no. 2, p. 149–158, 1955.

Available data on the Lisbon earthquake have been reviewed. Some new aspects of the earthquake have been brought out and a few others reinterpreted in the light of data of the recent Assam earthquake. The fresh calculations made show that this Lisbon earthquake may be considered as the strongest of

all shocks for which scientific data are available. The magnitude of the earthquake has been approximately determined as 8.7 and energy between 10^{27} ergs and 7×10^{27} ergs or double the energy of the Assam earthquake of 1950 with depth of focus 18 km.

Seiches appear to be associated with shallow earthquakes of magnitude exceeding 8.5. True seiches are generally observed over the region just outside the felt area. The shock may be felt and hanging objects may oscillate at isolated places over the same region. The maximum epicentral distances of these phenomena are proportional to the energies of the shocks. Isolated seiches may occur at very large distances, say, even 4,000 or 5,000 miles, from the epicenter.—*Author's abstract*

162–120. Mercier, P. A. Les tremblements de terre du Valais et la structure profond de la Suisse [The earthquakes of Valais and the deep structure of Switzerland]: Soc. vaudoise sci. nat. Bull., v. 66, no. 287, p. 63–73, 1954.

Studies of the *S–P* intervals in records of the many shocks in the Valais region between 1946 and 1954 with respect to the macroseismic data indicate the most satisfactory results are obtained by assuming the velocity in the granitic layer is that given by Mohorovičić.—*M. C. R.*

162–121. Grandazzi, Maurice. Le tremblement de terre des îles Ioniennes (août 1953) [The earthquake in the Ionian Islands, August 1953]: Annales Géographie, 63e année, no. 340, p. 431–453, 1954.

A description with photographs of the effects of the earthquakes of August 9–12, by an eyewitness. More than 400 were killed, nearly 2,500 injured, and 98 of 100 houses damaged.—*M. C. R.*

162–122. Bhan, Som Nath. Earthquakes felt at Srinagar during 1923–1952: Indian Jour. Meteorology and Geophysics, v. 6, no. 2, p. 197–198, 1955.

Between 1923 and 1952, 176 shocks were felt at Srinagar, the capital of Kashmir. None was severe enough to have caused severe damage. Dates of occurrence are tabulated.—*M. C. R.*

162–123. Special Committee for the Investigation of the Tokachi-Oki earthquake. Report on the Tokachi-Oki earthquake [In Japanese with English abstract]: 1018 p., Sapporo, Japan, 1954.

A report on the strong earthquake accompanied by a severe tsunami which occurred on Mar. 4, 1952 and caused considerable damage in the southeastern part of Hokkaido, Japan. The epicenter was located at 143°52′ E., 42°09′ N., and the depth of focus was 46±10 km. The report discusses physical phenomena including seismic observations, field investigations, investigation of volcanoes and springs before and after the earthquake, geological observations, result of first-order leveling, and hydrographic observations; damages to civil engineering work and structures; damages to buildings; damages to electrical equipment; and damages to farmlands and fisheries. Numerous maps, pictures, and diagrams are included.—*V. S. N.*

162–124. Girlanda, Antonino. Il terremoto dello Hokkaido del 4 marzo 1952 [The earthquake in Hokkaido of March 4, 1952] : Annali Geofisica, v. 8, no. 1, p. 83–102, 1955.

In an analysis of seismograms of the shock of Mar. 4, 1952 from more than 75 observatories in different parts of the world, an anomalous frequency in the residuals of the P_n wave of about 12 seconds and the recording at several stations of a strong *iP* about 12 seconds after the registration of the first shock suggested there had been a second, more intense shock from the same epicentral zone. Calculations by Caloi's statistical method confirm the double character of the shock and indicate that the first superficial shock was followed 24 seconds later by a second shock with practically the same epicenter but a focal depth of about 100 km. [For previous papers, see Geophys. Abs. 14918 and 157–98.]—*S. T. V.*

162–125. Matuzawa, Takeo. Feldtheorie der Erdbeben [Field theory of earthquakes] : Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 3, p. 179–201, 1953.

In this theory Matuzawa attempts to explain mathematically the relation between the spatial and temporal distribution of earthquakes and the amount of energy released. An "earthquake field" is a region within the crust in which stress energy is stored up to the critical point. The energy is derived from heat from the interior of the earth. Where the transfer of heat to the surface is uninterrupted and uniform, the region is aseismic. But where, owing probably to phase transformations immediately below the crust, energy is constantly being built up, shocks occur periodically. The mechanism is somewhat analogous to the steam engine. The boiler is represented by the liquid phase below the crust, the piston is the earthquate field.—*D. B. V.*

162–126. Matuzawa, Takeo. Feldtheorie der Erdbeben: Vergleichung vom Grossbeben vom 21. Dez. 1946 mit dem Nachbeben vom 18. April 1948 [Field theory of earthquakes: comparison of the major earthquake of Dec. 21, 1946 with the aftershock of Apr. 18, 1948] : Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 4, p. 249–253, 1953.

Matuzawa compares seismograms of the major earthquake of Dec. 21, 1946 with those of the aftershock of Apr. 18, 1948 from the same focus, at about 470 km from the focus. The field theory of earthquakes (see preceding abstract) satisfactorily explains the records. In the major earthquake, in which 10^{25} ergs of energy were released, movement occurred along a chain of ruptures extending to the surface of the earth. In the second, much of the stored stress having been relieved, 10^{23} ergs were released, and movement occurred only along the lower part of the same line, extending no farther than the lower part of the uppermost crustal layer. First traces of the *P* waves, which originated in both cases from this lower line of rupture, are the same in both records.

Study of long-period waves of major earthquakes (those in which the rupture extends to the surface) at stations near the epicenter should throw light on the vibration of the earthquake field; since the physical properties (elastic constants) of the space under stress would differ markedly from those of the surroundings, the long-period vibrations of the earthquake field should be distinguishable on seismograms from the corresponding vibrations of the surrounding space.—*D. B. V.*

162–127. Kanai, Kiyoshi. Examinations of the assumption concerning mechanism of earthquake origin through seismograms: Tokyo Univ. Earthquake Research Inst. Bull., v. 30, pt. 1, p. 39–50, 1952.

The pendulum motion caused by seismic waves from an earthquake originating as a sudden rectangular pressure change has been calculated and compared with the records of the earthquake of Jan. 26, 1951 obtained in the Hitachi mine. Results are not contradictory.—*M. C. R.*

162–128. Ritsema, A. R. The fault plane technique and the mechanism in the focus of the Hindu Kush earthquakes: Indian Jour. Meteorology and Geophysics, v. 6, no. 1, p. 41–50, 1955.

The mechanism at the focus of the Hindu Kush earthquakes centering at 36½° N. lat, 70½° E. long and a depth of about 220 km has been determined by a simplified form of the technique developed by Byerly. Data from the International Seismological Summary, Bureau Central International de Séismologie, as well as some original records, were used. It is concluded that the motion at the focus was that of a thrust fault with only a small component of movement in the direction of the strike. The fault plane either strikes N. 20° E. and dips 52° E., or strikes N. 65° E., with dip 48° NW. If the former, the movement is directed N. 155° E. dipping 42°; if the latter, the movement is N. 290° E., dipping 38°. A stress system in which the principal component acts in the horizontal direction in a northwest-southeast azimuth and the smallest component is directed nearly vertical but slightly southwestward is consistent with the forces which must have produced the northeastward-trending Hindu Kush system.—*M. C. R.*

162–129. Tandon, A. N. Direction of faulting in the great Assam earthquake of 15 August 1950: Indian Jour. Meteorology and Geophysics, v. 6, no. 1, p. 61–64, 1955.

The direction of faulting in the Assam earthquake of August 1950 has been determined from the direction of first motion at 44 observatories by the method devised by Byerly. The displacement was along a normal fault striking east and dipping 75° N., with the hanging wall moving down and slightly west relative to the footwall.—*M. C. R.*

162–130. Kogan, S. D. O sushchestvovanii glubinnoy fokal'noy poverkhnosti na granitse Tikhogo Okeana [On the existence of a deep focal surface on the border of the Pacific Ocean]: Akad. Nauk SSSR Doklady, tom 101, no. 1, p. 63–64, 1955.

Analysis of records for 1909–44 indicates that foci of deep earthquakes in the northwestern part of the Pacific Ocean along the island arcs of the Marianas, Bonin, Japanese, Kuril, and Aleutian Islands, and especially those in Japan, are concentrated in two groups along the boundary of the Asiatic Continent separated by a narrow, almost aseismic strip. The focal surface nearest to the continent is the deeper and dips under the continent at an angle of about 40°. The hypothesis is that seismic dislocations at depths of 400–600 km produce a relative motion of the Eurasian Continent toward the Pacific Ocean. This can be tested by investigations of the first motion at the foci of the corresponding earthquakes.— *S. T. V.*

162–131. Kanai, Kiyoshi. Relation between the nature of surface layer and the amplitudes of earthquake motions: Tokyo Univ. Earthquake Research Inst. Bull., v. 30, pt. 1, p. 31–37, 1952.

Mathematical expressions are obtained for primary distortional waves propagated vertically upward through a stratified visco-elastic layer, and the ratio of the displacements at the free surface of a layer to the displacements of the incident waves calculated for several combinations of velocity, viscosity, density, and layer thickness. The results indicate when the weak layer is fairly thick, the amplitudes of earthquake motions at the free surface increase as the velocity in the weak layer decreases, but the relation is not simple with a thin weak layer. In all cases, amplitudes increase as the thickness of the weak layer increases.—*M. C. R.*

162–132. Kanai, Kiyoshi. Relation between the nature of surface layer and the amplitude of earthquake motions. II: Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 3, p. 219–226, 1953.

Vibrations in a two-layered medium at the surface are of maximum amplitude when the period of the seismic waves is the same as the period of the upper layer, except when that layer is thin.—*M. C. R.*

162–133. Veshnyakov, N. V. O kolichestvennoy otsenke sily zemletryaseniya [The quantitative evaluation of the intensity of an earthquake]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 3, p. 207–214, 1955.

In almost all scales, the measurement of intensity of an earthquake is based on its effect on men and animals or of the destruction caused. By analyzing the differential equation of damped vibrations, Veshnyakov shows that vibrations caused by a seismic wave in a building and producing destruction are determined to a great extent by the ratio of the frequency of seismic waves and the natural frequency of the building, so that neither the amplitude alone, nor the acceleration, can be used as the measure of the intensity of the earthquake. He suggests taking as the quantity determining the intensity of an earthquake at any point the greatest density of the energy of seismic waves propagating through the ground. This will be expressed in joules per centimeter.—*S. T. V.*

162–134. Kanai, Kiyoshi; Osada, Kaio; and Yoshizawa, Shizuyo. The relation between the amplitude and the period of earthquake motion: Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 1, p. 45–55, 1953.

Observations of the initial motion of earthquakes recorded at Hitachi mine indicate that the amplitude varies as the square of the period. This corresponds to the mathematical case of a constant pressure or shearing force at a spherical origin for all earthquakes. The strain at the spherical surface where the waves are generated is calculated to be 10^{-4}~10^{-3}. This is near the elastic limit of material of the earth's crust. In such a mechanism of earthquake origin, the energy varies as the 3/2 power of the amplitude and the cube of the period.—*M. C. R.*

162–135. Kanai, Kiyoshi; Osada, Kaio; and Yoshizawa, S[h]izuyo. Observational study of earthquake motion in the depth of the ground. IV. [Relation between the amplitude at ground surface and the period]: Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 3, p. 227–234, 1953.

Earthquake observations at Hitachi mine, both at the surface and 300 meters underground and at the high school 6 km away, indicate a maximum amplitude at the surface when the period at depth of 300 meters is the same as the peak frequency of periods observed at the surface. If the peak frequency is the natural period of the surface layer, resonance of the surface layer is suggested.—*M. C. R.*

162–136. Kanai, Kiyoshi; Tanaka, Teiji; and Suzuki, Tomisaburo. Relation between the earthquake damage and the nature of the ground (Case of wooden houses and peat bed): Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 1, p. 57–62, 1953.

A peculiar distribution of damage to farmhouses in Hokkaido by the Tokachi earthquake of Mar. 4, 1952 is related to the subsurface structure. In the area where the surface layer of peat is indicated by seismic prospecting to be 15 meters thick the damage was considerably less than in nearby areas where the peat is indicated to be only 2 meters thick.—*M. C. R.*

162–137. Housner, G. W., Hudson, D. E., and Alford, J. L. Ground shock and building motions produced by quarry blast: Soc. Expt. Stress Analysis Proc., v. 11, no. 2, p. 133–138, 1953.

