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GEOPHYSICAL ABSTRACTS 93

APRIL–JUNE 1938

COMPILED BY

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GEOPHYSICAL ABSTRACTS 93, APRIL–JUNE 1938

Compiled by W. AYVAZOGLOU

1. GRAVITATIONAL METHODS

4269. Aslakson, C. I., Gravity observations and their uses: U. S. Coast and Geodetic Survey Field Engineers Bull. 11, pp. 14–21, 1937.

After a brief explanation of the fundamentals of gravity and the principal causes of gravity variations, a general discussion is given on: (1) The significance of gravity variations; (2) gravity as an aid to the geologist; (3) methods of observing gravity; and (4) contemplated improvements to instruments.—*W. A.*

4270. Boneff, N., Method of determining the mean density of the earth by the attraction of mountains [in Bulgarian]: Univ. Sofia Annuaire Fac. phys. math., vol. 33, no. 1, pp. 29–36, 1937.

It is proposed to correct the oldest method of determining the mean density of the earth from the difference of plumb-line deviations at both sides of an isolated mountain by selecting mountains which, although not isolated, are still approximately "osculation-bodies." By osculation-bodies, the author understands bodies which have the property of exercising upon an external point the same attraction as if the whole mass of the body were concentrated in its center of gravity. The existence of an infinite number of such bodies is proved by using Tomson's and C. Neumann's formula. According to this formula, of which the author gives a new proof by using the fundamental properties of Legendre's spherical functions, a spherical surface, the density of the surface of which is in an inverse ratio to the third power of the distance from an internal point, produces an external effect which is the same as if the whole mass were concentrated at the center of gravity.—*Wl. Hristow, Zentralbl. Geophys., Meteor. u. Geod., vol. 1, no. 9, 1938.*

4271. Borisov, A. A., and Fotiadi, E. E., Some conclusions drawn from the general gravitational survey made in the region of the near-Caspian depression [in Russian]: Neftianoe Khoziaistvo, vol. 18, no. 12, pp. 63–66, Moscow, 1937.

The so-called near-Caspain depression is bounded on the west by the Volga River, on the north by the fifty-second parallel, on the east approxmately by the Orenburg-Tashkent Railroad, and on the south by a line just south of the Emba region. The authors give a summary of geophysical and geological information collected by the Emba-Neft Trust and make suggestions for a further detailed study of this depression. A schematic map of the distribution of gravity, characterized by constant and considerable variation of the field of gravity, is given. The relation between gravity and geologic structure is considered to be evident, and it is concluded that the study of the structure of the Emba area must be made in the light of the regional geology.—*W. A.*

4272. Cassinis, G., Dore, P., and Ballarin, S., Tavole fondamentali per la riduzione dei valori osservati della gravita [Fundamental tables for reducing values of observed gravity]: R. Com. geod. Italia Pub., new ser., no. 13, 119 pp., Pavia, 1937.

The use of the tables is explained in the preface. Examples are given for calculating the topographic reduction, isostatic reduction according to Hayford and Heiskanen, and condensation reduction according to Helmert.—*W. A.*

4273. Favre, Bernard, Le gravimètre statique Thyssen et son application à la prospection du bassin salière Alsacien [The Thyssen statical gravimeter and its application to prospecting the Alsatian salt basin]: 1e Cong. Mondial Pétrole, Paris, June 1937; 9 memoirs on geophysical prospecting, 8 pp.

Results of measurements made with the Thyssen gravimeter in the region of Hettenschlag, Alsace, are summarized. Isogams traced from milligal to milligal agree well with the results obtained previously from measurements made with the Eötvös torsion balance. The two maps are given for comparison.—*W. A.*

4274. Gabriel, V. G., Torsion balance exploration for oil: Louisiana Cons. Rev., pp. 55–59, Autumn 1937.

Explains in a somewhat nonmathematical way the principles and interpretations employed in torsion balance prospecting. Gives data on densities of several rocks and minerals and a guide table that might be useful in exploration for oil. The article is illustrated by numerous diagrams.—*W. A.*

4275. Glennie, E. A., Note on E. A. Ansel's paper, "Zur Analyse von Schwereanomalien": Beitr. angew. Geophysik, vol. 7, no. 2, pp. 89–93, Leipzig, 1937.

Glennie calls Ansel's attention to the discrepancy between the gravity anomalies in the region of Cuddapah calculated by him and those previously given in Ansel's article "Contribution to the analysis of gravity anomalies." (See Geophys. Abstracts 91, no. 3936).—*W. A.*

4276. Goudey, Raoul, Mesures de l'intensité de la pesanteur faites en France pendant l'année 1934 [Measurements of the intensity of gravity in France during 1934]: Acad. sci. Paris Comptes rendus, vol. 206, no. 2, pp. 100–102, 1938.

Measurements were made with Holweck's gravimeter no. 52. The results obtained at 58 stations are given in a table. Bouguer's correction was calculated, using the uniform density 2.7; no topographic correction was applied.—*W. A.*

4277. Guillet, Amédée, Détermination d'un réseau de valeurs de l'intensité "g" de la pesanteur centré sur une station donnée [Determination of a series of values of "g" about a given station]: Acad. sci. Paris Comptes rendus, vol. 205, no. 23, pp. 1123–1125, 1937.

A pendulum device comprising two masses which can be separated from one another while the position of their center of gravity remains fixed, is suggested for the measurement of variations of "g" at different stations.—*J. S. G. T., Sci. Abstracts, vol. 41, no. 482, 1938.*

4278. Ising, Gustaf, Gravity measurement: Arkiv Mat. Astron. och Fysik, 25A, no. 25, 14 pp., Stockholm, 1937.

The errors involved in the static method of measuring gravity are analysed.—*W. A.*

4279. Ising, Gustaf, Zur Theorie statischer Schweremessungen [Contribution to the theory of statical gravity measurements]: Arkiv Mat., Astron. och Fysik, vol. 25, no. 4, pp. 1–14, Stockholm, 1937.

A general formula is derived for the value of the mean error in determining "g", which results from Brown's oscillation of the measuring device in every instrument used for statical gravity measurements. By applying this formula to any instrument of a special type, the conditions of construction valid for this special type must have the characteristic value.

$$\text{Dimension mass} \times \text{length (or mass} \times \text{time}^2) \geq \frac{\text{Constant}}{(\delta g)^2}$$

Under these conditions the mean Brown's error of a measurement will remain below the value δg. The formula is explained in detail for a few special cases.—*Author's abstract, translated by W. A.*

4280. Jeffreys, Harold, The determination of gravity anomalies from deflections of the vertical: Royal Astron. Soc. Monthly Notices, Geophys. Suppl., vol. 4, no. 4, pp. 313–314, London, 1938.

Mathematical discussion of calculation of the disturbance of gravity from the empirical determination of the form of level surfaces outside the earth.—*W. A.*

4281. Köller, Wilhelm, Untersuchungen über die Vorgänge an der Schneide beim Schwingen eines Schwerependels [Investigations on the process at the knife edge during the oscillation of a gravity pendulum]: Zeitschr. Geophysik, vol. 13, no. 7/8, pp. 269–291, Braunschweig, 1937.

A decrease of the period of oscillation of a Sterneck pendulum accompanied by a reduction in amplitude was observed by making measurements of the periods of oscillation during periods of time up to 12 hours after all the usual corrections were taken into consideration. It is shown that the form of the decrease (reduced values of the period of oscillation as a function of the amplitude) cannot be theoretically explained solely by the rolling off process on the knife edge. An approximate solution by which the form of the decrease of the period of oscillation can be explained is furnished by a theory of rolling off and simultaneous sliding back of the edge on the bearing during the oscillation of the pendulum. The value of the radius of curvature of the knife edge which produces the effect on the process of rolling off is discussed.—*Author's abstract, translated by W. A.*

4282. Larmor, Joseph, Distorted mountain strata in relation to final isostasy: Nature, vol. 141, no. 3570, p. 603, London, 1938.

The author considers that if mountain ranges rest on a viscous foundation of denser material, as the mountains accumulate locally, they would gradually sink. A mountain would thus settle into the denser viscous material to a depth exceeding its height in order to compensate for the extra column aloft, very much like a submerged iceberg.—*Editorial abstract.*

4283. Miyabe, Naomi, A summary of results of studies made in Japan during the period 1931–1936, on deformations of the earth's crust: Union géod. géophys. internat., Assoc. séismologie, ser. B, no. 7, pp. 24–37, Nogent-le-Rotrou, 1937.

This is a summary of the results of studies made in Japan during 1931–36 on crustal deformations of both the intense and the usual types. Of a great number of publications written by Japanese authors on this subject, 81 references are given.—*W. A.*

4284. Sundberg, Karl, The Boliden gravimeter—a new instrument for ore prospecting: Inst. Min. Met. Bull. 402, 25 pp., London, March 1938.

The function of the new gravity meter constructed by the Boliden Mining Co. in Sweden is to distinguish the electrical indications given by graphitic slate and other bodies of no commercial value from those given by ore bodies. The underlying principle is based on the slight differences in specific gravity between such bodies as graphitic slate and their adjoining rocks in contrast to the relatively great differences between ore bodies and their adjoining rocks. Of course this new gravity meter may be applied to ordinary gravity work in connection with structural studies for ore prospecting and other purposes. After a general description of the possibilities of ore prospecting by measurements with a gravity meter, the principles of construction and use and the accuracy and speed of the new instrument are given in detail. Practical application of the instrument is demonstrated by the description of the tests carried out over several ore deposits in Sweden. The conclusion is drawn that very useful information in prospecting for ore may be obtained with the Boliden instrument.—*W. A.*

4285. Thyssen-gravimeter, Rückblick über die Entwickelung des [Thyssen gravimeter, review of the development of] [editorial]: Montan. Rundschau, vol. 30, no. 3, p. 8, Vienna, 1938, and Zeitschr. Petroleum, vol. 34, no. 5, pp. 10–11, 1938.

To show the advantages of the Thyssen gravimeter, a brief review of transportable gravimeters known at the beginning of 1938 and their performance in field work is given in the following table:

Transportable gravimeters

Gravimeters, type and number of years ago first manufactured	Principle	Approximate number manufactured	Transported in field by—	Approximate weight in kg.	Approximate accuracy by making 1 repetition	Time of 1 reading, approximate	Average number of stations per day	Personnel required	Thermostat
Sterneck (4 pendulum apparatus); about 50.	Dynamic	100+	Truck, ship, submarine	100	±1–2 mgal	2–12 hours	1	3–4	Not necessary.
Holweck; 10	do	60	Automobile, carrying on the back.	12	±1–2 mgal	30 minutes	2–3	1–2	Do.
Ising; 20	Static (leaf-spring)	2	Truck or automobile	30	±1 mgal	do	3–5	1–2	Necessary (ice).
Haalck; 10	Static (barometric)	2	Truck, ship	350	±0.5–1 mgal	1 minute	20	2	Do.
Berroth; 1926–31	Static (bifilar)	[1] 2		40		do		2	Not necessary.
Thyssen; 4	Static (helical spring)	70+	Automobile, airplane (carrying on the back), boat.	15	±0.1–0.3 mgal	do	[2] 3–15	2	Do.

[1] Not suitable for field work.
[2] Depending on method of measurement and distance between stations.

4286. Whetton, J. T., The gravitational method of geophysical surveying: Mine and Quarry Eng., vol. 2, no. 12, pp. 461–470, London, 1937.

A brief outline of the principles of the gravitational method of prospecting precedes a description of instruments (Eötvös torsion balance, Cambridge gradiometer), their operation, and methods of interpreting the results. Field work is demonstrated by examples of gravitational prospecting carried out on the Ahwaz ridge (Persia), Pentland fault (Scotland), Swynnerton Dyke (Staffordshire), and Gelliondale brown-coal field, Victoria, Australia. The article is illustrated with 25 figures.—*W. A.*

2. MAGNETIC METHODS

4287. Burgaud, Maurice, Observations magnétique en Chine [Magnetic observations in China], Acad. sci. Paris Comptes rendus, vol. 206, no. 4, pp. 272–273, 1938.

Readings made at 38 stations, situated mainly in the provinces of Hunan, Kweichow, and Kwangsi, are summarized in a table. A weak magnetic anomaly was found near Panhsien.—*W. A.*

4288. Fanselau, G., Über die Struktur des Magnetfeldes der Erde [On the structure of the earth's magnetic field]: Sterne, Band 17, pp. 201–206, 1937.

This is a comprehensive summary of the present condition of the problem. The explanation of the "dynamic theory of the earth-magnetic variations," by A. Schuster, results in the conclusion that conducting layers exist in the uppermost atmosphere. This is based on his observations of variations made 20 years before those of Heaviside. The paper discusses the practical application of earth magnetism to geologic investigations, prospecting for ores, traveling on sea and in the air, and propagation of electric waves.—*Karl Stöckl's abstract in Zentralbl. Geophys., Meteor. u. Geod., vol. 1, no. 8, 1937.*

4289. Fleming, J. A., Magnetic survey of the oceans: International aspects of oceanography, pp. 50–56, 1937.

The determination of accurate values of the magnetic elements at sea is considered a major objective of the world-wide magnetic and electric survey. Observational work had been done over a distance of 297,579 nautical miles before the destruction of the *Carnegie* in 1929. The data obtained during these cruises and the three previously made by the *Galilee* include declination to 3,844 points, inclination and horizontal intensity at 2,321 and 2,322 points, respectively, and atmospheric-electrical elements on 1,913 days. A plate shows the extent of the survey on land and sea. The necessity of theroetical investigations requring continuation of the oceanic survey is emphasized, and the hope is expressed that the great task of the geophysical survey of the oceans will result in building by maritime nations, including the United States, of nonmagnetic ships similar to that recently completed by the British Admiralty.—*W. A.*

4290. Gabriel, V. G., and Dunbar, C. P., Magnetic prospecting: Louisiana Cons. Rev. summer 1937, pp. 28–31.

The essential purpose of this article is to explain for the nontechnical man the principles employed in magnetic prospecting. Magnetic anomalies are discussed and examples of magnetic profiles are given. A table showing the suceptibilities of different rocks and minerals, examples of field notes in magnetic prospecting, and a magnetometer guide table are added.—*W. A.*

4291. Gibault, Gaston, Sur la perturbation magnétique du 25 Janvier 1938 [On the magnetic disturbance of January 25, 1938]: Acad. sci. Paris Comptes rendus, vol. 206, no. 5, pp. 357–358, 1938.

This magnetic disturbance, the greatest ever observed in France, occurred at the same time as an auroral phenomenon of exceptional intensity in France. It began on January 25, at 11:51 a. m., with the highest intensity at about 5:30 p. m., the disturbance subsiding at about 3 or 4 a. m. The amplitude of variations attained about 1½ for declination and 400γ for the horizontal component. Extremely rapid variations were observed, for example one of 70′ declination in 6 minutes and 130γ of horizontal component in 15 minutes. A detailed description of the disturbance will appear later.—*W. A.*

4292. Groszkowski, Janusz, The vibration magnetometer: Jour. Sci. Instr., vol. 14, no. 10, pp. 335–339, London, 1937.

An instrument called a vibration magnetometer for the measurements of magnetic fields of 1–30,000 gauss is described. The action of the magnetometer depends on the measurement of the electromotive force induced in a small search coil which vibrates with known amplitude and frequency in the magnetic field to be measured. The electromotive force, after magnification by means of a valve amplifier, is read on a rectifier type voltmeter, calibrated directly in gauss. The instrument is operated from A. C. 50 c. p. s. supply mains.—*Author's abstract.*

4293. Harrison, E. P., and Rowe, H., An impedance magnetometer: Physical Soc. Proc., vol. 50, part 2, no. 278, pp. 176–184, Cambridge, 1938.

This magnetometer measures local variations of magnetic field. It uses the principle that the impedance of a nickel-iron wire of high permeability varies with the axial component of the magnetic field in which the wire is placed. Details of construction, the rectifier detector bridge, the input current, the sensitivity of the apparatus, and the assembly for survey are described.—*W. A.*

4294. Hasegawa, Mankiti, and Tamura, Yūiti, Regular progressive changes of the magnetic field of diurnal variations of terrestrial magnetism: Imp. Acad. Japan Proc., vol. 13, no. 7, pp. 311–315, Tokyo, 1937.

The diurnal variation (d. v.) of the terrestrial magnetism is studied to find whether the zonal component exists in the average state of d. v.; this problem is related to the problem of the existence of progressive changes in the mean state of the magnetic field of d. v. General expressions of Fourier's coefficients a and b are given as functions of latitude and longitude and curves of these components shown for the same latitude and longitude for the autumn 1905, also zonal terms (a_t and b_t) and rotating terms ($a_2\lambda$ and $b_2\lambda$) for different seasons in the northern hemisphere. The magnetic field of d. v. undergoes a regular diurnal change with time during its revolution round the earth. This is termed the universal diurnal (u. d.). The variation of u. d. is comparable with that of the mean d. v., so there is no doubt as to its reality. Only 24-hour terms of the harmonic analysis have been taken, since for 12-hour and higher terms lack of necessary data increases the difficulties.—*H. M. B., Sci. Abstracts, vol. 41, no. 482, 1938.*

4295. Hess, V. F., Demmelmair, A., and Steinmaurer, Rudolf, Relations between terrestrial magnetism and cosmic ray intensity: Terres. Magn. and Atmos. Electr., vol. 43, no. 1, pp. 7–14, Baltimore, March 1938.

Certain relations between the variations of the earth's horizontal magnetic force H and of the observed cosmic ray ionization J have been found in the continuous registrations of the cosmic ray ionization on the Hafelekar, 2,300 meters above sea level (near Innsbruck, Austria), during the year 1936–37, as follows:

1. A positive magnetic effect, ME_1, is indicated during magnetic storms with increase of J associated with increase of H and vice versa. A similar effect has been noticed rather often also in the daily mean values of J and H during magnetically und sturbed days. ME_1 amounts to +0.57 per mille of the cosmic ray ionization for an increase of the horizontal force by one γ(0.00001 gauss).

2. The analysis of the daily mean values for one year discloses a second effect, ME_2, of opposite sign (increase of H accompanied by decrease of J) and smaller than ME_1. ME_2, for the average of the year 1936–37, is about −0.20 per mille per γ.

3. A similar negative magnetic effect, ME_3, is found from the strong correlation between the diurnal variation of H and J; $ME_3 = -0.2$ per mille per γ.

4. Another negative effect, ME_4, can be derived from the anti-parallel variations of the monthly means of H and J (seasonal curves); $ME_4 = -1$ per mille per γ.

The three first mentioned effects can be explained qualitatively by adopting the hypothesis of the electronic ring currents in the outer space around the globe. The seasonal effect is not yet explained, and it seems possible that its connection with terrestrial magnetism is accidental in spite of the strong correlation.—*Authors' abstract.*

4296. Lauterbach, R., Geomagnetische Messungen an Lämprophyrgängen in der Lausitz [Geomagnetic measurements over lamprophyre dikes in the Lausitz]: Zeitschr. Geophysik, vol. 13, no. 7/8, pp. 291–301, Braunschweig, 1937.

Anomalies in magnetic measurements produced by lamprophyre dikes in the Lausitz are attributed to the magnetic minerals contained in the dikes; the anomalies agree well with the form, strike, and thickness of the disturbing bodies.—*Author's abstract, translated by W. A.*

4297. Poisson, Charles, Les anomalies magnétiques a l'observatoire d'Ambohidempona, Madagascar [Magnetic anomalies at the Ambohidempona observatory, Madagascar]: Gouvernement Général de Madagascar, Annales géologiques du service des mines, vol. 8, pp. 7–16, Tananarive, 1937.

Measurements of D, H, and I made before and after 1934 are described. The results are shown in a table and on a map of magnetic anomalies.—*W. A.*

4298. Schmidlin, Hans, Über entmagnetisierende Wirkung der Änderungen des magnetischen Erdfeldes [On the demagnetizing effect caused by the changes in the magnetic earth's field]: Beitr. angew. Geophysik, vol. 7, no. 2, pp. 94–111, Leipzig, 1937.

When a material with remanent magnetism is exposed to an alternating magnetic field, its magnetic moment decreases. The decrease is a function of the intensity of the field and of constants characteristic of the material. The magnetic moment decreases as soon as the field is switched in. The demagnetizing effect was found to be independent of frequency within the limits of error of measurement to about 5 percent and up to about

300,000 Hertz. The effect of direct- and alternating-current fields depends on the previous magnetic history of the material. The effect of a field at right angles to the direction of remanent magnetism is smaller than the effect of a field parallel to this direction. Materials showing the phenomenon of magnetic viscosity attain a complete demagnetization only after a great number of periods. The remanent magnetism of some materials rises when the demagnetizing field is switched off. From the experiments the conclusion is drawn that the small amplitude of variations of the terrestrial magnetic field observed south of the Arctic Circle cannot serve as an explanation for the decrease of remanent magnetization in geologically old rocks. The loss of this magnetization can be due to heat, vibration, or alternating magnetic fields. The apparatus used in experiments, materials investigated, and method of operation are described.—*W. A.*

4299. Steiner, W. F., A method for producing nonmagnetic castings of copper, brass, and aluminum: Terres. Magn. and Atmos. Electr., vol. 43, no. 1, pp. 47–48, Baltimore, March 1938.

A method of obtaining sound nonmagnetic castings for use in magnetic measurements has been developed. This is done by a close control of the melting temperatures, a method of purification of the metal, and design of the patterns.—*Author's abstract.*

4300. von Zwerger, Rudolf, Die magnetische Vermessung von Mecklenburg-Strelitz [Magnetic survey of Mecklenburg-Strelitz]: Mecklenburg, geol. Landesanstalt Mitt., vol. 43, no. 8, pp. 31–40, 1936.

After a discussion of the technique of magnetic measurements, the magnetic survey of the area is briefly discussed with particular reference to a number of lows and highs. A magnetic chart is added showing a predominant direction of strike of the magnetic anomalies in the northeast-southwest direction. In the main area the anomalies are not of considerable magnitude and do not exceed 40 gammas.—*C. A. H., Annot. Bibl. Econ. Geology, vol. 10, no. 1, 1938.*

4301. Yakovlev, D. A., Accuracy of measurements with Tiberg Thalen's type magnetometer [in Russian]: Razvedka Nedr, vol. 8, no. 2, pp. 66–67, Moscow, 1938.