Ground and building accelerations were measured at a point 400 yards from a charge of 370,000 pounds of nitramon explosive. The instrument used was a variable-reluctance balanced-armature accelerometer with natural frequency of 80 cycles per second, and damped 60 percent of critical. The maximum horizontal acceleration of the ground was 0.13 *g*, and the horizontal acceleration in the building in the direction measured was 0.11 *g*. The records obtained are similar in character to those obtained in earthquakes.—*M. C. R.*

162–138. Okada, Atusi; and Nagata, Takesi. Land deformation of the neighborhood of Muroto Point after the Nankaido great earthquake in 1946: Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 2, p. 169–177, 1953.

Leveling surveys of the neighborhood of Muroto Point, Shikoku were carried out seven times after the Nankaido great earthquake in 1946. The results of the surveys together with those before the earthquake show that the remarkable northward tilting of this locality, about 6.2 seconds in magnitude, accompanying the earthquake has been gradually recovering and the present rate of southward tilting is nearly constant, being 0.035 second per year, which is almost equal to that for the pre-earthquake period. The main results are graphically represented.—*Authors' abstract*

162–139. Shimozuru, Daisuke, and Akima, Tetsuo. Reflections on the tsunami of December 21, 1946: Tokyo Univ. Earthquake Research Inst. Bull., v. 30, pt. 3, p. 223–230, 1952.

Long-period waves in the tide gage records of the tsunami have been tentatively identified as reflected waves from the coast of Guam.—*M. C. R.*

162–140. Tomaschek, R. Earth tilts in the British Isles connected with far distant earthquakes: Nature, v. 176, no. 4470, p. 24–25, 1955.

The records of sensitive tiltmeters at Winsford, Cheshire were compared with observations of tilt movements in Japan reported by Nishimura. Most of the tilts connected with earthquakes observed in Japan simultaneously at several stations have no corresponding movement at Winsford. An extremely strong correspondence, however, occurred during the Formosa earthquake of Oct. 22, 1951. Tilt records taken at the Tidal Institute at Bidston also show this disturbance. The records at Winsford show also that a spectacular readjustment took place on Oct. 24, 1950. Tomaschek believes that the seasonal recurrence of these readjustments may be connected with the change of rotational speed of the earth and the seasonal change of the temperature distribution over the northern hemisphere.—*R. G. H.*

162–141. Caloi, P[ietro], and Spadea, M. C. Prime indicazioni di registrazioni clinografiche ottenute in zona ad elevata sismicità [The first indications from clinographic records obtained in areas of high seismicity]: Annali Geofisica, v. 8, no. 1, p. 121–133, 1955.

Observations beginning in September 1952 with two clinometers installed in specially built cabins on opposite sides of a surface fracture near Tolmezzo showed that the opposite sides of the line were undergoing slow displacements in opposite directions until late in 1953 at which time the movements were reduced in intensity and practically ceased. In April 1954 seismic activity of moderate intensity began with relatively sharp shocks on April 25 and May 16. Apparently energy was first liberated in the form of slow deformation and then as much deeper, more violent displacements. The clinometric observations in this area could have been used as forecasts of the seismic disturbances.—*S. T. V.*

162–142. Koridalin, E. A. Sessiya soveta po seysmologii AN SSSR [The session of the Seismological Council of the Akademii Nauk SSSR]: Akad. Nauk SSSR Izv. Ser. geofiz, no. 3, p. 288–290, 1955.

Prediction of earthquakes was the subject of a conference by the Seismological Council of the Russian Academy of Sciences in February 1955. Gamburtsev discussed tectonic factors related to the genesis of earthquakes; Koridalin pointed out that the crust at present consists of relatively strong blocks separated by much weaker seismic "seams." Slow relative displacement of the blocks causes stresses in seams, finally leading to ruptures that are the immediate cause of earthquakes. The accumulated energy released by great earthquakes can be as much as 10^{17} times greater than the energy of the weakest seismic shocks. Such a great ratio of energy can be explained only by a corresponding increase in the volume of the focus—that is, the volume of the seams breaking down. Investigations of tectonic seams can now with a certain accuracy circumscribe the limits of the eventual zones of seismic shocks. The prediction of the time when such seismic shocks will be released can be made by studying the other factors causing seismic shocks.

Vvedenskaya spoke on earthquakes of Central Asia during 1942 to 1952 and emphasized that in this region weak earthquakes occur in the same seismic zones as the violent ones; the violent earthquakes are often, though not always, preceded by a diminishing of seismic activity.—*S. T. V.*

162–143. Petrushevskiy, B. A. Znachenye geologicheskikh yavleniy pri seysmicheskom rayonirovanii [The significance of geologic factors in seismic zoning]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 28(155), p. 1–59, 1955.

Petrushevskiy finds the "seismo-tectonic" method recently proposed by Gubin [see Geophys. Abs. 14053] to be based on erroneous assumptions and supports Gorshkov's "seismo-geologic" method. Tectonic features of the near-surface strata of a region cannot determine the genesis of seismic phenomena which have their source at much greater depths. Only the study of deep geology of an area can make possible the localization of the focus of an earthquake to determine its mechanical cause and to relate seismologic evidence with the most important geologic features. Therefore, the first step in seismic zoning ought to be the study of the geology of the region. Tectonic features can be of secondary importance and must be explored for their local value, of interest primarily in engineering problems. Examples are given of geologic features of seismically active regions in the U. S. S. R., and parallels are drawn with the seismic phenomena observed during previous earthquakes.—*S. T. V.*

SEISMIC SURVEYS

162–144. Carlson, R. O., and Brown, M. V. Seismic refraction profiles in the submerged Atlantic Coastal Plain near Ambrose Lightship: Geol. Soc. America Bull., v. 66, no. 8, p. 969–976, 1955.

Two mutually perpendicular, reversed seismic refraction profiles were obtained by shooting across a point at 40°27′55″ N. and 73°41′40″ W., about 8 miles south of Long Beach, Long Island, and 6 miles east of Ambrose Lightship. Three ground layers were detected with slopes of less than 1° along either profile. The seismic velocities and thicknesses of the layers are: water—4,905 fps, 80 feet; unconsolidated sediment—5,630 fps, 780 feet; semiconsolidated sediment—6,840 fps, 1,020 feet; basement—18,600 fps. The precision of the ground layer seismic velocities is estimated as ±5 percent, that of the layer thicknesses as ±10 percent. The velocity values and basement-rock depth agree with previous seismic refraction results for nearby continental shelf areas. The sedimentary layers are tentatively identified with those more exhaustively studied on Long Island itself.—*Authors' abstract*

162–145. Bruce, R. J. M., and Bull, C. Geophysical work in North Greenland: Nature, v. 175, no. 4464, p. 892–893, 1955.

The British North Greenland Expedition, in the course of its surveys to measure the thickness of ice by seismic reflections from the ice and bedrock interface, found a line east of which no reflections were obtained. Thicknesses of 2,650, 2,700, and 2,950 meters were found at three stations west of the line. Best reflections were obtained with Poulter air-pattern shooting. On a gravity profile between two points on either side of the line there was a 4 milligal discontinuity.—*R. G. H.*

162–146. Cruickshank, J. W., and Fitch, A. A. Seismic surveying in a coal mining problem: Colliery Eng., v. 31, no. 361, p. 99–102, 1954.

An experimental seismic refraction survey was made at Alva, Clackmannanshire, Scotland, in the late summer of 1952 to determine the profile of the buried channel of the River Devon. If the filling of the channel is waterlogged and if

the profile is not well known, shallow coal workings may break through to the channel and result in flooding the mine. Depths determined were confirmed by data from boreholes.—*M. C. R.*

162–147. Reinhardt, Hans-Günter. Steinbruchsprengungen zur Erforschung des tieferen Untergrundes (Grundlagen, bisherige Ergebnisse und Ausführungs-Möglichkeiten in der DDR) [Explosions in stone quarries for exploration of the deep underground. (Principles, present results, and future possibilities in Germany)]: Frieberger Forschungshefte, C15, Geophysik, p. 1–91, 1954.

This is a detailed review of studies of artificial earthquakes throughout the world and of their significance in exploration of the upper part of the crust. Included in "Steinbruchsprengungen" are not only the industrial explosions in quarries, but also such great explosions as those in Helgoland and Haslach. Significant explosions in central Europe, the United States, Japan, South Africa, and the Soviet Union are reviewed. A bibliography of 119 titles is included.—*S. T. V.*

162–148. Meinhold, R. Der Untergrund des westlichen Mecklenburg nach den Ergebnissen reflexionsseismischer Messungen [The subsurface structure of western Mecklenburg according to the results of seismic reflection measurements]: Geologie, Jahrg. 4, no. 1, p. 55–64, 1955.

Results of extensive seismic reflection investigations in western Mecklenburg suggest several changes in the indicated geologic structure of the region. Existence of three presumed salt domes was not confirmed, but two new ones were located.—*S. T. V.*

162–149. Krey, Th[eodor], Wendt,(?), and Roepke, K. Some examples of geological results obtained from recent reflection seismic surveys in Germany: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, fasc. 9, p. 246–266, 1954.

This presents recent results obtained in Germany by seismic reflection surveys for petroleum, coal, and ore. In the salt dome basin of northwest Germany, improved instruments and techniques provided data on the deep-seated structures between salt domes, where dips are relatively flat and stratigraphic traps important. In the northwestern Ruhr district, faults cutting the Carboniferous and even folded structures within the coal measures were worked out. In the Siegerland siderite region, a new vein was discovered in the Neue Haardt mine.—*D. B. V.*

162–150. Lohr, Jakob, and Nodop, Immanuel. Versuch zur Darstellung der seismischen Geschwindigkeitsverteilung im Tertiär des nördlichen Oberrheintalgrabens [Attempt to establish the seismic velocity distribution in Tertiary formations of the northern part of the Oberrheintal (Upper Rhine) graben]: Erdöl u. Kohle, Jahrg. 8, Heft 7, p. 461–464, 1955.

An attempt was made to establish a correlation between the velocity of seismic waves and the geologic age and depth of the corresponding layer. The present attempt is based on measurements made in only 12 drill holes over an area of 5,000 km^2. Both linear and exponential functions were tried, but the scattering of the measured values was too great when applied to several layers. The linear law was more successful when applied to individual wells.—*S. T. V.*

162–151. Carabelli, E. Misure dirette della velocità delle onde elastiche nella roccia di fondazione della diga di Beauregard (Valgrisanghe) [Direct measurements of the velocity of elastic waves in the foundation rock of the Beauregard dam (Valgrisanghe)]: Riv. Geofisica Appl., anno 15, no. 2, p. 85–92, 1954.

This presents the results of well-shooting experiments undertaken to check the efficiency of cement grouting of the shattered rock underlying the site of the Beauregard earth dam in Valgrisanghe (Val d'Aosta). In the injected zone the velocity was found to be 70 percent higher than in the unconsolidated rock.—*D. B. V.*

162–152. Aynard, Cl., Lepetit, (?), and Société Chérifienne des Pétroles. Étude sismique du front de la nappe prerifaine [Seismic study of the front of the pre-Riff nappe]: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, Sec. 9, fasc. 9, p. 275–283, 1954.

In a series of seismic reflection profiles across the front of the pre-Riff nappe in Morocco, the Miocene above and the Cretaceous within the nappe, both marly, behaved seismically as a unit. Velocities in the nappe were higher than normal. Evidence from boreholes confirms the seismic results. The nappe forms an anticlinal buttress below the Miocene; its position can be predicted seismically within a few hundred meters.—*D. B. V.*

162–153. Aynard, Cl., Vallet, (?), and Société Chérifienne des Pétroles. Étude sismique du bassin jurassique de Petitjean [Seismic study of the Petitjean Jurassic basin]: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, Sec. 9, fasc. 9, p. 285–295, 1954.

A seismic survey in the Petitjean region, Morocco, located the major dislocations separating the Jurassic basin from the crystalline foreland, and showed that the Jurassic is overlain sometimes conformably, sometimes with strong unconformity, by the Miocene. Seismic data were confirmed by borings.—*D. B. V.*

162–154. Raitt, Russell W. Seismic refraction studies of Bikini and Kwajalein Atolls and Sylvania Guyot, 1950: U. S. Geol. Survey Prof. Paper 260–K, p. 507–527, 1954.

Seismic refraction studies made at Bikini Atoll, Sylvania Guyot, and Kwajalein Atoll on the joint University of California-U. S. Navy Electronics Laboratory Mid-Pacific Expedition of 1950 expanded the scope of the original 1946 studies to include a section across Sylvania Guyot and several deepwater sections extending from Bikini Atoll. Also Bikini Lagoon was surveyed in much greater detail, with particular emphasis on more complete control with reversed profiles. In addition, one short section was obtained at Kwajalein Atoll.

It was found that the seismic velocities beneath Bikini Lagoon vary laterally as well as with depth. They can be grouped into six more or less well defined layers averaging approximately 2.5, 3, 4, 5.5, 6.5, and 8 kmps. The first four were observed only in the lagoon profiles, and the remaining two were found only in deep water.

From sections taken on Sylvania Guyot and the flanks of Bikini Atoll near regions where samples of volcanic rock were obtained from the sea bottom, it was concluded that the third layer, of about 4 kmps seismic velocity, represents volcanic rock. Its estimated depth under Bikini Lagoon ranges from 600 m to

2,100 m and averages about 1,800 m. One short section at the south end of Kwajalein Lagoon shows somewhat greater depths of the third layer than that at Bikini Atoll but the lagoon coverage was insufficient to demonstrate that Kwajalein differs significantly from Bikini.

Indications were found that the 6.5 kmps layer is deeper under Bikini Atoll than under the surrounding deep sea. If real, this local depression is unlikely to be greater than 3 km.—*Author's abstract*

162–155. Dobrin, M. B., and Perkins, Beauregard, Jr. Seismic studies of Bikini Atoll: U. S. Geol. Survey Prof. Paper 260–J, p. 487–505, 1954.

During Operation Crossroads in July 1946 a seismic refraction survey of Bikini Atoll was made by Joint Task Force I to determine stratification of the subsurface and if possible the thickness of the calcareous sediments. One hundred twenty-six depth charges were exploded during the survey along 4 profiles extending across the lagoon. One year later a hole was drilled to 2,556 feet below sea level on Bikini Island, and vertical velocities were measured from a depth of 1,800 feet to the surface.

The time-distance curves indicate the existence of a surface of zone with a seismic velocity of 7,000 fps. Below this at a depth of about 2,500 feet lies a zone with a velocity of 11,000 fps. A third zone in which the seismic velocity is 17,000 fps ranges in depth from 7,000 to 13,000 feet below sea level. The vertical velocity measurements indicate that the velocity increases with depth from the surface velocity to 11,000 fps at about 2,000 feet. Thus the calcareous material at the surface extends down to two or three thousand feet and may extend to the top of the 17,000 fps zone. However, since Emery, Tracey, and Ladd have reported dredging basalt and pyroclastics at 1,000 and 1,150 fathoms, respectively, it is more likely that the base of surface calcareous sediments rests on pyroclastics of lower seismic velocity which in turn rest on the 17,000 fps zone. This last zone is believed to be igneous rock.

These findings would indicate a minimum subsidence of about 3,000 feet and a maximum of about 13,000 feet.—*Authors' abstract*

162–156. Dooley, J. C. Seismic reflection survey at Roma, Queensland: Australian Bur. Min. Res., Geology and Geophysics Rept., no. 16, 39 p. and 20 plates, 1954.

A seismic reflection survey was made to test the results of earlier gravity surveys in the Roma area [see Geophys. Abs. 156–30]. Good reflections were obtained in some parts of the area, but the quality was not consistent. A small closure was indicated near one of the gravity anomalies, which could be an oil trap; test drilling is recommended.—*M. C. R.*

MICROSEISMS

162–157. Wilson, James T., and Press, Frank (editors). Symposium on microseisms: Natl. Acad. Sci.–Natl. Research Council Pub. 306, 125 p., 1953.

Eight papers presented during a 3-day conference in September 1952 sponsored by the Office of Naval Research and the Geophysical Research Directorate of the U. S. Air Force and discussion of each are included in this volume. Macelwane reviewed the history of "microseismology." Ramirez described the use of tripartite stations in determining the direction of approach of microseisms. Tracking of storms by an empirical method based on amplitude distribution and "micro-

ratio techniques" was reviewed in detail by Gilmore. Problems in the Scandinavian area were described by Båth. The origin of microseisms was considered by Longuet Higgins (Can sea waves cause microseisms?), von Straten (Storm and surf microseisms), Press and Ewing (The ocean as an acoustic system), and Scholte (A mathematical discussion of the origin of microseisms).—*M. C. R.*

162–158. Walsh, Daniel Hallaron. An observational study of the origin of short-period microseisms near Saint Louis, Missouri: Am. Geophys. Union Trans., v. 36, no. 4, p. 679–687, 1955.

Data in the form of gross hourly occurrences, times of storm beginning and ending, and of maximum displacements, as well as investigations of many individual cases, point toward a correlation in time between small regular group microseisms of characteristic 0.3-second period at Florissant and short-period microbarographic activity at the same station. The great majority of these microseismic storms seem to be associated either with the approach or passage, or both, at the station of a cold frontal-type discontinuity or with local, nonfrontal convective activity. Atmospheric turbulence seems a prime factor in the generation of these microseisms. Study of the hourly activities suggests that, while the microseisms and microoscillations are probably not related as cause and effect, they may well proceed from the same source. Finally, the study suggests that with more precise knowledge of the methods of production and propagation of these oscillations, combined analyses may prove useful tools in elucidating the local turbulence mechanism of the atmosphere.—*D. B. V.*

162–159. Lacaze, J. R. Applications géologiques d'études sur les microséismes à Alger [Geologic applications of studies on microseisms at Algiers]: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, Sec. 9, fasc. 9, p. 297–304, 1954.

To explain the fact that cold fronts over certain places in the Mediterranean and Atlantic Ocean do not produce microseisms at the Algiers station, it is suggested that certain geologic features screen out the microseisms approaching from those directions. One of these features appears to be an outcropping of the African shield in south-southeast Spain, another a discontinuity somewhere east of Algiers whose exact position and nature have yet to be determined.—*D. B. V.*

ISOTOPE STUDIES AND AGE DETERMINATIONS

162–160. Besairie, Henri. Etat de la géochronologie à Madagascar en Décembre 1954 [State of geochronology in Madagascar in December 1954]: Madagascar Service géol. Rapport ann. 1954, p. 15–17.

Age determinations are reported for eight samples. Five cycles are deduced, 255, 485, 600–700, 2,420±100 million years, and an undated most ancient cycle.—*M. C. R.*

162–161. Baranov, V. I., and Kuz'mina, L. A. Ionevvy metod opredeleniya vozrasta morskikh ilov [The determination of the age of the sediments taken from the sea bottom by the ionium method]: Akad. Nauk SSSR Doklady, tom 97, no. 3, p. 483–485, 1954.

The usual determinations of the geologic age of the sediments of the sea bottom are based on the assumption that the amount of radium is proportional to

the ionium content, these two substances being in isotopic equilibrium. This relation was checked by analyzing the composition of specimens taken from the bottom of the Pacific Ocean and the Sea of Okhotsk and was found to vary considerably. Therefore, direct determination of the ionium content is suggested. A description is given of rather complicated chemical procedures necessary for such determination. Results of five analyses are given; they closely agree with one another. By forming the Io/Th ratio, the age of the specimens can be reliably determined.—*S. T. V.*

162–162. Chapman, Randolph W., Gottfried, David, and Waring, Claude L. Age determinations on some rocks from the Boulder batholith and other batholiths of western Montana: Geol. Soc. America Bull., v. 66, no. 5, p. 607–610, 1955.

Ages of rocks from the Boulder, Philipsburg, and Idaho batholiths in western Montana have been determined by the method based on lead-alpha activity ratios in accessory minerals, principally zircon and monazite [see Geophys. Abs. 154–14732]. The average age of five rock types determined from the Boulder batholith is 68 million years, suggesting the emplacement of the batholith at or near the close of the Cretaceous. One age determination for the Philipsburg batholith was 50 million years and two from the Idaho batholith 54 and 51 million years, suggesting that these rocks are as young as if not younger than the rocks of the Boulder batholith. However, previous determinations on other rocks from the Idaho batholith gave an average age of 100 million years, and it seems probable that the bulk of this batholith is mid-Cretaceous in age although it may contain plutonic rocks of different ages.—*V. S. N.*

162–163. Tilton, George R.; Patterson, Claire [C.]; Brown, Harrison; Inghram, Mark [G.]; Hayden, Richard; Hess, David; and Larsen, Esper [S.], Jr. Isotopic composition and distribution of lead, uranium, and thorium in a Precambrian granite: Geol. Soc. America Bull., v. 66, no. 9, p. 1131–1148, 1955.

The isotopic compositions and concentrations of lead and uranium have been determined for some separated minerals and for the composite of a granite from Monmouth township, Haliburton County, Ontario, by chemical and mass spectrometric methods. The age of the zircon from the granite is 1,050 million years. Much of the lead, uranium, and thorium exists in chemically unstable and presumably interstitial phases of the granite. Comparison of the observed amounts of uranium, thorium, and lead in the various minerals with the amounts that should have been present, had these three elements existed within the minerals as closed systems, shows a nonbalance of these elements in every case. Thus the granite as a whole seems to have closely approximated a closed system since it was formed with respect to uranium and its decay products, but it has been an open system with respect to thorium and its decay products. The distribution of the lead, uranium, and thorium isotopes in granites and their constituents may help trace rock histories and explain related geochemical phenomena. The leads developed in different phases of the rock, being of different isotopic composition, provide the internal tracers.—*D. B. V.*

162–164. Ahrens, L. H. The convergent lead ages of the oldest monazites and uraninites (Rhodesia, Manitoba, Madagascar, and Transvaal): Geochim. et Cosmochim. Acta, v. 7, no. 5/6, p. 294–300, 1955.

The lead-age distribution (206/238, 207/235, 208/232, and 207/206) of three specimens of Rhodesian monazite form a regular pattern. Such an array, produced evidently by varying lead loss, may be used for a precision estimate of age—the convergent age. The convergent age of each Rhodesian monazite is estimated at $2{,}680\times10^6$ years. The lead-age distributions of monazite from Antsirabe, Madagascar, and uraninite from the Huron Claim, southeastern Manitoba, fit an extension of Rhodesian age pattern closely ($\pm20\times10^6$ years) and hence their convergent ages are estimated also at $2{,}680\times10^6$ years; uraninite from Klerksdorp, Transvaal, may have a similar age. The convergent ages of those most primitive specimens are somewhat greater ($50–700\times10^6$ years) than previously recommended estimates. The formation of a well-ordered age array suggests that physical causes, rather than chemical, have controlled lead loss.—*Author's abstract*

162–165. Gretener, P. E. F., Farquhar, R. M., and Wilson, J. Tuzo. Age of some African minerals: Royal Soc. Canada Trans., ser. 3, v. 48, sec. 4, p. 17–30, 1954.

Age determinations of radioactive and lead minerals from the Canadian Shield have been used to delineate and date the principal provinces originally defined on the basis of structure and petrology. The same basic principles may hold for other continents. On the basis of the ages of 45 specimens from Africa it may be concluded that in Africa, as in Canada, the Archean and Proterozoic types of rocks can be divided into provinces of different ages. In both continents the oldest provinces are more than 2,000 million years old. These nuclei have the same lithology and structure wherever found, and they are markedly different from all later rocks. The existence of younger gneissic belts with similar characteristics to those in Canada is indicated. All are less than 2,000 million years old. Associated with the gneissic belts and generally on their inner sides are belts of Proterozoic types of rocks. These are of many different ages, the oldest being 2,000 million years. Vein minerals, unlike pegmatites, give only lower limits for the age of a geologic province, and hence they may be much younger than the rocks in which they are found.—*V. S. N.*

162–166. Louw, J. D. Geological age determinations on Witwatersrand uraninites using the lead isotope method: South African Min. and Eng. Jour., v. 65, no. 3226, p. 621–625, and no. 3227, p. 677–680, 1954.

Ages of uraninite and "carbon" concentrates from a suite of samples representing almost every one of the recognized series of the Witwatersrand system have been determined by the lead isotope method. Despite the unsuitability of these uraninites as age index material it is concluded that all the uraninites of the Witwatersrand system fall within narrow age limits and that they are apparently all derived from the same ancient source which is older than the sedimentary system. The results obtained seem to favor a probable age of between 1,850 and 1,950 million years [see also Geophys. Abs. 160–149].—*D. B. V.*

162–167. Davidson, C. F. Age of mineralization of the Witwatersrand: Nature, v. 175, no. 4457, p. 606, 1955.

Davidson is unimpressed by Louw's use of new isotopic assays of radiogenic lead in support of arguments for a placer origin for the Witwatersrand deposits.

Mineragraphic control was lacking, and the uraninite samples were contaminated by galena of unknown isotopic composition. Pb^{207}/Pb^{206} age determinations are cited in support of already weighty arguments favoring an epigenetic origin for the Witwatersrand ores.—*R. G. H.*

162–168. Davidson, C. F. The mineralization of the Witwatersrand: Mining Mag., v. 92, no. 3, p. 152–156, 1955.