Results of measurements of ΔZ made at more than 100 stations with a Tiberg Thalen's type magnetometer and with Schmidt's variometer are shown for comparison in a table. The desirability of using a Tiberg Thalen's type magnetometer, although its accuracy is only about one-tenth that of Schmidt's variometer, is shown by the following considerations: (1) 100 to 150 measurements can be made a day, as compared with only 40 to 60 with Schmidt's variometer; (2) the cost of observations can be reduced twice and even three times; (3) calculation of the results of observations is simpler and quicker; (4) the instrument requires less care, thus is more suitable for field work.—*W. A.*

3. SEISMIC METHODS

4302. Bastings, L., Some seismological aspects of the Buller earthquake: New Zealand Jour. Sci. Technology, vol. 19, no. 6, pp. 388–400, Wellington, 1937.

The Buller earthquake records are discussed in regard to the more prominent phases produced by reflection at the earth's surface or by refraction at the core boundry where such change has been accompanied

by transformation in the form of wave vibration. Where the data seemed adequate, travel times have been deduced, and these are compared with similar tables, either theoretical or observational, published by other authors. (See Geophys. Abstracts 92, nos. 4142, 4143).—*Author's abstract.*

4303. Bazerque, Jean, Sur les méthodes de calcul de la prospection sismique par ondes réfléchies [On the methods of calculation in seismic prospecting by reflection]: 1e Cong. Mondial Pétrole, Paris, June 1937; 9 memoirs on geophysical prospecting, 16 pp.

The conditions under which simplified hypotheses may be used in the seismic reflection method of prospecting are examined and advantages resulting from the application of them in practice are discussed.—*W. A.*

4304. Beers, R. F., A problem in seismic depth calculation [abstract of paper presented before Am. Assoc. Petroleum Geologists and Soc. Expl. Geophysicists, March 17, 1938, in New Orleans]: Oil and Gas Jour., vol. 36, no. 44, p. 78, 1938.

In geologic provinces where surface erosion has removed several hundred feet of the section, the customary method of depth calculation for the reflection seismograph with an empirically determined velocity function frequently fails to show true subsurface relief. Seismograph structure maps frequently show evidences of the surface topography, and intervals between two reflection horizons may appear in excess of the true value. A method is presented here which seems to eliminate the effect of topography on the depth calculations.

4305. Birch, Francis, and Bancroft, Dennison, The effect of pressure on the rigidity of rocks, I and II: Jour. Geology, vol 46, no. 1, pp. 59–87, and no. 2, pp. 113–141, Chicago, 1938.

A dynanic method has been adapted to the measurement of the velocity of torsional waves in cylinders of rock exposed to pressures as high as 4.000 kg/cm^2, at 30° C. and at 100° C. From these results rigidities of the rocks under these conditions are derived, as well as approximate values for the pressure and temperature coefficients of velocity and rigidity. Very large changes of rigidity are observed in many cases upon the application of the first few hundred atmospheres; at high pressure the change of rigidity with pressure becomes nearly linear and small. The following questions are discussed: stress conditions in aggregates of crystals, the effect of anisotropy upon velocity, the calculation of other elastic parameters from rigidity and compressibility, damping and dispersion in rocks, the effect of combined pressure and temperature on velocity in the earth's crust, and the identification of materials in the crust by comparison with seismological data. With regard to the effect of combined temperature and pressure in the crust, a precise determination of this effect in suitable combination upon the velocities, combined with correspondingly precise seismological determinations of velocity as a function of depth in the upper crust, would enable us, not only in all probability to identify the material at different depths, but also to estimate the thermal gradient at these depths.—*Authors' abstract.*

4306. Bouche, Gustave, L'élimination des erreurs systématiques en sismique réflexion pas la méthode des polygones fermés [Elimination of systematic errors in seismic reflection by the method of closed polygons]: 1e Cong.

Mondial Pétrole, Paris, June 1937; 9 memoirs on geophysical prospecting, 5 pp.

The application of the seismic reflection method has shown that generally there are many reflecting horizons but that it is often possible to identify one of these horizons and to follow it from station to station. It is proposed to make measurements along a closed polygon. It is shown in this paper how these measurements can be made in simple cases.—*W. A.*

4307. Bullen, K. E., An analysis of the Hawke's Bay earthquakes during February 1931: New Zealand Jour. Sci. Technology, vol. 19, no. 8, pp. 497–519, Wellington, 1938.

An analysis has been carried out of the readings of the Hawke's Bay earthquake of 1931, February 2 (Greenwich meridian time) and the after shocks occurring during the following month. The seismological evidence of both distant and near stations is consistent with the adoption of an epicenter of 39°20′ S., 176°40′ E., for the main earthquake, with a standard error of about 0.2°. This epicenter is situated several miles to the west of the zone of maximum surface damage, and is not greatly distant from the epicenter previously found by the writer for the deeper-seated Hawke's Bay earthquake of 1921, June 29. Arguments are given in support of the formation during the main 1931 shock of a shear surface sloping on the whole from the focus towards the east with diminishing depth. The largest aftershock, that of February 13, appears to have had an epicenter close to that of the main earthquake. The solutions for other aftershocks, though less precise, suggest the development of movements tending further in an easterly direction from the main shock during the following month. The analysis has provided useful information bearing on a number of points in New Zealand seismology. In particular, strong support is given to the existence of a layer closely resembling the "intermediate" layer of Europe, and also to the relative thinness of the granitic layer.—*Author's abstract.*

4308. Bullen, K. E., The phase S* in New Zealand earthquakes: New Zealand Jour. Sci. Technology, vol. 19, no. 8, pp. 519–522, Wellington, 1938.

Attention has been drawn to the fact that the phase S* appears to be more strongly recorded in earthquakes in the New Zealand region than in Europe. Support is given to the suggestion that there is a substantial "intermediate" layer in the New Zeland region and an abnormally thin granitic layer. It is suggested that the phase S* is of some special importance to practical seismology in New Zealand, and tables have been constructed to make use of this phenomenon in supplementing the general tables already in use. With less delicate instruments it appears that S* is generally recorded more strongly than the normal S_n.—*Author's abstract.*

4309. Cloud, R. T., The energy and amplitude of reflected seismic waves [abstract of paper presented before Am. Assoc. Petroleum Geologists and Soc. Expl. Geophysicists, March 17, 1938, New Orleans]. Oil and Gas Jour., vol. 36, no. 44, p. 78, 1938.

The experimentally determined calibration of seismic recording instruments is used to obtain the amplitude of surface motion resulting from the arrival of a typical reflection. Assuming the validity of conventional ray theory the history of the amplitude of the reflected waves is followed back to the vicinity of the source. The amplitude of the

initiating wave is then arrived at by two independent methods, one theoretical and one experimental, and found to be of the same order of magnitude as that deduced on the basis of ray theory. It is concluded that there is no foundation for distrust of ray theory in the interpretation of the data of dip shooting. A short discussion of the energy involved in a reflected wave is offered.

4310. Fujiwhara, S., On the so-called Mukuhira's arc as the foreshadow of an earthquake: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 15, no. 3, pp. 706–710, 1937.

A peculiar optical phenomenon in the sky resembling a rainbow arc first reported by Mukuhira and observed before several Japanese earthquakes is described. There are some, among them Mukuhira, who are inclined to look upon the phenomenon as one of electrical nature. In the present state of knowledge, however, the phenomenon cannot be explained and thus cannot be used yet for predicting earthquakes. A scientific investigation is necessary.—*W. A.*

4311. Gabriel, V. G., and Wilson, R. M., The value of shot point and short distance geophones in seismic prospecting: Oil Weekly, vol. 88, no. 9, pp. 14–16, Houston, 1938.

This article is dealing with the data pertaining to both the shot point and 100 foot distant geophones. Simple formulas are derived and put in a form well suited for use in seismic field work; then the results of the study of a few seismograms are given in a table. Finally, the conclusions are drawn that small deviations from the mean in the determination of the thickness of a weathering layer by the application of the formulas given in this paper show that these formulas can be safely and more broadly used in seismic prospecting to find the thickness of a slow velocity (weathering) layer.

The consistency of data obtained for a 100-foot distant geophone indicates that the paths of elastic motion in the first high velocity underlayer for short distances are straight lines connecting the point charges and practically a common point situated in the same medium for the same shot point and the same distance geophone. The study of the charge of dynamite in pounds shows that the degree of deviation from the mean is independent of the amount of dynamite used for the shot.—*Author's abstract.*

4312. Gardner, D. H., Measurement of relative ground motion in reflection recording: Geophysics, vol. 3, no. 1, pp. 40–45, Houston, 1938.

A description of the method employed in determining the relative sensitivity of a reflection seismograph to harmonic displacement of 10^{-3} inches is given. Results of comparing the sensitivity obtained at this level to the sensitivity used in reflection recording show a ground motion of 10^{-8} inches for the deeper reflections. Comparisons are made between the sensitivities of the reflection seismograph and a mechanical seismograph taken at a level of 10^{-5} inches.—*Author's abstract.*

4313. Gutenberg, Beno, and Richter, C. F., Seismic waves in the core of the earth: Nature, vol. 141, no. 3565, p. 371, London, 1938.

The velocity of longitudinal waves in the earth's crust increases continuously to a depth of about 2,900 km, where it drops suddenly from 13.7 km to about 8 km a second. The velocity of the waves in the earth's core increases from 8 km a second at a depth of 2,900 km to

about 10.2 km a second at 4,850 km, where a rapid increase takes place, the velocity reaching 11.4 km a second at 5,150 km, then decreasing very slowly to 11.3 km a second in the central part of the core.—*W. A.*

4314. Gutenberg, Beno, and Richter, C. F., Depth and geographical distribution of deep focus earthquakes: Geol. Soc. America Bull., vol. 49, no. 2, pp. 249–288, 1938.

Known or suspected deep-focus shocks have been investigated in detail, including revision of epicenter, origin time, and depth for each. The resulting catalogue probably contains nearly all important deep shocks from 1918 through April 1932; to these are added selected shocks of earlier and later date.

The writers distinguish (1) normal shocks, at depths not exceeding about 60 km; (2) intermediate shocks, at depths to 250 km; (3) deep shocks. The intermediate shocks are on Tertiary or younger tectonic lines and consequently show correlation with vulcanism. The true deep shocks occur in limited regions or zones about the Pacific Basin, inland from the normal and intermediate shocks. Except for a few regions, mostly at the intersection of zones, there is a considerable gap in depth between intermediate and deep shocks.

The mechanism of origin of shocks seems to be the same at all depths.—*Authors' abstract.*

4315. Hayes, R. C., The Pahiatua earthquake of 1934, March 5. A report on the seismological aspects: New Zealand Jour. Sci. Technology, vol. 19, no. 6, Wellington, 1937.

Distribution of seismic intensity of the Pahiatua earthquake is given in a map of New Zealand showing the approximate isoseismal lines. Magnitude of the earthquake, seismograph records, epicenter, time of origin, and focal depth are discussed. Some particulars of the most important after-shocks are given in a table.—*W. A.*

4316. Heck, N. H., Earthquakes and the western mountain region: Geol. Soc. America Bull., vol. 49, no. 1, pp. 1–22, 1938.

The term western mountain region as used in this paper is applied to the region extending from the eastern edge of the Rocky Mountains to the eastern boundary of California, the 120th meridian in Oregon, and the eastern edge of the Cascade Mountains in Washington. A map shows the epicenters of all known earthquakes from 1868 to 1936 whose intensity was five or more on the Rossi-Forel scale. Principal earthquakes of the western mountain region and their characteristics, earthquake frequency, a selected group of earthquakes graded according to the Rossi-Forel scale, and a list of seismological stations of this region are given in tables. After the discussion of: (1) strong-motion instruments; (2) noninstrumental earthquake information; (3) earthquakes and geology; (4) earthquakes and crustal movements; (5) location of buried faults; (6) engineering values; (7) gravity observations and anomalies; and (8) present situation in the western mountain region, the author summarizes the principal needs to be met as follows: (1) Additional seismograph stations; (2) a fault map; (3) more local triangulation and leveling for the determination of crustal movements; (4) use of seismic and other geophysical exploration methods to trace buried fault planes; and (5) additional strong-motion stations.—*W. A.*

4317. Heck, N. H., Some unsolved and partially solved seismological problems: Seismol. Soc. America Bull., vol. 28, no. 1, pp. 33–38, 1938.

Although an earthquake prediction in time and place is impossible at the present time, the determination of the existence of increasing stress would be very useful, as many precautions could be taken. Indirect methods of measuring crustal stress such as triangulation, leveling, belt measurement, and study of the earthquake occurrence pattern before and after a severe earthquake, are examined. A new method is discussed based on two known facts: One, that earthquakes are very frequently accompanied by sounds, which proves that vibrations with a certain range of frequencies can pass from earth to air; the other essential fact, that materials tested to destruction in a testing machine give forth sounds as they approach the breaking point. A plan is proposed to test this possibility by installation of microphone stations. Finally, problems of structural design and insurance in relation to earthquakes are discussed.—*W. A.*

4318. Hidaka, K., Free oscillations of water in a basin with smooth boundaries: Geophys. Mag. Tokyo, vol. 11, pp. 161–163, 1937.

The problem of free tidal motion in a basin of any given shape is studied. An approximate solution can be obtained unless the shape is extremely complicated. If the basin is not of uniform depth, the Ritz method of perturbation may be applied.—*W. A. R., Sci. Abstracts, vol. 41, no. 482, 1938.*

4319. Inouye, Win, Notes on the origin of earthquakes; Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 15, no. 3, pp. 674–696, 1937.

An approximate theoretical calculation in elliptic coordinates of elastic waves in an infinite solid (two-dimensional problem) is given.

Two types of distribution of pull and push waves at the initial phase of earthquake waves, the conical and quadrant types, are observed in most earthquakes. These types cannot yet be obtained by means of artificial earthquakes.—*W. A.*

4320. Inouye, Win, Revisions of my "Notes on the origins of earthquakes": Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 15, no. 4, pp. 954–964, 1937.

In a previous paper, "Notes on the origins of earthquakes", op. cit., vol. 14, p. 582, 1936, a theoretical study of the elastic waves generated from a seismic source was made. It was shown that, assuming the radius of the area in which the seismic impulse originated to be constant, the azimuthal distributions of displacement of the dilatational wave at a distant point vary with the wave length. The calculations and conclusions previously stated are revised, and the conclusion is now reached that nothing absolutely certain can be said regarding the wave length of such waves as might be generated from a seismic source but that probably the wave length is related to the radius of the area of origin.—*W. A.*

4321. Ives, R. L., Stealing neptune's secrets: Sci. News Letter, vol. 33, no. 7, pp. 102–103, and 106, Washington, District of Columbia, 1938.

The possibility of mapping the ocean's depths is discussed, and a diagram shows apparatus designed by Maurice Ewing for producing and studying

artificial earthquakes on the floor of the sea at depths as much as 3 miles below the surface. Vibrations set up in the rock by the explosion of the bombs are automatically recorded by the seismographs.—*W. A.*

4322. Jabiol, Marcel, La détermination des forts pendages par la méthode de sismique réflexion [Determination of steep dips by seismic reflection method]: 1. Cong. Mondial Pétrole, Paris, June 1937; 9 memoirs on geophysical prospecting, 6 pp.

Examples are given to show that steep dips are not an obstacle to the seismic reflection method of prospecting. If some precautionary measures are taken, it is possible to discover structural features of great interest to regional geology without any previous knowledge of the seismic properties or the tectonics of the area. Two examples are studied, one involving dips of as much as 28° and another involving dips of as much as 40°.—*W. A.*

4323. Johnson, C. H., Steady state polar sensitivity curves [abstract of a paper presented before Am. Assoc. Petroleum Geologists and Soc. Expl. Geophysicists, March 17, 1938, in New Orleans.]: Oil and Gas Jour., vol. 36, no. 44, p. 78, 1938.

The equation for the resultant amplitude of the steady state summation of n detector outputs as a function of angle of wave arrival is derived and polar sensitivity curves drawn for groups of from 2 to 10 detectors. The effects of wave lengths and detector spacing are also illustrated.

4324. Kelly, Dunford, A reaction type steady state shaking table [abstract of paper presented before Am. Assoc. Petroleum Geologists and Soc. Expl. Geophysicists, March 17, 1938, in New Orleans]: Oil and Gas Jour., vol. 36, no. 44, p. 78, 1938.

A steady state shaking table utilizing the principle of reaction has been constructed for the measurement of the response of seismometers and the overall response of seismographic apparatus. A mass of 500 pounds is driven at amplitudes of the order of 10^{-4} inches by a small eccentric mass which is rotated at the center of percussion of a bar, the upper end of which is pivoted to the bottom of the heavy mass. The amplitude of motion of the table top is independent of frequency between 10 cycles per second and an undetermined upper limit higher than 150 cycles per second. The construction and characteristics of the table were illustrated by slides.

4325. Kinosita, Zyuniti, The arrangement of layers in the earth's crust as deduced from seismometrical observations at Hongo, Tokyo (first paper): Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 15, no. 4, pp. 965–973, 1937.

In the preliminary tremors of seismograms observed at Hongo there are several phases which Matuzawa and others have already studied. According to this study, another new phase was found, which appears about 0.75 second after P. The new phase is named E, and the next phase, which was named "I" by Matuzawa, is named here E_2. With these data, the depths of two discontinuous planes in the earth's crust have been determined.—*Author's abstract.*

4326. Krug, Hans-Dietrich, Ausbreitung der naturlichen Bodenunruhe (Mikroseismik) nach Aufzeichnungen mit transportablen Horizontalseismographen [Propagation of natural ground oscillation (microseismics) recorded by transportable horizontal seismographs]: Zeitschr. Geophysik, vol. 13, nos. 7/8, pp. 328–348, Braunschweig, 1937.

A transportable horizontal seismograph has been developed for special investigation of microseismic movements of the ground (within periods of 4 to 8 seconds). The proper period of these seismographs can be changed within 3 to 12 seconds, aperiodicity can be obtained by means of air-damping, and the magnification changed by a special optical system within the limits 1,000 to 10,000. Determinations of the velocity and direction of propagation of the microseismic movement were made with this seismograph in the region of the Göttinger Hainberg. Observations of the microseismic disturbance in two components (north-south and east-west), were made at three stations situated in the form of an approximately equilateral triangle. Directions of the wave normals and velocities for all the values of travel times were determined. An attempt is made to explain the observed regular temporal deviations in periods, amplitudes, and travel times. Dependence of the intensity of movement on geological conditions was proved by the qualitative evaluation of the material. Relation between the depressions at the coast of Norway and the intensity of microseismics in Göttingen was established.—*W. A.*

4327. Lawlor, Reed, Chart for dip computations [abstract of a paper presented before Am. Assoc. Petroleum Geologists and Soc. Expl. Geophysicists, March 17, 1938, in New Orleans]: Oil and Gas Jour., vol. 36, no. 44, p. 78, 1938.

A universal chart to be used in seismographing with three dimensional control is presented. This chart can be used for computing the dip components in and perpendicular to the wave travel plane. By a simple change of scales it can be adapted to all shot distances, detector intervals, and all wave velocities which are functions of wave travel time only. Principles underlying the construction of the chart are given.

4328. Leleu, Robert, Exploitation d'une station isolée en séismique réflexion [Utilization of one single station in seismic reflection]: 1e Cong. Mondial Pétrole, Paris, June 1937; 9 memoirs on geophysical prospecting, 4 pp.

The method consists of recording the indications of a group of seismographs distributed along two directions. As a rule perpendicular directions are taken and several shots are fired. If the average velocity of propagation is supposed to be known, the determination of the depth of the reflecting horizon may be determined. In an example it is shown how this interpretation can be made by a simple graphic method.—*W. A.*

4329. Martin, Henno, Ein neuer mechanischer Beschleunigungsmeter [A new mechanical accelerometer]: Zeitschr. Geophysik, vol. 13, nos. 7/8, pp. 241–250, Braunschweig, 1937.

The construction of a new mechanical accelerometer and of a special oscillation table used for testing it is described. Schematical design of the accelerometer and diagrams showing the resonance curves of the oscillation table and calibration curves of the accelerometer are given. Finally, some results obtained by the accelerometer are discussed.—*W. A.*

4330. Meisser, O., Beiträge zur Konstruktion eines Vertikalseismometers [Contributions to the construction of a vertical seismometer]: Zeitschr. Geophysik, vol. 13, nos. 7/8, pp. 251–269, Braunschweig, 1937.

General viewpoints concerning magnification, natural period (or sensitiveness), and indicator-length of all the components of the known types of seismometers are examined. A vertical seismometer with time 6 to 8 seconds, and magnifications of 1,000 to 2,000 times seems to be suitable for microseismic measuring purposes (registration of close and distant earthquakes). The model has small dimensions, great range of stability in spite of high astaticism, magnetic damping, and sufficiently clear optical magnification obtained by the increase of the number of the reflections. Photographic recording furnishes sufficiently distinct curves even if the magnification is very great.—*Author's abstract, translated by W. A.*

4331. Mott-Smith, L. M. On seismic paths and velocity-time relations [abstract of a paper presented before Am. Assoc. Petroleum Geologists and Soc. Expl. Geophysicists, March 17, 1938, in New Orleans]: Oil and Gas Jour., vol. 36, no. 44, pp. 78–79, 1938.

Most of the simple mathematical curves that have so far been used for the velocity-depth relation cannot be fitted to any observed velocity at all, and are, therefore, quite useless from a practical standpoint. The main point of this paper is the direct derivation of the path equations from the velocity-time relation rather than from the velocity-depth relation, as has hitherto been the practice.

4332. Nakano, M., Energy of the secondary undulations of oceanic tides in a bay: Geophys. Mag., Tokyo, vol. 11, pp. 139–159, 1937.

The problem of expressing the rate of variation of energy of the secondary undulations in a bay as a function of its size and form is discussed. Fourteen bays in Japan are examined. The damping factor for each bay is calculated, and the correlation of the damping factor and the shape of the bay is examined.—*W. A. R., Sci. Abstracts, vol. 41, no. 482, 1938.*

4333. Oddone, Emilio, Séismicité de l'Ethiopie [Seismism of Ethiopia]: Union géod. géophys. internat. Assoc. séismologie, Ser. B, no. 7, pp. 13–14, Nogent-le-Rotrou, 1937.