Discrepancies between ages derived from Pb^{206}/U, Pb^{207}/U, and Pb^{207}/Pb^{206} have been attributed to radon leakage, but underground observations in three mines indicated no trace of radon. An alternative explanation, the introduction of old radiogenic lead at the time of initial mineralization, is also untenable. The existence of two generations of uraninite has been indicated by mineragraphic work. The discrepancies are due to the existence of two or more generations of uraninite, arising from partial reworking—that is, solution and redeposition nearby—of the initial minerals. The initial mineralization must have occurred slightly more than 2,000 million years ago, and was apparently epigenetic in origin. [See also Geophys. Abs. 162–166.]—*M. C. R.*

162–169. Demay, André. Détermination de l'âge absolu d'une pechblende du gisement filonien de la Crouzille dans le massif granulituque du St. Sylvestre, au Nord de Limoges [Determination of the absolute age of a pitchblende from the Crouzille vein deposit in the granulitic massif of St. Sylvestre north of Limoges]: Acad. Sci. Paris Comptes Rendus, tome 237, no. 1, p. 48–50, 1953.

The age has been determined by three methods: relative contents of uranium, thorium, and radiogenic lead; Pb^{207}/U ratio; and Pb^{207}/Pb^{206} ratio as 146, 147, and 157 million years. If a 5 percent loss of radon is assumed these ages become 147, 147, and 148 million years. The age of the vein corresponds to the beginning of the Jurassic, or end of the Triassic, much younger than the granulite.—*M. C. R.*

162–170. Hoekstra, H. R., and Katz, J. J. "Age of uraninites from crystallographic data." A criticism with reply by B. Wasserstein: Nature, v. 175, no. 4457, p. 605, 1955.

Wasserstein's proposed method of age determination of uraninites based on X-ray measurements of the shrinkage in cube edge and his classification of uraninites into α, β, and γ groups are an over-simplification and not consistent with the known chemistry of uranium oxides. Factors not considered by Wasserstein such as oxidation due to weathering, radiation damage, presence of rare-earth and alkaline-earth oxides affect lattice dimensions and consequently make such age calculations of doubtful value.

Defending his thesis Wasserstein states that the replacements of uranium are in accordance with certain valency principles. Proper selection of samples obviates problems of weathering and presence of rare earths. Radiation damage and the role of alkaline earths he regards as inconsequential.—*R. G. H.*

162–171. Patterson, Claire C. The Pb^{207}/Pb^{206} ages of some stone meteorites: Geochim. et Cosmochim. Acta, v. 7, no. 3/4, p. 151–153, 1955.

The isotopic compositions of leads isolated from three stone meteorites have been determined. If it is assumed that the original lead had the same isotopic composition as that isolated from iron meteorites, then the radiogenic lead may

be used for calculation of ages. The Pb^{207}/Pb^{206} ages are about 4.5×10^9 years. Using the observed lead concentrations and a decay period of 4.5×10^9 years, the minimum required concentrations of uranium and thorium have been calculated as 0.1 ppm and 0.5 ppm, an order of magnitude higher than concentrations previously regarded as acceptable.—*M. C. R.*

162–172. Thomson, S. J., and Mayne, K. I. The ages of three stony meteorites and a granite: Geochim. et Cosmochim. Acta, v. 7, no. 3/4, p. 169–176, 1955.

The ages since solidification of the stone phases of three meteorites were determined by the potassium-argon method as between 1.9 and 3.8×10^9 years. The age of a granite from South Harris, believed to be Precambrian, was found by the same method to be 4.9×10^8 years, but there may have been loss of argon as a result of diastrophism. If the K^{40} branching ratio is taken as 0.085 rather than 0.125, the ages are 2.3 to 4.4×10^9 years for the meteorites and 6.6×10^8 years for the granite.—*M. C. R.*

162–173. Yashchenko, M. L., and Gerling, E. K. Vozrast i proiskhozhdeniye tektitov [The age and origin of tektites]: Akad. Nauk SSSR Lab. Geologii Dokembriya Trudy, vypusk 2, p. 232–246, 1953.

The ages of three tektites have been determined from the potassium-argon ratio as $<1.2\times10^7$, 4.6×10^6, and $<3.4\times10^6$ years, respectively. These ages are consistent with other tektite determinations (Suess, Hayden, and Inghram, 1951) of $<10\times10^6$, $<32\times10^6$, and $<73\times10^9$ years. Determinations on meteorites range from 480 million to 3 billion years. After a review of various theories regarding the origin of tektites, it is concluded that their age is more consistent with a terrestrial origin than meteoritic, and that the most logical explanation is that they are volcanic material transported for considerable distances by air currents.—*D. B. V.*

162–174. Moljk, A., Drever, R. W. P., and Curran, S. C. Trace-quantity analysis. Neutron activation applied to potassium-mineral dating: Nucleonics, v. 13, no. 2, p. 44–46, 1955.

The mineral to be dated is treated to yield A^{40} as a gas, either by salt fusion or by dissolving in water. The gas is irradiated, converting some A^{40} to A^{41} by the (n, γ) reaction. If the effective neutron flux is ϕ and bombardment time is long compared with the half-life, the activity produced is $\sigma\phi n$, where σ is the integrated cross section and n is the number of A^{40} atoms irradiated. By measuring the activity subsequent to activation, and knowing $\sigma\phi$, n can be obtained. The product is determined experimentally by irradiating a known amount of pure argon in a quartz container placed in the reactor near the sample of radiogenic argon. Comparison with the monitoring gas allows close estimation of the amount of radiogenic argon that had been released from the mineral. For specimens of age t, very much less than the half-life of K^{40}, n and t are substituted in the general decay equation for dN and dT, giving $n=-\lambda_k N t$, where n (amount of A^{40}), λ_k (partial decay constant for K-capture), and N (original number of K^{40} atoms) are known. Ages of 10^4 years can be determined, but the practical lower limit may be 10^6 years because of experimental problems. This latter corresponds to measuring $30\text{–}40\times10^{-9}$ grams of A^{40}. An age of 6×10^7 years was obtained for a sample of sylvite believed to be

10^5 years old. The discrepancy may be the result of inefficient collection of gas, because of adsorption of the gas on crystal surfaces.—*M. C. R.*

162–175. Kulp, J. Laurence. Low-level counting, key to advances in radiocarbon dating: Nucleonics, v. 12, no. 12, p. 19–21, 1954.

A report of a conference at Andover, Mass., Oct. 21–23, 1954. The assumptions and basic problems, techniques, and results of radiocarbon dating were subjects of discussion.—*M. C. R.*

162–176. Funt, B. L., Sobering, S., Pringle, R. W., and Turchinetz, W. Scintillation techniques for the detection of natural radiocarbon: Nature, v. 175, no. 4467, p. 1042, 1955.

Synthesis and use of toluene as a solvent in a liquid scintillator for C^{14} age determinations has been investigated. The incorporation of the carbon content of a sample into a liquid scintillator should produce a detector of high sensitivity, excellent geometry, and relatively low background counting rate. The background counting rate can be reduced by means of a massive lead and mercury shield, and by selection of pulses in the range of energies corresponding to the beta spectrum of C^{14}. From synthesized toluene samples simulating 16,800 years, 24,800 years, and 35,000 years, the net counting rates were 1.86 ± 0.04, 0.94 ± 0.04 and 0.30 ± 0.04 counts per minute, based on the average of two 24-hour counts in each case. The C^{14} counting efficiency was about 50 percent. The results indicate that significant results can be obtained for ages as great as 45,000 years.—*R. G. H.*

162–177. Fergusson, G. J. Radiocarbon dating system: Nucleonics, v. 13, no. 1, p. 18–23, 1955.

An improved method for radiocarbon dating developed in New Zealand centers around a well-shielded 7.7-liter proportional counter. Carbon in the sample to be dated is converted to carbon dioxide and is purified by the procedure developed by Rafter [see Geophys. Abs. 161–133]. Pulses from the counter are linearly amplified and electronically sorted into four groups depending on their amplitude. A low background rate is achieved by extensive gamma-ray shielding, and cosmic-ray background is identified by a surrounding ring of anticoincidence Geiger-Müller counters. For most problems a filling pressure of 1 atmosphere seems to be the best compromise between accuracy and man-hours of work per sample. For increased accuracy a 3-atmosphere filling is used. A maximum age of 45,000 years can be measured with a 2-day count on sample and on background with a 3-atmosphere filling.—*M. C. R.*

162–178. Powers, Howard A. A new date in Kilauea's history: Volcano Letter, no. 527, p. 3, 1955.

The date of an eruption of Kilauea which killed and buried an old fern forest on its northeastern rim has been determined by measuring the amount of C^{14} in the charcoal. The steam blast eruption of mud and boulders occurred about 2,500 years ago.—*V. S. N.*

162–179. Horberg, Leland. Radiocarbon dates and Pleistocene chronological problems in the Mississippi Valley region: Jour. Geology, v. 63, no. 3, p. 278–286, 1955.

Radiocarbon dates now available cover all major divisions of the Wisconsin stage over a large part of the Mississippi Valley and agree consistently with

geological interpretation of relative ages and boundaries. A duration of 25,000 years is indicated for the Wisconsin stage. Ages based on depth of carbonate leaching are in striking agreement with radiocarbon chronology, but ages based on rate of glacier movement or on varves [see Geophys. Abs. 154–14734, Antevs, 1953] are more than twice those based on C^{14}.

The major geological objection to radiocarbon chronology is that a long and complex series of Wisconsin glacial events is crowded into 25,000 years. Objections are supported by varve chronology, the rate of postglacial isostatic uplift, significant time required for the Brady interval and other interstadial soils, rates of erosion and sedimentation suggesting 300,000–900,000 years for the Wisconsin, and excessive rates of ice-front movement required to account for fluctuations recorded by the glacial deposits.

Geological problems involved in evaluating radiocarbon dates are: stratigraphic interpretations and correlations; the secondary deposition; varying conditions at the sample sites which may have a bearing on age determination; and evaluation of interstadial soils in terms of time requirements.—*V. S. N.*

162–180. Ruhe, R. V., and Schottes, W. H. Radiocarbon dates in central Iowa: Jour. Geology, v. 63, no. 1 p. 82–92, 1955.

The following substages and dates for the Wisconsin stage of central Iowa were recognized from a study of the four available radiocarbon samples: Mankato; Cary-Mankato, 11,404±350 years; Cary, 12,161±540–13,300±900 years; Brady, 14,042±1,000; Tazewell; Iowan-Tazewell, 16,367±1,000 years; and Iowan, >17,000 years.—*V. S. N.*

Faul, Henry (editor). Nuclear geology. See Geophys. Abs. 162–184.

162–181. Suess, H. E. Radiocarbon concentration in modern wood: Science, v. 122, no. 3166, p. 415–417, 1955.

Earlier determinations [see Geophys. Abs. 158–171, 172] on modern wood have indicated a decrease of specific C^{14} activity during the past 50 years, since the industrial revolution became widespread. In order to obtain more quantitative data on this effect, the concentration of C^{13} and C^{14} was measured for 11 tree ring sections from 4 different trees grown in Alaska, Massachusetts, California, and Peru, and for 3 samples of marine carbon for comparison. Results from 19th century wood, after correction for age and C^{13} variation, deviated by not more than 0.12 percent from their mean; results from recent wood, however, showed marked variations, always in the direction of lower C^{14} content, the largest effect being noted in the tree from the east coast of the United States. The relatively large local variation of CO_2 in the atmosphere derived from local coal combustion, with worldwide contamination of the atmosphere of less than 1 percent, are indicated. The rate by which this CO_2 exchanges and is absorbed by the oceans must be greater than previously assumed. Marine carbon shows lower C^{14} content than expected under assumption of complete equilibrium with the atmosphere; no explanation can be offered at present.—*D. B. V.*

162–182. Jeffery, P. M., Compston, W., Greenhalgh, D., and DeLaeter, J. On the carbon-13 abundance of limestones and coals: Geochim. et Cosmochim. Acta, v. 7, no. 5/6, p. 255–286, 1955.

Mass spectrometric determinations of the carbon isotope composition of about one hundred specimens of limestones and coals of Australian origin show wide

variations. The observed variations in limestones are not due entirely to varying environments of deposition, and in the coals not entirely to differing plant biotopes. They can be attributed to changes in the isotopic composition of the hydrosphere and atmosphere at different times. The changes seem to be cyclic in nature and periodic in time, and to correlate with major diastrophism which would change the balance of the carbon cycle in the lithosphere.—*M. C. R.*

162–183. Landergren, Sture. A note on the isotope ratio C^{12}/C^{13} in metamorphosed alum shale: Geochim. et Cosmochim. Acta, v. 7, no. 5/6, p. 240–241, 1955.