A seismic station has been established at Asmara (Eritrea) to make astronomic and geophysical observations. In cooperation with the French stations at Ksara and Tananarive and the Egyptian station at Helouan, the new station will investigate earthquakes occurring in Asia Minor, Egypt, Sudan, Abyssinia, and the Indian Ocean.—*W. A.*

4334. Patterson, W. D., Fault noises studied as possible earthquake warnings: Eng. News-Record, vol. 120, no. 17, pp. 626–627, New York, 1938.

The nature of sounds heard by listening devices deep underground at fault zones in California was investigated. These fault noises are believed to be resultants of very slight movements in the earth's crust caused by internal stress of the kind that, when sufficiently large, produces an earthquake ("fault-murmur hypothesis"). There is a brief description of the development of suitable instruments. Data obtained so far are too meager to be taken as the basis for definite conclusions, and additional investigations are needed. However, progress thus far indi-

cates that stress and strain along an earthquake fault produce both continuous and intermittent noises, which vary in volume from day to day and from week to week and which can be recorded continuously.—*W. A.*

4335. Pospelov, P. A., and Vasiliev, M. V., Application of the seismic reflection method in the Apsheron-Khodyjensk area [in Russian]: Neftianoe Khoziaistvo, vol. 18, no. 12, pp. 58–63, Moscow, 1937.

Characteristics of the seismic-reflection method are briefly discussed. Results of the work by this method carried out in the oil-bearing region of Apsheron-Khodyjensk in 1935 and 1936 are presented in the form of 13 profiles and 2 maps. Based on these results, the conclusion is drawn that the seismic-reflection method may be applied successfully in this region provided that the data are interpreted after a careful consideration of the geological facts obtained by drilling.—*W. A.*

4336. Reich, H., Der Untergrund von Schleswig-Holstein nach den Ergebnissen seismischer Refraktionsmessungen [Subsurface of Schleswig-Holstein in the light of seismic refraction surveys]: Pumpen und Brunnenbau, Bohrtechnik, vol. 33, no. 24, pp. 763–769, Berlin, Nov. 26, 1937.

The following review includes a map showing the results of seismic determinations in Schleswig-Holstein, Lower Elbe.

"In a strict sense this map does not represent an ordinary contour map, but a map of equal times of arrival of seismic waves; that is, of the seconds needed by the seismic energy to arrive at a distance of 4 km from the shot point. The times of arrival were determined by refraction fan shooting and were checked by time-distance profiles. The depth figures of the map represent approximately the depth of the first bed with a velocity higher than 3,000 m/sec. This bed can be of Upper Cretaceous, Upper Permian (Zechstein), or Lower Permian (Rotliegendes) age. The map, therefore, represents also, at least approximately, a contour map of the pre-Tertiary surface. Based on the very scanty outcrops of pre-Tertiary rocks in Schleswig-Holstein geologists previously assumed a northwestward structural trend in the subsurface of this province and have assumed a northwesterly arrangement of salt plugs within the Lower Elbe area. The map, however, shows clearly that this is not the fact, the strike of the main structural features of Schleswig-Holstein being north-northeast and the salt plugs on the south of the Lower Elbe being scattered irregularly. A very characteristic feature revealed by this work is the existence of at least four north-northeastward trending horstlike ridges, each of which is approximately 50 km long and 5 km wide. The cores of these ridges consist of Rotliegendes (Lower Permian) salt and marl series. The known oil-chalk occurrence of Heide-Hemmingstedt is located on the westernmost of the ridges (Hennstedt-Heide-Meldorf). The second ridge follows Grevenhorst, Tellingstedt, Suderhastedt, Belmhusen; the third one extends from Königsbach via Oldenbüttel toward Schenefeld. Near the southern and northern ends these ridges apparently are cut off by faults. An important structural element is furthermore represented by a northeastward-striking fault zone which trends from Glueckstadt across Bad Bramstedt toward Warnau, the so-called Holstein fault zone. Southeast of this line, the Cretaceous is dropped at least 1,000 m, and no more elongate ridges have been found, but numerous salt plugs of Rotliegendes or Zechstein were recorded by the refraction work. Some of the salt plugs represent the shallow piercement type; in other places they are

deep-seated, as indicated by doming of both the Upper Cretaceous and Tertiary near Neuengamme. Farther east the Cretaceous is nearer the surface and forms the Eastern Holstein uplift.

"The map is an excellent illustration of the complex structural conditions of this region and the many newly discovered structures, some of which have been confirmed by drilling. Other structures are now being tested by drilling and everybody concerned with oil geology and geophysics in Germany is eagerly looking forward to a continuation of this interesting and important work."—*W. Kauenhowen, Am. Assoc., Petroleum Geologists Bull., vol. 22, no. 4, 1938.*

4337. Repetti, W. C., Microseisms in the Philippines: Union géod. géophys. internat., Assoc. séismologie, Ser. B, no. 7, pp. 3–12, Nogent-le-Rotrou, 1937.

Hypotheses to explain the origin of microseisms are grouped into three divisions: in the first is that of Wiechert, who attributed microseisms to surf beating on rocky coasts; in the second is that advanced chiefly by Gherzi, who attributes them to atmospheric pumping; and in the third is that put forward by Banerji, who believes that the pressure of sea waves is transmitted to the bed of the ocean, there setting up forced vibrations which constitute microseisms.

The writer of this paper believes that microseisms in the Philippines may be explained by Wiechert's wave theory, with some modifications. According to his observations, when microseisms show a conspicuous increase in amplitude it is always found that the wind and, therefore, the wave action has increased at some section along the coast. The effect of steep coasts is discussed.—*W. A.*

4338. Rock, S. M., Three-dimensional reflection control [abstract of a paper presented before Am. Assoc. Petroleum Geologists and Soc. Expl. Geophysicists March 17, 1938, in New Orleans]: Oil and Gas Jour., vol. 36, no. 44, p. 79, 1938.

A method is presented in which two straight-line detector groups, B feet in length, intersect on the line of exploration a distance A from the shotpoint. Group 1 makes an angle σ with the line of exploration and yields ΔT_1. Group 2 makes an angle β with group 1 and yields ΔT_2.

Assuming (a) plane wave fronts at the detectors, and (b) rectilinear wave propagation, formulas are obtained for: 1. ψ, the angle of arrival of the reflected wave in the wave travel plane (i. e., the plane through the line of exploration and perpendicular to the reflecting plane); 2. θ, the angle between the wave-travel plane and a vertical plane through the line of exploration; 3. α, the dip component in the wave-travel plane; 4. δ, the total dip; and 5. ρ, the angle between direction of total dip and the line.

Examples are presented from profiles and from strike and dip maps obtained by using the special cases of this pattern, in which $\beta=90°$, and $\delta=0$ or 45°.

4339. Rybner, Jörgen, The determination of the instrumental constants of the Galitzin seismograph in the presence of reaction: Gerlands Beitr. Geophysik, vol. 51, no. 4, pp. 375–401, Leipzig, 1937.

In the theory of the electromagnetic seismograph, the reaction of the motion of the galvanometer coil upon the motion of the pendulum is mostly neglected. However, it has lately been shown by Schmerwitz

and by Wenner and McComb that the influence of the reaction on the magnification is quite perceptible, even in case of the ordinary Galitzin seismograph.

The present paper shows that in the tests usually employed for the determination of the instrumental constants, the effect of the reaction is of the same order of magnitude as that of the deviations of the frequencies and dampings from the Galitzin condition $n=n_1=\epsilon=\epsilon_1$. The formulas of Galitzin and Somville, therefore, give misleading results, unless they are extended to account for the reaction. As the reaction (the coupling coefficient) is an unknown quantity, this extension requires an extra test besides the usual "knocking test." Two methods are proposed, and the necessary formulas developed.

Finally, the influence exerted on the general performance of the seismograph by the reaction and by small deviations of the frequencies and dampings from the Galitzin condition is studied, and the formulas obtained illustrated by curves.—*Author's abstract.*

4340. Seismological tables [editorial]: Observatory, vol. 60, pp. 296–298, London, 1937.

This note describes two complementary ways of working up instrumental data relating to earthquakes. First, routine readings of the times of arrival of P, S, L, and M, are made at a large number of stations, and these are sent to the University Observatory, Oxford, from which data the International Seismological Summary is compiled. Second, special studies of particular earthquakes, such as the one recently made by Dr. A. W. Lee of the Baffin Bay earthquake of November 20, 1933, are undertaken, from which more exact conclusions concerning the internal structure of the earth can be drawn.—*B. C. Browne, Zentralbl. Geophys., Meteorol.* u. *Geod., vol. 1, no. 9, 1938.*

4341. Sezawa, Katsutada, and Kanai, Kiyoshi, Relation between the thickness of a surface layer and the amplitudes of dispersive Rayleigh waves: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 15, no. 4, pp. 845–859, 1937.

Rayleigh waves of extremely shallow origin are treated mathematically in the present paper. The results probably apply to almost any condition of the subjacent medium.

The writers conclude that although a very special type of dispersive Rayleigh waves was dealt with, the result appears to represent some of the fundamental characters of the general dispersive Rayleigh waves.—*W. A.*

4342. Sezawa, Katsutada, and Kanai, Kiyoshi, The problem of elastic stability of the earth treated in polar coordinates: Tokyo Imp. Univ., Earthquake Research Inst., Bull, vol. 15, no. 4, pp. 860–877, 1937.

The general solution of the problem of electric stability of the earth was solved in previous papers without consideration of gravitational force (idem, vol. 6, pp. 1–18, 1929, and vol. 10, pp. 299–334, 1932). The problem is here reinvestigated by means of polar coordinates with special regard to the earth's pressure and to the gravitational forces within the earth. It is considered that traces of certain past states of instability of the earth should be emphasized.—*W. A.*

4343. Sezawa, Katsutada, Plastic state of the earth under gravitational forces: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 15, no. 4, pp. 878–886, 1937.

Following on previous work (see Geophys. Abstracts 92, no. 4182), the effect of plastic conditions of the earth is examined. The conditions under which the shell and core are plastic are discussed. Considerations of the plastic equilibrium of the earth enable conclusions to be drawn as to difference between shallow and deep-focus earthquakes.—*W. A. R., Sci. Abstracts, vol. 41, no. 483, 1938.*

4344. Shnirman, G. L., An elementary theory of the spring suspension of the vertical seismometer: Acad. Sci. U. R. S. S., Comptes rendus (Doklady), vol. 17, no. 6, pp. 311–314, Moscow, 1937.

A mathematical discussion of the theory is given.—*W. A.*

4345. Silverman, Daniel, The steady state response of electromagnetically damped dynamic and reluctance type seismometers [abstract of a paper presented before Am. Assoc. Petroleum Geologists and Soc. Expl. Geophysicists, March 17, 1938, in New Orleans]: Oil and Gas Jour., vol. 36, no. 44, p. 79, 1938.