Determinations of C^{12}/C^{13} ratio in alum shale which has undergone thermal metamorphism in comparison with corresponding ratios in shale that has not been metamorphosed indicate thermal metamorphism has not affected the isotopic composition.—*M. C. R.*

RADIOACTIVITY

GENERAL

162–184. Faul, Henry (editor). Nuclear geology: 414 p., New York, John Wiley & Sons, Inc., 1954.

The purpose of this book is "to introduce the graduate student and the practicing professional geologist to a new approach to some questions of the Earth." The book includes ten chapters entitled: Fundamental considerations, instruments, and techniques of detection and measurement; Uranium and thorium; The abundance of potassium; Rare gases and fission in nature; Heat from radioactivity; Radiation damage and energy storage; Hydrocarbons formed by the effects of radioactivity and their role in the origin of petroleum; Geophysical exploration by nuclear methods; Determination of absolute age; and The origin of the earth.

Contributors are John A. S. Adams (Uranium and thorium contents of volcanic rocks); L. H. Ahrens (The abundance of potassium. The strontium method for determining geological age); James R. Arnold (Carbon^{14} age method); Kenneth G. Bell (Uranium and thorium in sedimentary rocks); Francis Birch (Heat from radioactivity); S. H. A. Bowie (Nuclear emulsion techniques); Farrington Daniels (Radioactivity, energy storage, and volcanism); Francis J. Davis (Scintillation counters); Henry Faul (The radon method of radium analysis. Helium, argon, and radon. Nuclear logging of drill holes for mineral exploration and soil studies); Irving Friedman (Mass spectrometry); Heinrich D. Holland (Radiation damage and its use in age determination); Patrick M. Hurley (The helium age method and the distribution and migration of helium in rocks); D. H. Johnson (Radiometric prospecting and assaying); F. H. Koczy (Geochemical balance in the hydrosphere); E. S. Larsen, Jr. and George Phair (Distribution of uranium and thorium in igneous rocks); John Putman Marble (Historical introduction); Hans Pettersson (Radioactive elements in ocean waters and sediments—Historical review and experimental results. Radioactivity and chronology of the ocean floor); G. R. Tilton (Isotope dilution techniques); C. W. Tittle (Gamma-ray and neutron logging in the petroleum industry); H. G. Thode (Spontaneous and neutron fission in nature); H. C. Urey (The origin of the earth); G. J. Wasserburg (Argon^{40}: Potassium^{40} dating); Walter L. Whitehead (Hydrocarbons formed by the effects of radioactivity and their role in the origin of petroleum); E. J. Zeller (Thermoluminescence of carbonate sediments).—*M. C. R.*

RADIOACTIVITY CONSTANTS

162–185. Dixon, D., McNair, A., and Curran, S. C. Radioactivité naturelle du lutétium, du rhénium et de l'osmium [Natural radioactivity of lutetium, rhenium, and osmium]: Jour. Physique et Radium, tome 16, no. 7, p. 538–540, 1955.

Decay of Lu^{176} was studied with a large proportional tube spectrometer and scintillation spectrometers. The half-life was 4.56×10^{10} [years]. Studies of Re^{184} and Os^{184} failed to reveal beta activity, and minimum half-lives of 10^{16} years were deduced.—*H. F.*

162–186. Tobailem, Jacques. Mesures précises de périodes radioactives [Precise measurements of radioactive half-lives]: Jour. Physique et Radium, tome 16, no. 1, p. 48–53, 1955.

Half-lives of several radioactive elements have been precisely determined with an apparatus consisting of two differential ionization chambers connected to an electrometer tube. One obtains a precision of the order of 1 percent for half-lives of the order of several years and of the order of 0.1 percent for half-lives of the order of several days. The following results have been obtained: Co^{60}: 5.27 ± 0.07 years; Rn^{222}: 3.825 ± 0.005 days; Ac^{227}: 21.6 ± 0.4 years; Ga^{67}: 77.9 ± 0.3 hours; Na^{24}: 14.90 ± 0.05 hours; Cu^{64}: 12.8 ± 0.03 hours; and Au^{198}: 2.686 ± 0.005 days.—*Author's abstract, H. F.*

162–187. Tobailem, Jacques. Mesure de la période du RaD [Measurement of the half-life of Pb^{210}]: Jour. Physique et Radium, tome 16, no. 3, p. 235–236, 1955.

The half-life of Pb^{210} was redetermined with a differential twin ionization chamber. The result, $t = 19.40 \pm 0.35$ years, corresponding to $\lambda = 1.13 \pm 0.02 \times 10^{-9}$ seconds^{-1} confirms the previous determination by the Curies made in 1929.—*H. F.*

162–188. McNair, A., Glover, R. N., and Wilson, H. W. K^{40} branching ratio: Phys. Rev., v. 99, no. 3, p. 771, 1955.

The ratio of gamma to beta transitions occurring in the decay of K^{40} has been accurately determined by two different counting methods, yielding the ratios 0.124 ± 0.002 and 0.121 ± 0.004, respectively.—*Authors' abstract*

INSTRUMENTS AND METHODS OF OBSERVATION

162–189. Krebs, A. T. Early history of the scintillation counter: Science, v. 122, no. 3157, p. 17–18, 1955.

This is a brief review of the history of the development of the scintillation counter. A bibliography of 28 items is included.—*M. C. R.*

162–190. Davis, F. J., Harter, J. A., Reinhardt, P. W., and Harris, D. F. Scintillation detector for carborne and airborne use: Nucleonics, v. 12, no. 12, p. 46–47, 1954.

A description, with circuit diagrams, of a scintillation detector for geologists and prospectors. The equipment weighs 31 pounds, not including the recorder and scintillation head, and is operated from either the 6-volt or 12-volt storage battery of any car or light aircraft.—*M. C. R.*

162–191. Cadudal, Mlle. Dosage du radon dans les mines d'uranium par la méthode prélèvement sur charbon [Measurement of radon in uranium mines by adsorption on carbon]: Jour. Physique et Radium, tome 16, no. 6, p. 479–482, 1955.

A method of measuring radon in air is described, using the adsorption of radon on active carbon. The beta rays emitted by the solid decay products of radon on the carbon are measured with a Geiger counter. The volumes of air passed over the carbon range from 10 to 200 liters. The limit of sensitivity is 10^{-12} curies per liter, and the usual precision is about 7 percent. This method is intended for the monitoring of radon in mine air or of air in rooms containing uranium.—*H. F.*

162–192. Bhatnager, A. S., and Ghosh, P. C. Using autoradiography for quantitative study of U in ore: Nucleonics, v. 12, no. 4, p. 58–59, 1954.

A combination of radioassay and autoradiography provides data to calculate the percentage of uranium in radioactive minerals without the necessity of separating the minerals from the ore. Radioassay gives the percentage of uranium in the sample; counting a large number of particles in the autoradiograph and distinguishing radioactive from nonradioactive ones gives a fairly accurate determination of the fraction of radioactive mineral in the ore. Two examples are given. An exposure of 240 hours was required for the autoradiograph.—*M. C. R.*

162–193. Hyman, Seymour C., Minushkin, Bertram, and Certaine, Jeremiah. How drill-hole diameter affects gamma-ray intensity: Nucleonics, v. 13, no. 2, p. 49–50, 1955.

Experimental determinations of gamma-ray intensity were made in mock drill holes of thin galvanized iron rolled into a cylinder surrounded by uranium-bearing ore in a 22-inch diameter drum. Geiger-Müller and ratemeter readings were taken inside the holes with and without the drum being surrounded by six additional ore-filled drums. These experiments show that 10-inch wall thickness of ore is effectively infinite within the sensitivity of the probe used. The experimental setup was arranged to establish a constant angle of view for the probe, and the wall thickness was kept constant. The size of hole had no effect on gamma-radiation intensity for holes 2 to 12 inches in diameter. Mathematical analysis, with isotropy and the inverse-square law assumed, also showed that the radiation intensity is independent of hole size for spherical and cylindrical holes.—*M. C. R.*

162–194. Przewłocki, Kazimierz. Mozliwości zastosowania w geologii poszukiwawczei metod promieniotworczosci [The possibility of the application of radioactive method in exploratory geology]: Przeglad geol., zeszyt 6, p. 295–296, 1955.

A brief review is given of radioactive methods of exploration and their possible applications in geophysical exploration. An extensive bibliography of the subject is given as an appendix.—*S. T. V.*

162–195. Hatuda, Zin'itiro. Radioactive method for geological exploration: Kyōto Univ. Coll. Sci. Mem., Ser. B., v. 21, no. 2, p. 231–271, 1954.

Radioactive prospecting as here described is the determination of geologic structure by measurements of radioactivity. Four methods are used: determina-

tion of radon in soil air, in which soil air extracted from the ground is introduced into an ionization chamber, and the ionization measured; use of a "ground-hole" ionization chamber, involving the measurement of ionization in a hole in the ground into which the central electrode of an electroscope is extended; use of photo plates, with a small sensitive plate attached to the lower end of a long handle inserted in the hole; and Geiger counter measurements.

The diffusion of radon in soil may be determined by analogy with electrical conduction. Experimental determinations have been thus made of diffusion near faults. Several field applications of the method have been successful.—*M. C. R.*

162–196. Brownell, George M. Prospecting with a scintillometer: Precambrian, v. 23, no. 3, p. 23–29, 1950; reprinted v. 28, no. 1, p. 12–17, 1955.

Scintillometer surveys were made of the main Nicholson vein, Goldfields, Saskatchewan; the Jim claim, also on the Nicholson property; and the Nistro Mines property at Black Lake, Saskatchewan. Isorad maps were successfully used to determine the vein system. Surveys may also be used to guide development, and in prospecting and assaying.—*M. C. R.*

162–197. Brownell, G[eorge] M., and Schaller, R. J. R. Prospecting local areas with the airborne scintillometer: Precambrian, v. 27, no. 3, p. 6–12, 1954.

Prospecting of groups of claims can be efficiently carried out in a helicopter, but conventional aircraft are more generally used especially in surveys of large areas. Helicopter surveys in the Foster Lakes area of north-central Saskatchewan and the Athabaska region were successfully made. Surveys were also made in conventional aircraft in the Blind River and Baldwin Township areas of Ontario.—*M. C. R.*

162–198. Gregory, A. F. Aerial detection of radioactive mineral deposits: Canadian Min. Metall. Bull., v. 48, no. 520, p. 479–485, 1955.

Airborne Geiger counters and scintillation counters have been used by the Eldorado Mining and Refining, Ltd., since 1947, and extensively so since 1949. Several limiting conditions were established for successful radioactivity detection, the most important being that natural vein exposures can only be assuredly detected at distances of less than 150 feet. Sedimentary and pegmatite radioactive deposits can be detected at greater distance. Helicopters offer a useful aerial prospecting possibility.—*L. C. P.*

162–199. Vice, William B. Applications and interpretations of radioactivity logs in southern Louisiana Miocene sands: Gulf Coast Assoc. Geol. Soc. Trans., v. 3, p. 127–146, 1953.

Applications of radioactivity logging, such as well depth measurement corrections, location of oil and gas contacts, tracer studies of cement operations, identification of formations missed by other logging methods, ordinary correlation, porosity determination in carbonate reservoirs, tracer studies concerned with secondary recovery and lost circulation, location of cased-off sands, identification of sulfur deposits, emergency logging, oil and water contacts, and casing leaks, are described with representative examples from producing areas in the gulf coast of southern Louisiana.—*M. C. R.*

RADIOACTIVITY OF ROCKS, WATERS, AND AIR

162–200. Libby, W. F. Dosages from natural radioactivity and cosmic rays: Science, v. 122, no. 3158, p. 57–58, 1955.

Total radiation dosages in milliroentgens per year have been calculated for exposures at various altitudes over ocean, ordinary granite, and typical sedimentary rock, from cosmic rays, from the natural radioactivity of the human body, and from special circumstances such as use of a radium dial wrist watch, x-rays, and crowds. Calculated total dosages for exposures over granite range from 143 milliroentgens per year at sea level at the equator to 560 at 20,000 feet at 55° N. lat. Surface dosages decrease with altitude, but the total increases because of the cosmic ray contribution. Calculated dosages are in reasonable agreement with direct measurements (for example, 104–182 milliroentgens per year over igneous rocks in Sweden).—*M. C. R.*

162–201. Slack, H. A., and Krumbein, W. C. Measurement and statistical evaluation of low-level radioactivity in rocks: Am. Geophys. Union Trans., v. 36, no. 3, p. 460–464, 1955.