The steady state shaking table devised by Mr. Kelly has been used to determine the response, as a function of frequency and terminating resistance, of a dynamic and a reluctance seismometer. The observed response of the dynamic seismometer is shown to be identical to that predicted by theory. The response curves for the reluctance seismometer qualitatively substantiate analytical predictions as to the value of terminating resistance for maximum damping, and of the shift, with decreasing resistance, of the peak of response to higher frequencies. A short discussion of the electrical equivalent seismometer is given, and a comparison shown between the experimentally determined response of a reluctance type seismometer and that of its equivalent network.

4346. Sparks, N. R., and Hawley, P. F., Maximum electromagnetic damping of a reluctance seismometer [abstract of a paper presented before Am. Assoc. Petroleum Geologists and Soc. Expl. Geophysicists, March 17, 1938, in New Orleans]: Oil and Gas Jour., vol. 36, no. 44, p. 79, 1938.

An explicit solution to the third order differential equation representing the action of an electromagnetically damped reluctance seismometer has been obtained for the case of greatest interest, i. e., when the value of terminating resistance is such as to make the damping a maximum. This solution provides useful interrelations among the values of the constants of the instrument at maximum damping.

4347. Sponheuer, W., Über die makroseismischen Verfahren zur Bestimmung der Herdtiefe und ihre Anwendung bei Lockerböden [On the macroseismic methods for determining the focal depth and their application to loose grounds]: Zeitschr. Geophysik, vol. 13, nos. 7/8, pp. 301–311, Braunschweig, 1937.

Methods of calculation of macroseismic observations must be considered only as reliable as the assumptions on which they are based. In order to eliminate the influence of different underground conditions, a clarified (abgedeckte) isoseismal map, serving as a foundation for macroseismic calculations, may be drawn by the restriction of observations to places of similar subsurface conditions.—*Author's abstract, translated by W. A.*

4348. Steidle, Edward, The seismograph station: Pennsylvania State College, Min. Industries, vol. 7, no. 7, p. 2, 1938.

The seismological station of the college has been moved into a new vault that will accommodate a complete set of three seismographs to record all components of ground motions. There will be also adequate housing for the controlling clock system. Provisions have been made also to install a system of distant recording in a room over the vault which will permit constant supervision of the instruments.—*W. A.*

4349. Steinmann, K. W., Pictorial story of seismic reflection shooting: Oil Weekly, vol. 88, no. 13, pp. 40–42, Houston, Texas, 1938.

Various steps followed by a seismic field party in its daily work are presented in a series of pictures, from the first arrival of the party at the location to the final computing of the records. Explanation of each picture is given. One particular type of instrument under certain field conditions is described; therefore, the steps may vary slightly if different equipment is used or the conditions of work are different.—*W. A.*

4350. Stetson, H. T., Correlation of frequencies of seismic disturbances with the hour angle of the moon: Am. Philos. Soc. Proc., vol. 78, no. 2, pp. 411–424, 1937.

The possibility that periodic tidal stresses in the earth's crust should be reflected in the frequency with which seismic disturbances occur has been investigated by various workers, usually from the point of view of phases of the moon or with a view to correlation of earthquake frequencies with distances of the epicenter from the sublunar point. Results from the former method of treatment have for the most part been conflicting, and the results from the latter method of analysis have been subject to a fortuitous distribution owing to the relatively few occasions when the moon can be near the zenith of the epicenter. The present investigation based on some 2,000 major earthquakes, seeks a possible correlation with lunar hour angle alone, which avoids the above-mentioned difficulty. When the seismic disturbances are restricted to major earthquakes recorded over 80° from the epicenter, and confined to the Philippine Island group, and the Japanese Archipelago, two maxima are suggested falling approximately 12 hours apart, one corresponding to lunar time 8 hours, and the other to lunar time 20 hours. These occurrences are not far from the time of maximum tidal stress. More significant are the results of a study of 150 deep-focus earthquakes with origins 100 km or more below the surface. The frequency distribution of these deep-focus earthquakes is compared with a sine curve corresponding to the horizontal tidal force at the epicenters. A least square solution shows the sum of the squares of the residuals from the most probable sine curve to be ¼ as large as would be the case were there but a chance distribution based on an arithmetic mean of the hourly frequency. Results, therefore, indicate a distinct tendency for major seismic disturbances to follow preferential positions of the moon with maxima occurring near the times when the horizontal component of the tidal force is a maximum.—*Author's abstract.*

4351. Takahasi, K., Seismic waves and block structure of the earth's crust: Geophys. Mag. Tokyo, vol. 11, pp. 117–138, September 1937.

Assuming that the earth has a block structure instead of a continuous one, it is shown that important effects on the energy problem result.

Examination of earthquake data would seem to indicate that the crust really has a block structure.—*W. A. R., Sci. Abstracts, vol. 41, no. 482, 1938.*

4. ELECTRICAL METHODS

4352. Belluigi, Arnaldo, Theoretische Grundzüge der Selbstpotentialmessungen über Erzlagerstätten [Theoretical foundations of self-potential measurements above ore deposits]: Beitr. angew. Geophysik, vol. 7, no. 2, pp. 172–178, Leipzig, 1937.

Generation of self-potentials and methods of measuring and recording them are mentioned. The theoretical value of the potential produced by natural currents on the surface of the earth is determined. The mathematical theory of Edge and Laby is improved and brought nearer to the real case. Possibilities of application are derived.—*Author's abstract.*

4353. Bilinsky, Solomon, On the field due to a vertical line source of current grounded to earth: Geophysics, vol. 3, no. 1, pp. 58–62, Houston, Texas, 1938.

An expression for the current density at any point in the earth due to a current in an infinitely long vertical wire is found for two types of current: (1) Simply periodic, (2) rectangular impulse. These are given respectively by equations where I_r is the horizontal radial component, and I_z the vertical component of the current density vector at the point (r, z), which is at a distance R from the grounding point. These formulas hold for frequencies not too high or times not too small to allow neglect of the displacement current.—*Author's abstract.*

4354. Breusse, J. J., Application de la méthode des résistivités dans le bassin pétrolifère Roumain [Application of the resistivity method in the Rumanian oil basin]: 1^e Cong. Mondial Pétrole, Paris, June 1937; 9 memoirs on geophysical prospecting, 11 pp.

The exploration of the Rumanian oil basin by the direct-current resistivity method, has been carried on since 1933. An area of 2,500 km^2, has been covered, mainly in the Buzau-Ploesti-Targoviste region. Maps and diagrams showing the results of exploration are given.—*W. A.*

4355. Dakhnov, V. N., Electrical coring of boreholes in oil industry and prospects of its further development (in Russian): Razvedka Nedr, vol. 8, no. 22, pp. 54–64, Moscow, 1937.

Methods of investigation by which the following problems may be solved by electrical coring are discussed:

1. Determination of the lithological character of rocks penetrated by boring.
2. Location of permeable horizons, possible collectors of oil.
3. Location of oil-bearing horizons.
4. Study of underground structure.
5. Study of the degree of saturation of productive horizons.
6. Determination of the movement of underground waters adjoining the oil-bearing horizons.
7. Calculation of oil reserves.

The discussion is accompanied by diagrams giving examples of electrical coring in various oil-bearing regions. In conclusion, the author points out the desirability of the improvement of the technique of electrical coring for studying lateral coring in the hole, electrical coring in tubed holes, calculation of oil reserves, etc.—*W. A.*

4356. Dale, C. R., and Guyod, Hubert. Locating water source is initial step in making well repairs: Oil and Gas Jour., vol. 36, no. 27, p. 66, 1937.

The water cut in California oil fields during 1936, as a whole, amounted to 43.97 percent, and records kept in many individual fields show that it ranges from 40 percent to 90 percent, and indicate that it is increasing yearly. The problem of reducing the water cut is not a new one, but the fundamental handicap has, in the past, been the lack of accurate information as to the point or points at which the formation water was entering the well. Modern oil-well water-locating service is available, and greater success is being obtained in repair work. A great deal of money can be saved if the point of entry is determined and the well repaired when the intrusion of formation water first takes place. Photo-electric water locating surveys are enabling the source of the formation water to be located accurately and swiftly. Methods of repairing wells in the older fields where accurate information is lacking are described.—*L. V. W. C., Inst. Petroleum Technologists Jour., vol. 24, no. 172, 1938.*

4357. Fritsch, Volker, Die Anwendung der kurzen Wellen in der Funkgeologie [Application of short waves in radio geology]: Beitr. angew. Geophysik, vol. 7, no. 2, pp. 190–205, Leipzig, 1937.

Application of short waves in different branches of radio geology is discussed. With the exception of branches engaged in the investigation of lightning, short waves are applied everywhere, and in some fields they occupy the first place. First, a classification of the different branches of radio geology is given. Then, a summary is given of the author's experiments, in which the propagation of short waves in and along geological conductors has been investigated. Further, the application of short waves to radio prospecting is discussed, and the question of limiting frequencies is examined. Finally, the problem of subterranean radio connections is dealt with. These are found to be possible under certain conditions and necessary for certain purposes. With their help, the examination of layers in greater depth may become possible. In a supplementary way, certain relations of radio geology to geopathology are mentioned. An account is given of experiments which purport to solve the problem of geopathogenous zones by means of radio-geological working hypothesis.

Short waves are used in the different fields of radio geology. Their specific properties can even be utilized for the solution of problems which cannot be solved by long waves alone. A brief survey of the different possibilities of application is given, and points of view for future research are developed.

The theory of propagation, radio prospecting, geopathology, and more fields of radio geology are considered from the point of view of short-wave physics.—*Author's abstract.*

4358. Geffrier, R. de, Les succés de la prospection électrique [Success of electrical prospecting]: Rev. Pétrolifère, no. 773, pp. 282–283, Paris, Feb. 18, 1938.

Success of electrical methods of prospecting attained in the Union of Soviet Socialist Republics is briefly outlined based on technical publications issued in that country. Electrical coring introduced in that country since 1929 is widely used in all oil fields.—*W. A.*

4359. Geneslay, Raymond, and Rouget, François, Sur l'anisotropie électrique des terrains et la pseudo-anisotropie [On the electrical anisotropy of for-

mations and pseudo-anisotropy]: 1e Cong. Mondial Pétrole, Paris, June 1937; 9 memoirs on geophysical prospecting, 18 pp.

Two kinds of anisotropy, microanisotropy and macroanisotropy, are distinguished. The authors show how anisotropy can be taken into consideration in calculations and how it can be measured. The importance of considering anisotropy is shown by an example in which the error in the determination of the depth of a deposit without considering the effect of anisotropy amounts to about 2,000 feet when the real depth is 3,000 feet.—*W. A.*

4360. Hawley, P. F., Transients in electrical prospecting [abstract of a paper presented before Am. Assoc. Petroleum Geologists and Soc. Expl. Geophysicists, March 17, 1938, in New Orleans]: Oil and Gas Jour., vol. 36, no. 44, p. 78, 1938.

Oscillograms will be shown of the build-up of current which occurs when a potential is suddenly applied between two grounded stakes at separations ranging from 1,000 to 12,000 feet, and of the potential transient between the inner electrodes of a Wenner configuration. These oscillograms were made by focusing the spot of a cathode ray oscillograph on ultra speed, post sensitized film, moving at velocities as much as 250 inches per second.

4361. Koenigsberger, J. G., Elektrische Vertikalsondierung von der Erdoberfläche aus mit der Zentralinduktions methode [Electrical vertical sounding from the earth's surface with the central induction method]: Beitr. angew. Geophysik, vol. 7, no. 2, pp. 112–161, 1937.