This is a progress report on the application of statistical methods to measurement of low-level radioactivity of certain black shales. The results suggest the possibility of estimating radioactivity within confidence limits selected by the investigator, although narrow limits may involve prohibitive counting times for each sample. Use of analysis of variance in designing a sample plan shows that the marked variation among closely spaced samples is such that it may represent a homogeneous population in any one sampling area; hence, a lesser number of samples from the grid could be used to estimate the mean radioactivity at the sampling point. This is important in designing a regional study, inasmuch as it eliminates the necessity of having almost innumerable closely spaced samples. Moreover, by designing the regional plan on a hierarchial basis, the total degrees of freedom in the experiment may be distributed over several levels to permit estimation of the variance introduced at any level of sampling, and to provide adequate degrees of freedom for estimating parameters of the total regional population.—*D. B. V.*

162–202. Hayase, Ichikazu. The radioactivity of rocks and minerals studied with nuclear emulsion II. Thorium content of granitic allanites: Kyōto Univ. Coll. Sci. Mem., Ser. B, v. 21, no. 2, p. 171–182, 1954.

The alpha radioactivity of minute granitic allanite was measured by the autoradiographic method. Allanite contains mostly thorium as the radioactive element, and the thorium can be calculated by the alpha track length and population. Granitic allanites treated here in this paper varied in thorium content from 0.5 to 1.6 percent even in the same thin section of the rock. The thorium content of allanite is peculiar to each granite mass, but has no direct relation with the radioactivity the host granite itself contains.—*Author's abstract*

162–203. Davidson, C. F., and Ponsford, D. R. A. On the occurrence of uranium in coals: Mining Mag., v. 91, no. 5, p. 265–273, 1954.

Although coal formations are usually among the least radioactive of the common sedimentary rocks, uranium-enriched coals have been found in England, Germany, Hungary, and the western United States. The radioactive coals are typically thin and usually form the topmost seam of a sequence overlain un-

conformably by redbeds, acid volcanic ash, or other formations from which uranium may be leached by downward percolating waters. The coal may adsorb the uranium and perhaps other elements such as germanium, as a result of an ion-exchange mechanism or in the form of organometallic compounds.—*M. C. R.*

162–204. Garrigue, Hubert. Sur la radioactivité de l'atmosphère d'origine atomique [On the radioactivity of the atmosphere of atomic origin]: Acad. Sci. Paris Comptes Rendus, tome 240, no. 2, p. 178–180, 1955.

Radioactivity with long-half-life was observed in flight in October, and radioactive snow fell Dec. 5–6, 1954 at Puy-de-Dôme.—*M. C. R.*

162–205. Garrigue, Hubert. Nouvelle recrudescence d'activité d'origine atomique dans l'atmosphère [New recurrence of activity of atomic origin in the atmosphere]: Acad. Sci. Paris Comptes Rendus, tome 240, no. 13, p. 1453–1455, 1955.

Samples of snow, dust, and frost obtained during the winter of 1954–55 were only weakly radioactive.—*M. C. R.*

HEAT

162–206. Jaeger, J. C., and Beck, A. The calculation of heat flow through disks and its application to conductivity measurements: British Jour. Applied Physics, v. 6, no. 1, p. 15–16, 1955.

A fairly general method for the solution of problems of axial flow through one or more disks has been developed to obtain corrections for small differences in the diameter of disks used in the divided-bar method of determining the thermal conductivity of rocks. As a first approximation the problem is idealized by considering a disk of given radius and diameter with a constant flux over circles of smaller diameter in its plane faces, and a satisfactory solution is obtained. Edge corrections thus determined are applicable also to the corresponding electrical problems and the measurement of permeability.—*M. C. R.*

162–207. Jacobs, J. A., and Allan, D. W. Temperature and heat flow within the Earth: Royal Soc. Canada Trans., ser. 3, v. 48, sec. 4, p. 33–39, 1954.

To obtain a practical solution for temperature and heat flow in the earth the following assumptions were made: the earth is solid throughout, and has been so for the past 4×10^9 years; it is spherically symmetric as regards all physical properties; the effects of contraction may be neglected; the thermal conductivity and diffusivity may be treated as constant; the radioactive substances are distributed in spherical shells, in each of which their concentrations are constant; and the surface temperature of the earth has remained at a constant 0°C for the past 4×10^9 years. With these assumptions the problem is divided into two parts: the solution for a nonradioactive earth cooling from a given initial temperature distribution, and the solution for a radioactive earth heating up from zero temperature. The complete solution is the sum of the two. Results have been worked out for two specific earth models, and the following conclusions seem indicated: thermal conditions in the earth's upper mantle were considerably different 4, 3, and even 2 billion years ago than those existing at present; near-surface thermal conditions under the oceans and continents may be quite differ-

ent; at great depths the earth has probably been heating up throughout its history; preliminary calculations of the amount by which the earth's radius has decreased by thermal contraction alone show that the contraction possibly does not exceed 10 km.—*V. S. N.*

162–208. Goguel, Jean. Le rôle de l'eau dans le régime thermique des couches superficielles [The role of water in the thermal regime of surface layers]: Acad. Sci. Paris Comptes Rendus, tome 237, no. 1, p. 81–82, 1953.

If the geothermic step approaches 7.50 meters, the value for which water reaches the critical state at a depth of about 2,700 meters, convection currents would be established of descending water and rising water vapor which would heat the rocks because of latent heat given out in condensation. Thus, no matter how great the source of heat, the average geothermic step will not be lowered below 7.50 meters.—*M. C. R.*

Faul, Henry (editor). Nuclear geology. See Geophys. Abs. 162–184.

VOLCANOLOGY

162–209. Perrin, R. Granitization, metamorphism and volcanism. Am. Jour. Sci., v. 252, no. 8, p. 449–465, 1954.

Current European thought rejects the concept of magmatic granite in favor of granitization. Perrin believes that two-way diffusion in a stationary medium can better account for the removal and introduction of material than circulation in a moving medium. Not only granitization, but also metamorphism, orogeny, and volcanism can be satisfactorily explained in this manner. Outpourings of lava prior to orogeny correspond to the beginning of diffusion in relatively deep strata. If the zone of diffusion reaches higher strata, deformation is possible, and the cycle of metamorphism, granitization, and orogeny is reached. After the intense period of orogenesis, the new attitudes of the strata increase their resistance to deformation, and continued diffusion in depth can generate only postorogenic volcanism with lavas emitted through fissures in the less resisting zones such as the edges of cordilleras. Volcanoes thus correspond to deep chemical reaction centers, unable to deform the crust, that break through to the surface by way of fissures developed by the tensions. Since equilibrium is never thoroughly attained in any compartment of the crust, volcanism may occur even in regions of old metamorphism and granitization.—*D. B. V.*

162–210. White, Donald E. Violent mud-volcano eruption of Lake City Hot Springs, northeastern California: Geol. Soc. America Bull., v. 66, no. 9, p. 1109–1130, 1955.

An eruption, unique in the history of hot springs, occurred on Mar. 1 and 2, 1951, in a group of hot springs and small mud volcanoes in northeastern California. Steam, gases, and mud particles rose several thousand feet in the air and distributed fine debris at least 4 miles to the southeast. More than 20 acres of the hot-spring area was greatly modified, and at least 6 million cubic feet or 300,000 tons of mud were involved. The area was barely active several days after the eruption.

Mud-volcano eruptions are caused by the sudden release of energy stored in near-surface hydrothermal systems and do not involve direct release of energy from new volcanic magma as in true volcanic eruptions. The energy of true

volcanic eruptions, however, may be increased by release of energy from previously existing hydrothermal systems, for example in the Rotomahana phase of the great Tarawera eruption of 1886 in New Zealand.—*V. S. N.*

162–211. Pfannenstiel, Max. Der Ausbruch des Parícutin-Vulkans in Mexiko im Jahre 1943 [The eruption of Parícutin Volcano in Mexico in 1943]: Naturwiss. Rundschau, Jahrg. 8, Heft 3, p. 100–103, 1955.

The history of Parícutin Volcano is briefly related.—*S. T. V.*

162–212. McBirney, A. R. Recent volcanic activity in Central America: Volcano Letter, no. 527, p. 1–2, 1955.

Activity in the volcanoes of Central America in 1952, 1953, and 1954 has been characterized by low-temperature steam and gas emissions, often of violent nature. Little if any juvenile material has been erupted.—*V. S. N.*

162–213. Macdonald, Gordon A., and Eaton, Jerry P. Hawaiian Volcano Observatory report for January–March, 1955: Volcano Letter, no. 527, p. 3–6, 1955.

The seismic uneasiness of the east rift zone of Kilauea volcano began in November 1954, and continued with general slight increase through December, January, and February. On February 28, 1955, it culminated in eruption of the volcano in the east rift area west-southwest of Cape Kumukahi (East Cape). The eruption is to be described in detail in a later issue of Volcano Letter.—*V. S. N.*

TECTONOPHYSICS

162–214. Bonchkovskiy, V. F., and Latynina, L. A. Krutil'nyy deformograf [Torsion deformograph]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 3, p. 275–277, 1955.

An instrument designed for measurement of the relative displacement of two rigid bodies consists of two bars, each connected with one of the bodies, and a thin cylindrical rod slightly squeezed between the bars. The rod is provided with a mirror so that its rotation can be measured by the displacement of a light beam on a circular scale. By choosing the diameter of the rod of 0.1 mm and the length of the light beam of 1 meter, it is possible to measure relative displacements as small as 0.1 μ.—*S. T. V.*

162–215. Sakuma, Shūzō. Elastic and viscous properties of volcanic rocks at elevated temperature. Part 1: Tokyo Univ. Earthquake Research Inst. Bull., v. 30, pt. 3, p. 269–278, 1952.

Elasticity and viscous flow in specimens of lava from the flow of Oosima of 1950 were measured by observing telescopically the change in curvature of a plate $1 \times 8 \times 0.3$ cm which was supported between two knife edges of fused silica, either under its own weight or caused by an applied load at the center, at different temperatures in the range from 20° to 1100°C. Young's modulus increased with increasing temperature to 700°–800°C and then decreased. The specimen behaved as a visco-elastic body at higher temperature. Changes in variation of elasticity with time and frequency of treatment suggest some kind of change of internal structure of the specimen. The viscosity (determined from the terminal velocity of deformation under a constant load at a constant temperature) was higher than that observed in the field in the molten state, but the

accuracy is unsatisfactory because of the high viscosity and slow velocity of deformation.—*M. C. R.*

162–216. Sakuma, Shūzō. Elastic and viscous properties of volcanic rocks at elevated temperature. Part 2: Tokyo Univ. Earthquake Research Inst. Bull., v. 31, pt. 1, p. 63–70, 1953.

Observations were made of elasticity and viscosity of vitreous silica, obsidian, and sanukite, using the method described in preceding abstract. The variation of Young's modulus with temperature in the obsidian and sanukite resemble that in artificial glass—that is, a slight decrease to 600°–650°C where a rapid decrease starts. Young's modulus in the vitreous silica specimens, however, showed a slight increase with temperature and a slight tendency to decrease at about 1,000°C.—*M. C. R.*

162–217. Beyl, Z. S. Heat and rock pressure: Colliery Eng., v. 31, no. 360, p. 62–64, 1954.

In conferences on rock pressure and support in mine workings, most authors have assumed that rock pressure originates from and is equal in weight to the mass of overlying strata. Beyl points out that heat resulting from the chemical metamorphic process of coalification and heat from magmatic processes also contribute to the compressive state of the earth's crust and to the amount of latent compressive elastic energy existing therein. The pressure resulting from heat is hydrostatic.—*M. C. R.*

162–218. Roberts, John. Thermo-dynamic agencies and their influence on rock-temperatures: Colliery Eng., v. 31, no. 363, p. 708–709, 1954.

Rather than heat as a cause of rock pressure, as suggested by Beyl, the heating of rocks results from movement induced by thrust forces, especially lateral ones.—*M. C. R.*

Perrin, R. Granitization, metamorphism, and volcanism. See Geophys. Abs. 162–209.

162–219. Gold, T. Instability of the earth's axis of rotation: Nature, v. 175, no. 4456, p. 526–528, 1955.

The movement of the earth relative to its axis of rotation is composed of an annual component, believed to be due to atmospheric effects, and a 14-month component of unknown origin, presumably corresponding to the Eulerian nutation. An internal damping associated with the motion is inferred to be of short duration and may arise from a dissipative deformation of the solid part of the earth involving plastic flow. If there were an angular separation between the axis of figure and axis of rotation, plastic flow would permit the figure to be deformed, and the axis of symmetry would approach the axis of rotation at a determinable rate. In geologic times when there have been variations in the distribution of masses, a secular motion might be produced whereby the axis of rotation hunts the direction of the greatest moment of inertia. An important consideration of this sort is circumpolar glaciation which would cause variation in mass and result in an alteration of the sea level.