This is a continuation of the earlier theoretical study of the central induction method. The new conclusions are based mainly on two articles by S. S. Stefanescu: (1) Measurement of apparent resistivities by the method of a circular current: Beitr. angew. Geophysik, vol. 5, no. 2, 1935 (Geophys. Abstracts 79, no. 2854); and (2) On the theoretical foundations of electromagnetic prospecting by alternating current at very low frequency, Beitr. angew. Geophysik, vol. 6, no. 2, 1936 (Geophys. Abstracts 88, no. 3613). By using the results obtained by Stefanescu, the theoretical calculation of the conductivity and thickness of any number of layers, as well as the evaluation of the limits of error, is possible.

The advantages and disadvantages of the central induction method (CIM) in comparison with the potential difference method (PDM), and conditions common to the two methods are examined in detail.

The PDM can be used for two or three layers, and the resistivity, depth, and thickness of the layers found, but for four or more layers it is theoretically difficult. The CIM is slow and less accurate to 50 m than the other method, but it is useful for great depths and is less complicated.—*W. A.*

4362. Liogenky, S., Determination of the thickness of pegmatite veins by the superficial coring method [in Russian]: Razvedka Nedr, vol. 8, no. 24, pp. 57–58, Moscow, 1937.

The method of electrical profiling by using three electrodes, called "superficial coring," is described. The results of tests of this method made over pegmatite veins in northern Karelia are given in four figures. In all four tests satisfactory results were obtained. The agreement of the results obtained by "superficial coring" with those obtained by

mining is shown in a table. The thickness of veins may be determined with an accuracy sufficient for practical purposes.—*W. A.*

4363. Niem, Günther de, Feldstärke und Stromdichte eines dipols im Erdboden [Field intensity and current density of a dipole in the ground]: Beitr. angew. Geophysik, vol. 7, no. 2, pp. 162–171, Leipzig, 1937.

First, one single point source is considered, under the assumption of an infinite distance between the electrodes, and the relations between the electrical field, density of current, and specific resistance are examined. Then, the same relations are established for the case of two poles at a finite distance apart. From the equation obtained for the potential, the intensity of the electrical field is derived. The field vectors of each pole are found to decrease with the square of the distance. The decrease of field strength and current density with depth as a consequence of current displacement is shown graphically. It is noted that the graphs are valid only for the waves at a right angle of incidence, that is, for a cross section at right angles to the direction of the current.—*W. A.*

4364. Petrucci, G., Un nuovo metodo induttivo di "sondaggio" del sottosuolo [A new induction method for sounding the subsoil]: L'Industria Mineraria, vol. 11, no. 12, pp. 420-424, Rome, 1937.

The importance of electrical sounding for obtaining geological information is noted and various methods employed are outlined. The principles of a new method are explained, the method being based on the induction of a current in the conducting layer in the subsoil by means of a double horizontal coil traversed by alternating current, and producing in the conducting layer a current flowing in the opposite sense. The intensity of this secondary field is measured on the surface of the ground by means of a special receiving coil placed between the two induction coils, at equal distances from them, and in a position such that a maximum action of the conducting layer may be obtained. The execution of the method is shown in diagrams. The field possibilities of the method and model tests made in the laboratory are discussed.—*W. A.*

4365. Poldini, E., Les phénomènes de polarisation spontanée électrique du sous-sol et leur application a la recherche des gîtes métallifères [Phenomena of electrical spontaneous polarization of the subsoil and their application to prospecting metalliferous deposits]: Soc. vaudoise sci. nat., Mém., vol. 6, no. 1, 42 pp., Lausanne, 1938, Price, Fr. 2.00.

Electromotive forces produced by the oxidation of metallic masses concealed in the ground (chemical cause of spontaneous polarization) and electromotive forces produced by friction of waters moving through the subsoil (electrocapillary cause of spontaneous polarization) are discussed in the first two chapters of the article. The measurement of spontaneous polarization and graphical representation of the results is explained in chapter 3. Chapter 4 gives examples of the study of the spontaneous polarization of the following deposits: (1) Nickeliferous pyrrhotites of New Hope, British Columbia; (2) limestones in the region of Veliki Majdan, Serbia; and (3) masses formed by pyrites, chalcopyrites covellite and chalcocite in the zone of propylitic andesites in the region

of Bar, Yugoslavia. An example of surveys carried out in Pallières, Department of Gard, France, and in Katanga, Africa, is given.

The concluding chapter 5 contains a discussion on the possibility of practical application of the measurement of spontaneous polarization in prospecting for metalliferous veins; the following five essential points are to be considered: (1) The nature of the mineral; (2) conductivity and electrical continuity of the type of the vein to be examined; (3) depth to which the oxidation has penetrated; (4) depth of the hydrostatic level, and (5) reaction of parasitic electrocapillary phenomena.—*W. A.*

4366. Rust, W. M., Jr., A historical review of electrical prospecting methods: Geophysics, vol. 3, no. 1, pp. 1–6, Houston, Texas, 1938.

The development of electrical prospecting methods from the discoveries of R. W. Fox in 1830, to recent inventions is traced briefly.—*Author's abstract.*

4367. Watson, R. J., and Johnson, J. F., On the extension of two-layer methods of interpretation of earth resistivity data to three and more layers: Geophysics, vol. 3, no. 1, pp. 7–21, Houston, Texas, 1938.

The two-layer problem has been solved completely. Considerable success with the three-layer problem has been attained by the extension of the two-layer methods of Tagg and Roman, making use of the principle established by Hummel.

Some of the limitations of these methods are examined by the comparison of theoretical curves for various values of h_2, ρ_2, and ρ_3, with help curves computed, using Hummel's principle. In general it is found that the three-layer problem of the type where a good conductor lies between two relatively poor conductors is more favorable for interpretation by the extension methods than is the opposite case where a poor conductor lies between two good conductors. The disadvantage in the latter case is that the field measurements must be carried to very much larger electrode spacings compared to the depth investigated. In all three-layer problems where $h_2 < h_1$, a good interpretation for h_1 is difficult. The four-layer problem is much more difficult and only very special types lend themselves to the extension methods.

The use of a large number of theoretical curves for curve matching is advocated both as a supplement to the extension methods and as a more powerful but slower method for the less favorable three-layer problems as well as for problems of four or more layers.—*Authors' abstract.*

4368. West, S. S., Electrical prospecting with non-sinusoidal alternating currents [abstract of a paper presented before Am. Assoc. Petroleum Geologists and Soc. Expl. Geophysicists, March 17, 1938, in New Orleans]: Oil and Gas Jour., vol. 36, no. 44, p. 79, 1938.

A method of electrical prospecting using alternating current of rectangular or other nonsinusoidal wave form is described. The change in wave form caused by subsurface structure is determined by a null method in which the detected electromotive force is balanced against an electromotive force produced by passing the output of a standard oscillator through an adjustable network. This process of measurement (applicable also to the transient method) makes possible a useful representation of the data in terms of two-dimensional contours.

5. RADIOACTIVE METHODS

4369. Gorshkov, G. V., and Starovatov, N. P., Determination of the relation Th/U in ores according to β and γ rays [in Russian]: Jour. Geophysics, vol. 7, no. 5, pp. 338–349, Moscow, 1937.

The possibility of determining the relation Th/U in ores by means of radiation is shown. The method and apparatus used are described. Ores with about 8 percent of U_3O_8 concentration were investigated. The results of tests by applying filters of gypsum, glass, aluminum, and waxed paper are given in diagrams and tables.—*W. A.*

4370. Grabianka, S., Recherches sur la radioactivité de quelques roches et minéraux [Investigation of radioactivity of some rocks and minerals] [in Polish]: Service Géol. Pologne Bull., vol. 9, no. 1, pp. 9–15, Warsaw, 1937.

Wulf's double-thread electroscope was used. The ionization chamber was provided with a 172.5-mm disc covered with the matter to be examined. The expulsion of radon, the accumulation of which could cause errors in measurements, was accomplished by a special arrangement for blowing in air. The following rocks and minerals were examined: (1) Paleozoic sandstone; (2) the same sandstone included in the original deposit; (3) andesite; (4) galena; and (5) sphalerite.

The results of the measurements are shown in three tables. In a fourth table are given the results of measurements of radium in mariupolite.—*W. A.*

4371. Schlundt, Herman, and Breckenridge, G. F., Radioactivity of the thermal waters, gases, and deposits of Yellowstone National Park: Geol. Soc. America Bull., vol. 49, no. 4, pp. 525–538, 1938.

In all, the radium content was determined for 77 water samples, 20 gas samples, and 16 samples of spring deposits and rocks. In addition, a number of residues analyzed by Herman Schlundt in 1933, are included. The results of radium measurements of several gases, waters, and residues from Thermopolis, Wyoming, are also included.

In general, the values obtained in 1936 agree with those obtained by Schlundt and Moore in 1906. For example, the 1936 value of Hot River showed a radium content of 172×10^{-11} grams per liter, compared with the 161×10^{-11} grams per liter value of 1906. For Apollinaris Spring the 1936 value of 166×10^{-11} compares favorably with the 1906 value of 121×10^{-11}. For Middle Spring at Terrace Springs, the 1936 value of 11.5×10^{-11} compares favorably with the 1906 value of 9.2×10^{-11}.

Considered as a whole, the springs and geysers of the Upper Geyser Basin show more radioactivity than those of other locations in Yellowstone Park. No correlation could be found between the radioactivity and the surface temperature of the spring. Neither could any relation be found between radioactivity and the acidity of the waters.

Although the amount of radioactivity in the spring waters of the Park is low, the amount is strikingly large for a long period of time. For example, the radioactive content of Hot River amounts to only 172×10^{-11} grams of radium equivalent per liter of water. However, by using the value of Allen and Day (1935), for the total discharge of Hot River, it can be shown that 33.9 grams of radium equivalent are discharged by Hot River during one year. Of course, most of the radioactivity of the water is due to radon and not to radium. The amount of radium discharged by Hot River in one year is calculated to be about 90 milligrams.—*Author's abstract.*

6. GEOTHERMAL METHODS

4372. Jeffreys, Harold, The disturbance of the temperature gradient in the earth's crust by inequalities in height: Royal Astron. Soc. Monthly Notices, Geophys. Suppl., vol. 4, no. 4, pp. 309–312, London, 1938.

The determination of the temperature gradient in the crust depends on the measurement of the actual temperature at a number of points in the same vertical line. If the conditions in the earth were symmetrical, the gradient would be the same in all such lines. Several types of departure from symmetry may disturb this uniformity, such as variation in the conductivity of the rocks where the measurements are made, and variations in the amount and distribution of radioactivity in the deeper rocks. Comparison of gradients in different places may help to estimate these differences. The disturbance of the temperature gradient by inequalities in height may be appreciable. Since it is calculable, it should be eliminated before the more obscure disturbances that affect the temperature gradient can be estimated. This paper shows how this can be done mathematically.—*W. A.*

7. UNCLASSIFIED METHODS

4373. Andreev, B. A., Application of geophysical methods for prospecting chromite deposits [in Russian]: Central Geol. and Prosp. Inst. Trans., no. 100, 34 pp., Leningrad, 1937.