The center of the curves of travel of the North Pole during the past 50 years has an estimated drift of about 0.1 second in the direction of Newfoundland. At this rate 2×10^8 years would be required to turn the earth through 90°. Drastic changes in climate have occurred in geologic time. Gold suggests that

there have been a few occasions when the axis has swung around, leading to time scales of the order of 10^5 or 10^6 years. Recent observations of fossil magnetism of rocks show promise of indicating the movements of the pole.—*R. G. H.*

162–220. Menard, Henry W. Deformation of the northeastern Pacific Basin and the West Coast of North America: Geol. Soc. America Bull., v. 66, no. 9, p. 1149–1198, 1955.

Four great bands of unusually irregular topography named "fracture zones" have been discovered in the northeastern Pacific basin, and three have been traced into western North America. Individual zones range from at least 1,400 to 3,300 miles long and average 60 miles wide. The zones follow great circles for most of their lengths, and are roughly parallel.

The fractured area includes 8 million square miles (5 percent of the earth's surface), and the parallel trends of the fractures indicate a single origin. It is tentatively concluded that an annular convection current rising near the Hawaiian Islands and sinking near North America stressed the crust and produced the fracture zones by plastic deformation. The Channel Islands and Transverse Ranges of California, and the Revilla Gigedo Islands and volcanic province of southern Mexico lie within continental extensions of the deep-sea fracture zones and lie parallel to the zones. The zones seem to cut Mesozoic structure. They contain more active volcanoes and earthquakes than is normal for the northeastern Pacific area.—*V. S. N.*

162–221. Pawłowski, Stanisław. Przyczynek do poznania ruchow pionowych skorupy ziemskiej w Polsce [Contribution to the determination of vertical movements of the earth's crust in Poland]: Przeglad geol., zeszyt 4, p. 155–158, 1955.

Changes in level of different points in the central part of Poland have been computed from data collected since 1870 by topographic surveys in different parts of present-day Poland. The results are presented as a map with lines of equal change of level. The greatest subsidence is above 50 mm, the greatest elevation 25 mm. The shape of these lines is such that it is improbable that the changes are related to the rising of Fennoscandia.—*S. T. V.*

162–222. Nasu, Nobuji; Kishinouye, Fuyuhiko; and Okada, Atusi. Levelling of the subsiding area in the southeastern part of Tokyo (In Japanese with English summary): Tokyo Univ. Earthquake Research Bull., v. 31, pt. 4, p. 335–337, 1953.

Precise levellings were made in the southeastern part of Tokyo and the northwestern part of Tiba prefecture. The subsiding area was found to be limited by the Edogawa (river), and the subsidence is attributed to settling of the sediments of the Arakawa (river). No appreciable effect of the earthquake of Jan. 1, 1951 was noted.—*D. B. V.*

INTERNAL CONSTITUTION OF THE EARTH

162–223. Filmer, W. E. Recent theories of the nature and origin of the universe: Victoria Inst. Jour. Trans, v. 86, p. 17–32, 1954.

Gamow's theory that the universe began about 4,000 million years ago as a very hot and dense neutron gas seems to offer a better explanation of the relative abundances of the elements than other theories. A theory such as Hoyle's

that requires an acceleration of the galaxies makes an unnecessary assumption. Hoyle's theory of continuous creation is also rejected because it does not satisfactorily explain the formation of the heavier elements and because of the Stebbins-Whitford finding that the more remote galaxies appear different from near ones, contrary to idea that the large-scale appearance of the universe should be the same at all times and in all places. The philosophical arguments are also discussed. Discussion by R. L. F. Boyd, W. H. McCrea, and John Byrt and reply by Filmer are on p. 93–100.—*M. C. R.*

162–224. Hawkes, L. Evolution of the earth—Report of joint discussion of the Geological and Royal Astronomical Societies: Nature, v. 175, no. 4457, p. 575–576, 1955.

Problems discussed by the late G. M. Lees in his presidential address to the Geological Society in 1953 were critically examined in this joint session. His view that there may be no fundamental difference between the basement of the oceans and the continental land masses was unacceptable to the principal speakers. L. Hawkes cited geological and geophysical evidence that rocks beneath the oceans are denser than those in the upper part of the continental crust. C. E. Tilley observed that Lees' estimates of thickness involved in tectonic belts in the Canadian Shield were excessive. E. Bullard pointed out that the Mohorovičić discontinuity represents a change of material rather than a change of phase and that although mountain building forces on the continent probably did not stop at the edge, it does not follow that continental rocks continue beyond the edge.

T. Gold discussed an earth model formed by the agglomeration of solid particles with heat derived from compression, impact, and radioactivity. The core may have arisen by downward percolation of dense liquid, the crust and atmosphere by upward penetration of lighter liquid. O. T. Jones commented that the Gold model did not bear a close relation to any earth with which the geologist is familiar.—*R. G. H.*

162–225. Haalck, H[ans]. Gegenwärtige Probleme und Aufgaben der Physik des festen Erdkörpers [Present problems and theorems of the physics of the solid earth]: 4 p., Berlin, Gebrüder Borntraeger, 1952

This is a review of some fundamental principles pertaining to the physical properties of the solid earth body.—*S. T. V.*

162–226. Kishimoto, Yoshimichi. Seismometric investigation of the earth's interior. Part 1. On the structure of the earth's upper layer: Kyoto Univ. Coll. Sci. Mem., Ser. A, v. 27, no. 2, p. 125–143, 1954.

The thickness and seismic velocity of the sedimentary and the upper layer of the earth were determined by the seismometric investigation of local and near earthquakes observed in Kyoto. From the analysis of the direct and refracted seismic waves the structure of the sedimentary layer and the upper layer near Kyoto were deduced as 3.8 kmps (Ps), 2.2 kmps (Ss), and 5.4 kmps (Pg_1), 3.1 kmps (Sg_1) for the velocities of P- and S-waves, and 1.5 km and 6 km for the thickness of layer respectively. It was also inferred that there exists a layer of 5.8 kmps (Pg_2), 3.3 kmps (Sg_2)-velocity underlying the upper layer.—*Author's abstract*

162–227. Laevastu, Taivo, and Mellis, Otto. Extraterrestrial material in deep-sea sediments: Am. Geophys. Union Trans., v. 36, no. 3, p. 385–389, 1955.

Cosmic black spherules have been separated quantitatively from a long sediment core taken at a depth of 5,000 m from the equatorial Pacific Ocean. Their size and mass distribution correspond with theoretical values obtained by Opik. Based on this quantitative examination and Pettersson's determination of the probable rate of sedimentation in this area, it is estimated that about 125 tons of black cosmic spherules reach the earth per year. Chemical analyses in this core average 0.056 percent NiO and 6.21 percent Fe_2O_3. These values are too great to be accounted for by the minute quantities of spherules present. Instead, the Ni and Fe appear to be derived in part from coprecipitation from sea water. The time of geochemical circulation of Ni and Fe in sea water has been estimated at 2,200 and 280 years respectively.—*Authors' abstract*

162–228. Oliver, Jack [E.]; Ewing, Maurice; and Press, Frank. Crustal structure of the Arctic regions from the L_g phase: Geol. Soc. America Bull., v. 66, no. 9, p. 1063–1074, 1955.

The L_g surface wave can be used to distinguish areas of continental from those of noncontinental crustal structure because this wave is sensitive to horizontal variations in the crustal column and easily read on seismograms; its use for such purposes is limited only by the geographic distribution of suitable epicenters and recording stations. The study of 149 records from different observatories indicate that water-covered areas of continental structure in the Arctic region include the Canadian archipelago, parts of Baffin Bay and Davis Strait, the shallow parts of the Bering Sea, and of the Greenland Sea, the Barents Sea and Bering Strait. Areas of noncontinental structure include the Arctic Ocean, Beaufort Sea, Greenland Sea, Norwegian Sea, and the deep Bering Sea. Nowhere is a continental structural column detected beneath oceanic depths.—*D. B. V.*

162–229. Crary, A. P. Bathymetric chart of the Arctic Ocean along the route of T–3, April 1952 to October 1953: Geol. Soc. America Bull., v. 65, no. 7, p. 709–712, 1954.

Bathymetric data obtained during the U. S. Air Force operations on Fletcher's Ice Island, commonly known as T–3, are briefly presented. The depths mapped suggest that the Arctic Ocean deep basin is limited to two areas north of Siberia and northwest of Alaska. A generally shallow Arctic area with two separate basins seems more probable than one basin divided by a narrow submarine ridge.—*V. S. N.*

162–230. Carsola, Alfred J. Bathymetry of the Arctic Basin: Jour. Geology, v. 63, no. 3, p. 274–278, 1955.

New soundings over an area of 35,000 square miles in the Arctic Ocean off the coast of North America were obtained by two scientific expeditions on the icebreaker U. S. S. *Burton Island* in 1950 and 1951. Further soundings along the continental slope north of Alaska were obtained by two airborne expeditions in 1951 and 1952. Most of the Arctic Basin lies between 2,000 and 2,200 fathoms in depth, and soundings suggest that the basin may be a broad, elongate trough divided into two depressions by a rise extending from Ellesmere Island to New Siberian Island. It is also possible that two basins exist—an elongate northward-

trending trough in the Beaufort Sea and a deeper, oval depression centered near the geographic pole. The slight amount of geophysical evidence available suggests that the basin may be a true oceanic area.—*V. S. N.*

162–231. Oliver, Jack E., Ewing, Maurice, and Press, Frank. Crustal structure and surface-wave dispersion, Part IV: Atlantic and Pacific Ocean Basins: Geol. Soc. America Bull., v. 66, no. 7, p. 913–946, 1955.

Properties of the suboceanic crust are deduced from dispersion of earthquake surface waves. Love waves and Rayleigh waves on seismograms of the Honolulu station from shocks occurring in the circumpacific earthquake belt show typical oceanic crust throughout the Pacific Ocean. They do not reveal anomalous areas of continental proportions which may once have stood above sea level. Similar results are obtained for parts of the North Atlantic. The method, however, is insensitive to relatively small or thin structures. The Easter Island Rise is somewhat anomalous and possibly represents a deviation toward the continental type of crust.

Some earthquakes cause a short-period train of surface waves to predominate over the more common long-period surface waves for purely oceanic paths. The beginning of the train is identified definitely as Love-wave motion. The later part of the train, which is apparently a noncoherent mixture of Love and Rayleigh waves, with periods of 6 to 9 seconds, is similar in character to long-period microseisms. These waves are sharply attenuated at continental margins but propagate easily through either continents alone or oceans alone.

From the coast of North America to the Easter Island Rise shocks generally produce short period surface waves at Honolulu, and other Pacific shocks produce long-period waves. Hawaiian shocks produce short periods on the North American coast.—*Authors' abstract*

162–232. Officer, Charles B., Jr. Southwest Pacific crustal structure: Am. Geophys. Union Trans., v. 30, no. 3, p. 449–459, 1955.

This investigation has been concerned with the determination of the crustal thicknesses of the various features of the southwest Pacific from Love- and Rayleigh-wave dispersion characteristics. The crustal thickness of the Tasman Basin between New Zealand and Australia is the same, 5 to 10 km, as that for the South Pacific Basin to the east of New Zealand. The thickness of East Cape-Kermadec-Tonga Ridge bordering the South Pacific Basin on the west and that of the Lord Howe Rise bordering the Tasman on the northeast is 20–25 km. A crustal refraction profile over New Zealand gives a thickness of 20 km. The interior region of ridges and troughs, northeast of New Zealand, has an average thickness of 15–20 km. The results are indicative of an origin from successive orogenic belts built out over an oceanic crust. The area is not part of an extensive continent.—*Author's abstract*

162–233. Bott, M. H. P. Interpretation of Gutenberg's low-velocity lithosphere channel: Geol. Soc. America Bull., v. 66, no. 9, p. 1199–1201, 1955.

It is suggested that the main decrease of velocity with depth of Gutenberg's lithosphere channel is caused by the downward change from intermediate to acidic bulk composition or possibly merely by an increasing sodium content. The acidic layer may have an unexpectedly low velocity because of increased water content of other changed physical properties at depth. Hence the seismological and geological concepts of crustal structure under the continents are satisfied by a combination of the physical and mineralogical hypotheses.

The boundary region is best understood if it separates the primary outer acidic layer of the earth below from the overlying rocks subsequently derived by geological processes which have formed a metasedimentary layer of intermediate bulk composition.—*Author's conclusions*

162–234. Gutenberg, Beno. Low-velocity lithosphere channel: Geol. Soc. America Bull., v. 66, no. 9, p. 1203, 1955.

Gutenberg points out that in three publications not available to Bott when he wrote "Interpretation of Gutenberg's low-velocity lithosphere channel," increase in temperature with depth is given as the main cause for two low-velocity channels in the upper lithosphere as well as for the channel extending downward from the Mohorovočić discontinuity deep into the asthenosphere. Effects of phase changes may be superposed.—*D. B. V.*

Kogan, S. D. On the existence of a deep focal surface on the border of the Pacific Ocean. See Geophys. Abs. 162–130.

162–235. Ritsema, A. R. Further evidence of a discontinuity at about 130 kilometers below the earth's surface: Indonesia Jour. Sci. Research, v. 2, no. 1, p. 10–12, 1953.

A clearly defined phase following P by a mean interval of 15 seconds has been observed at DeBilt on the records of 10 earthquakes in the Hindu Kush. The phase is a transverse wave, observed only on the north-south component (the azimuth from DeBilt to epicenter is 85°). The phase is taken to be $P(S)$, the P wave from the focus changed to S at a discontinuity. The time interval suggests the discontinuity is at a depth of 130 km. An analogous $S(P)$ phase was also observed.—*M. C. R.*

162–236. Bullard, E. C. Introduction to a discussion on "movements in the earth's core and electrical conductivity": Annales Géophysique, tome 11, no. 1, p. 49–52, 1955.

The relatively short time during which large magnetic secular variations occur makes it seem quite impossible that the origin of the variation is within the solid part of the earth. The order of magnitude of the velocities of fluid motion within the core is provided by the westward drift of the minor features of the magnetic field at the earth's surface. The mean density of about 10 gm per cm^3 at pressures of 2×10^6 kg per cm^2 strongly suggests that the core is metallic and therefore a conductor of electricity. Movements in the core are due to thermal convection produced by radioactive heating or perhaps due to some other cause, such as the settling of heavier materials within the core. Motions in the core will distort any magnetic field that may be present. Qualitatively such a distortion can account for the nondipole and secular variation fields, but it is not yet clear what features of the motion produce the main part of the effect.

The changes of magnetic field in the core are partially screened from observation by the conductivity of the core and the surrounding mantle. The frequency spectrum of the secular variation therefore enables an estimate of the conductivities to be made.

The dynamo theory of the origin of the earth's main magnetic field considers that the motions in the core act as a self-exciting dynamo and produce the main

field. In its simplest form the dynamo theory uses only the classical form of Maxwell's equations and makes no use of thermoelectric or electrochemical emf's or the Hall effect. It is important to determine whether or not all of these are really negligible.

Changing motions in the core will be associated with changes in angular momentum of the parts of the core. Changes in the core may be reflected in the rate of rotation of the mantle and in the length of the day.—*P. E. B.*

162–237. Bullen, K. E. Physical properties of the earth's core: Annales Géophysique, tome 11, no. 1, p. 53–64, 1955.

A short review is presented of evidence on the density, pressure, compressibility, and rigidity in the earth's core, with some related discussion on questions of composition. The reliability of the density determinations in the regions D^1 and E of the Bullen's earth models is discussed, and tables giving ranges for the densities and incompressibilities for the outer core are presented. Evidence for the existence of rigidity in the inner core is reviewed, and limits for its density and the pressure at the earth's interior presented.

The most probable composition of the outer core would seem to be a mixture of iron with material of lower representative atomic number, which may be a high-pressure modification of some combination of the phases SiO_2, MgO, and FeO. The question of the composition of the outer core is, however, by no means a closed question. The inner core is almost certainly composed of material whose mean atomic number is at least equal to that for iron, and there are signs of an accumulation of some materials of higher atomic number as well.—*P. E. B.*

162–238. Urey, Harold C. Distribution of elements in the meteorites and the earth and the origin of heat in the earth's core: Annales Géophysique, tome 11, no. 1, p. 65–72, 1955.

Comparisons are presented between thermochemical calculations of the equilibrium constants for various reactions and calculations of the constants based upon the observed composition of meteorites. There is approximate agreement for a number of elements, but it is found that titanium, uranium, and thorium should be present in observable amounts only in the silicate phases of meteorites, and that uranium and thorium are probably not present in the core of the earth, and, in fact, that radioactive heating of the earth's core may be due to potassium. However, any assumptions of the presence of radioactive elements in the core should be regarded as uncertain in the extreme. "The observed concentration of these elements in iron meteorites cannot be regarded as being related in any direct way to their concentrations in the earth's core."—*P. E. B.*

162–239. Rikitake, Tsuneji. Electrical conductivity of the earth's core: Annales Géophysique, tome 11, no. 1, p. 95–97, 1955.

Estimates of the electrical conductivity of the core are made for the case of a time-dependent electric current sheet of varying density at the surface of the core, a given earth model, and an assumed maximum rate of change of the magnetic field due to the secular variation of 100 gammas per year. A similar study was made assuming a magnetic dipole to be situated at the surface of the core. The conclusions are that the conductivity of the core is smaller than 10^{-5} emu.—*P. E. B.*

162–240. Runcorn, S. K., and Tozer, D. C. The electrical conductivity of olivine at high temperatures and pressures: Annales Géophysique, tome 11, no. 1, p. 98–102, 1955.

Three types of electrical conductivity are of importance for olivine: impurity semiconduction, intrinsic semiconduction, and ionic conduction. Impurity conduction, which is dominant in most semiconductors, arises from the excitation of electrons to or from energy levels produced by impurities in solid solution-impurity levels. An intrinsic semiconductor is one which conducts in the pure state by the excitation of electrons from the normally full valence band to the conduction band, which are separated by a band of forbidden energy. The temperature dependence of these types of conduction for an olivine indicates that their ranges of importance are 0°–600°C, 600°–1,100°C, and greater than 1,100°C, respectively, according to Hughes.

It is not certain which of the latter two types of conduction is predominant in the deeper parts of the earth's mantle. However, it is possible that ionic conduction does not play an important role below the first 400 km or so. Calculations based upon the assumption of dominant intrinsic semiconduction suggest that the temperatures in the lower part of the mantle may be greater than 10,000°C. This is at variance with the estimates of Uffen and Verhoogen and indicates that more experimental work must be done on conductivities. Such information will be very valuable for determining both the distribution of conductivity and of temperature in the mantle.—*P. E. B.*

162–241. Revelle, Roger, and Munk, Walter [H.]. Evidence [on movements in the earth's core] from the rotation of the earth: Annales Géophysique, tome 11, no. 1, p. 104–108, 1955.

Any explanation of observed changes in the earth's rotation must satisfy the following restraints: conservation of angular momentum; conservation of mass; the deduced wobble and length of day must be consistent with observations; rates of displacement and acceleration of mass must be "reasonable"; and the inferred processes must be reversible for some observed changes and must continue in the same direction for others.

The astronomic evidence concerning motions in the fluid core are as follows: the only satisfactory explanation of the observed changes over a decade or so in the length of day is that there are rather large variations in the fluid motions of the core; the deduced variations agree in sign and magnitude with those inferred from the westward drift of the magnetic field; and the motion in the core is largely zonal.—*P. E. B.*

Knapp, David G. The synthesis of external magnetic fields by means of radial internal dipoles. See Geophys. Abs. 162–30.

Vestine, E. H. Relations between fluctuations in the earth's rotation, the variation of latitude, and geomagnetism. See Geophys. Abs. 162–31.

Elsasser, W. M., and Takeuchi, H. Nonuniform rotation of the earth and geomagnetic drift. See Geophys. Abs. 162–32.

Coulomb, J. Secular variation due to convergence or divergence at the surface of the core. See Geophys. Abs. 162–34.

Lowes, F. J. Secular variation and the non-dipole field. See Geophys. Abs. 162–35.

Runcorn, S. K. Core motions and reversals of the geomagnetic field. See Geophys. Abs. 162–36.

GEOPHYSICAL EXPLORATION

162–242. Sorokin, L. V., Uryson, V. O., Ryabinkin, P. A., and Dolitskiy, V. A. Lebrbuch der geophysikalischen Methoden zur Erkundigung von Erdölvorkommen [Textbook of geophysical methods in prospecting for oil] : 579 p., Berlin, Verlag Technik, 1953.

This is the translation by Dr. Barnitzke of Berlin of the textbook of geophysical prospecting "Kurs geofizicheskikh metodov razvedki neftyanykh mestorozhdeniy" [see Geophys. Abs. 12607].—*S. T. V.*

162–243. Skeels, D. C. Correlating geological and geophysical data: Oil and Gas Jour., v. 54, no. 14, p. 156–157, 1955.

Geological data should be used to evaluate and help interpret geophysical data in geological terms. Similarly, the geophysical data should be used to fill in gaps in the geological data. The result should be a product which takes into account all of the available data.—*D. R. M.*

162–244. Griffiths, D. H. Geophysics in the search for coal: Colliery Eng., v. 30, no. 349, p. 106–108, 1953.

A brief review of electrical resistivity, well logging, gravity, magnetic, and seismic methods being introduced in exploration for coalfields.—*M. C. R.*

162–245. Fordham, Glenn, W. Atmospheric electricity and geophysical operations: Geophysics, v. 20, no. 3, p. 638–653, 1955.

The safety hazards of lightning to seismic crews using explosives are well known. Lightning is a result of high potential gradients in the atmosphere. These high gradients, which accompany stormy weather, can be detected by measuring the corona-discharge current from a sharp metal point called a point collector. Oscillograms of point-collector currents taken during thunderstorms may be a definite aid to field personnel in determining when lightning is imminent. Many more data are needed. It is hoped that others in the industry will take similar measurements and pool the data thus obtained.—*Author's abstract*

162–246. Bolinger, John W. History of the Imogene oil field, Atascosa County, Texas: Gulf Coast Assoc. Geol. Soc. Trans., v. 3, p. 13–30, 1953.

This paper was also published in Geophysics, v. 18, no. 2, 1953 [see Geophys. Abs. 14533].—*M. C. R.*

162–247. Chapman, C. J. Geophysics scores in western Canada: Oil and Gas Jour., v. 54, no. 15, p. 140–147, 1955.

It is probable that almost all of the oil and gas field discoveries in western Canada can be credited to seismograph exploration. Some special techniques of geophysical exploration have been developed to meet the problems of climate and terrain of western Canada.—*D. R. M.*

162–248. Garcia Rojas, Antonio. Estudios geofisicos que dieron origen al descubrimiento del campo petrolifero de José Colomo en el Estado de Tabasco [Geophysical investigations which led to the discovery of the José Colomo oil field in the state of Tabasco]: Congreso Cientifico Mexicano Mem. Univ. Mexico, v. 4, p. 144–148, 1953.

In 1944 Petroleos Mexicanos began a gravimetric survey of the eastern part of Tabasco and the western part of Campeche to locate regions with geologic structures favorable to oil accumulation. Several pronounced gravimetric minimums were found; some of them were later explored by the seismic reflection method and the structure of José Colomo established. The best seismic results were obtained when shooting with low frequencies of 25 to 35 cycles per second. Drilling confirmed the results of the geophysical surveys.—*S. T. V.*

162–249. Régie Autonome des Pétroles, Société Nationale des Pétroles d'Aquitaine, Richard, H[enri], and Beaufort, (?). Trois cartes géophysiques du Bassin d'Aquitaine—zone sud [Three geophysical maps of the Aquitanian Basin—south zone]: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, Sec. 9, fasc. 9, p. 325–336, 1954.

The results of geophysical exploration of the Aquitanian Basin, carried on over a period of years by gravimetric, electrical, and seismic reflection methods, are discussed. It is concluded that the procedure used here is suitable for exploration of any similar sedimentary basin, as follows: first, a reconnaissance gravity survey to determine the large-scale basement structures; second, a more detailed telluric study when one or more horizons can be traced; and finally, seismic reflection work where structures and surface conditions are suitable, or more detailed electrical or even gravimetric resurveys. As the seismic method is rather expensive it need not be used except where the other methods are inapplicable, as where stray currents interfere with electrical surveys.—*D. B. V.*

162–250. Jaboli, D., and Roger, A. Esquisse structurale de la Fosse Bradanique (Italie méridionale) [Structural sketch of the Bradano Trough (southern Italy)]: Internat. Geol. Cong., Algiers, 19th sess., Comptes Rendus, Sec. 9, fasc. 9, p. 305–324, 1954.

The Bradano trough, a structural depression lying between the folded Apennines and the Murge plateau in southern Italy, has been investigated by gravity, earth-current, seismic reflection and refraction surveys, and four borings. Results obtained by the various geophysical methods are in perfect agreement. The limestone basement is cut by a series of normal faults parallel to Apennine trends and by a series of lesser faults, transverse to the first, having a Tyhrrhenian trend.—*D. B. V.*

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