After a brief description of the geological conditions in which chromite deposits are found (Urals, Bashkiria) and of their physical properties, the results obtained by different methods of geophysical prospecting for them are examined. Magnetic, gravimetrical, and electrical methods were tested, and the conclusion is drawn that only the gravimetrical method may be applied with certain success, the other two being rejected because most of the chromite deposits investigated did not produce any distinct magnetic anomalies, and no regularity in electrical properties of chromite ores could be found from tests made in the laboratory or in the field. The testing of a new method called the "spectrometric survey" is recommended. This method consists of determining the concentration of ore components in the "aureoles of dissemination" by means of spectrcanalysis; a sharp increase of concentration of chromite was determined in the alluvial layer directly over the main ore body.—*W. A.*

4374. Bartels, J., and Fanselau, G., Geophysikalischer Mond-Almanach [Geophysical lunar almanac]: Zeitschr. Geophysik, vol. 13, no. 7/8, pp. 311–328, Braunschweig, 1937.

Full information on the daily movement of the "apparent" (wahren) moon is given in astronomical yearbooks. These tables serve often also as a basis for geophysical calculations on the effects produced by the moon because similar information concerning the "mean" (mittleren) moon is so far lacking. But, in doing so the connection with the harmonic analysis of tidal forces is not observed as the latter are referred to the "mean" moon; also, the unequal length of the apparent lunar day makes the calculations more complicated. Values: μ $(\pi+\mu)$, and $(\rho+\mu)$, introduced by Adolf Schmidt, show in a convenient form the phase of the "mean" moon and its distance from the mean perigee and from the mean ascending node of the moon's orbit. Tables showing these values, which can be read for each day of the years 1850 to 1975,

are given. Differences between motions of the "apparent" and "mean" moon are illustrated numerically.—*Authors' abstract, translated by W. A.*

4375. Blackburn, M. S., Geophysical interpretations: Oil Weekly, vol. 88, no. 4, p. 15, Houston, Texas, 1938.

An analysis of geophysical interpretation is given, based on the result of 6 years of gravity work and 2½ years of research work with electromagnetic waves for the determination of subsurface structural conditions in the Balcones and Gulf Coast areas in Texas. The value of geophysical work may be greatly improved by taking geological data into consideration.

Each geophysical method has its good points: some can give greater detail than others but are slower and more expensive; some work better than others in certain regions. A combination of methods is recommended. Instruments which can locate structure but cannot tell depth should be used for reconnaissance work and their findings checked by a depth-measuring method.—*W. A.*

4376. Fekete, Jenö, Prospecting salt domes with geophysical methods [In Hungarian]: Földtani Közlöny, vol. 67, no. 7/9, pp. 216–227, Budapest, 1937.

Geophysical methods for prospecting salt domes were first used in Texas and Louisiana as early as 1923, applying the Eötvös torsion balance and the refraction seismic method. The results of torsion-balance surveys proved Böckh's theory that a *gravity minimum* will appear above an uplift when the core of the uplift is rock salt, and a *gravity maximum* will be obtained above such uplifts the core of which is heavier than the overlying formation, although it was found in Texas that gravity maximum will appear above salt domes lying close to the surface if a *heavy cap rock* is present. From the gravity results it is possible to determine the form and depth of the salt dome. A salt dome in Texas is mentioned, which in spite of a cap rock shows a gravity minimum; this is explained by the fact that the positive gravity effect of the cap rock cannot compensate the large negative gravity effect of the salt mass.

In case of deep-lying salt domes, the oil occurs mostly in the uplifted sedimentary beds just above the apex of the dome, the exact determination of which can be made by the reflection seismic method. Refraction seismic method can be used for detecting deep-lying salt domes only if the shot distance is very long and a great amount of explosives is used; therefore it is not economical. Principles of magnetic and electrical methods are briefly explained.—*From author's English abstract by W. A.*

4377. Gabriel, V. G., and Dunbar, C. P., Miscellaneous geophysical methods used in prospecting for oil: Louisiana Cons. Rev., vol. 6, no. 1, pp. 2–4, and 24, 1937.

Certain fundamental geological concepts are presented, and there is an elementary discussion of geophysical methods of prospecting including geothermal measurements and electrical logging.—*W. A.*

4378. Geophysical prospecting [editorial note]: Mine and Quarry Eng., vol. 3, no. 3, p. 82, London, 1938.

A brief historical outline of geophysical prospecting is given. The capabilities of coordinated electrical and magnetic indications are shown by the location and identification of a hidden diabase dike in the Sudbury district, Ontario, demonstrating the accuracy of the conductivity method.

An example cited by Lundberg is mentioned, in which an 11-inch quartz vein was encountered by drilling at a depth of 249 feet as compared with the 250 feet predicted from a geophysical survey.—*W. A.*

4379. Geophysical surveying [editorial]: Mining Mag., vol. 58, no. 1, pp. 52–54, London, 1938.

This is a detailed review of Lundberg's paper "Recent advances in geophysical prospecting," published in Canadian Min. Met. Bull., no. 308, pp. 758–788, December 1937. (See Geophys. Abstracts 92, no. 4228).—*W. A.*

4380. Gross, W. V., American Institute of Mining and Metallurgical Engineers presents widely diversified program: Oil Weekly, vol. 88, no. 11, pp. 46–48 and 216–218, Houston, Texas, 1938.

A brief report on the 148th annual meeting of the American Institute of Mining and Metallurgical Engineers, held in New York, Feb. 14–18, 1938, is given.

The following papers on geophysics presented at this meeting are discussed:

1. Geophysical study of soil dynamics, by R. K. Bernhard. Geophysical methods for investigating the reactions of soil and structure to artificial vibrations and their dynamic constants, such as amplitudes, phase speeds, damping, reflection, and interference effects are described.

2. Trends in gravitational prospecting during the past few years, by Donald Barton. Changes in the observational technique that have taken place during the past 5 years are discussed. Advantages and disadvantages of the gravimeter are listed.

3. Electrical prospecting summary, by J. J. Jakosky. This method is of economic importance in deep structural mapping for oil exploration. At the close of 1937 there had been covered an area in excess of 10,000,000 acres by electrical prospecting. In addition, over 1,500,000 feet of traverse lines had been run, chiefly in the San Joaquin Valley and in the coastal areas of the Los Angeles Basin in California.

A number of papers were contributed for a round-table discussion on geophysical education. There are summaries of two of them: (1) The status of geophysics in a department of geology, by M. K. Hubbert, and (2) The organization of a department of geophysics, by C. A. Heiland and Dart Wantland.—*W. A.*

4381. Kelly, S. F., Geology plus physics aids mining exploration: Reprint from Annual Mining Issue of Timmins Daily Press, Timmins, Ontario, 12 pp., 1937.

After a brief historical outline on geophysical methods of prospecting (electrical and magnetic), a description is given of the geophysical survey conducted by the writer in 1936, on a property of the Broulan Porcupine Mines, Ltd., adjoining the claims of the Pamour Porcupine Mines, Ltd., in Northern Ontario. Electrical and magnetic methods were used in an effort to delineate the underlying structure and to locate silicified zones favorable to the occurrence of gold ore. The results are represented in a plan of electrical and magnetic survey and in profiles showing (1) the electrical ground-resistance profile, (2) profile of strength of spontaneous ground current, and (3) in a profile of magnetic readings as obtained from the results of superdip-needle survey. In discussing the work on the Broulan Porcupine property, it is stated that before a

final interpretation of the geophysical results, the available drill hole data were considered. It is concluded that to obtain valid results of the maximum utility, any program must include geophysical prospecting as a vital part of the geological study of the area under investigation.—*W. A.*

4382. Maillet, Raymond, and Ceccatty, R. P., Le physicien devant la tectonique [The physicist confronted by tectonics]: 1e Cong. Mondial Pétrole, Paris, June 1937; 9 memoirs on geophysical prospecting, 17 pp.

As long as the tectonical conceptions are limited by describing only the relative displacements of certain elements of the subsoil that change into structural features revealed by direct observation, they remain within the geological control. But as soon as dynamic hypotheses of forces causing this displacement are involved, the physicist has to intervene. As the direct measurement of the forces concerned is not always possible the method of small-scale models is applied. But results can be valid only if certain relations are similar in linear dimensions as well as in the duration of the phenomenon and in the physical properties of the materials used in the experiment. These relations are specified in the article. Many of the experiments cannot be considered valid, and other paths to be followed are indicated. Besides, the degree of reliability of the different tectonical theories proposed at the present time is examined. In particular, the sliding of sediments under the force of gravity only must be much more important than has been assumed so far. The sliding may occur without any effect being produced by the hypothetical lateral compressions.—*From the English abstract added to the article, by W. A.*

4383. McNish, A. G., The earth's interior as inferred from terrestrial magnetism: Am. Geophys. Union Trans., 18th annual meeting, Washington, part 1, pp. 43–50, 1937.

Absence of any satisfactory theory to account for the earth's magnetic condition consistent with the view that the interior of the earth is at a high temperature calls into question the validity of the temperatures assigned to it. Secular change indicates that large fluctuations occur in the magnetic condition of matter at great depths which progress rapidly with respect to geologic time. These changes are not consistent with the view that the earth's interior is static. Study of the magnetic fields arising from electric currents induced by diurnal variations and magnetic storms leads to the inference that at depths of 200 km the electric conductivity increases greatly relative to that of surface rocks. If the thermal and electrical conductivities follow the Wiedemann-Franz relationship, temperatures of the interior of the earth may be considerably lower than is ordinarily supposed. Speculations in this connection suggest that the temperature at the center of the earth may have been as low as 2,200° C. when convective cooling ceased.—*Author's abstract.*

4384. Melton, E. R., A military aspect of exploration geophysics: Geophysics, vol. 3, no. 1, pp. 46–57, Houston, Texas, 1938.

That branch of exploration geophysics using refraction and reflection methods of seismographing employs equipment and methods similar to military sound ranging. Present methods and equipment used in geophysical seismographing show results from developments in the art of sound ranging during the last war. The accuracy obtained in sound

ranging is considerably greater than that obtained in refraction shooting where the air wave is used to measure distance. Corrections are applied for direction and velocity of wind and for temperature.

Personnel in the sound ranging unit is organized similar to a geophysical field crew, having motor truck transportation, instrument operators, and record interpreters. However, the geophysical crew is more of a mobile outfit.

In any future war, the geophysical personnel, particularly the exploration geophysicist, will be expected to place his specialized training at the disposal of the Government.—*Author's abstract.*

4385. Migaux, M., Sur les diverses études de géophysique appliquée exécutées au Maroc Français de 1930 à 1935 [On the various applications of geophysics in French Morocco from 1930 to 1935]: Union géod. géophys. internat., assoc. séismologie, Ser. B, no. 7, pp. 51–60, Nogent-le-Rotrou, 1937.

Brief information on the application of geophysics in mining prospecting and in public works is given.

1. *Mining prospecting.* Important application has been made in prospecting for oil in Morocco since 1929 (electrical, gravimetrical, and seismic methods). Electrical methods have also been used in prospecting for minerals (molybdenite, manganese).

2. *Public works.* Electrical methods were used in connection with supplying water for three cities, Casablanca, Rabat, and Port Lyautey, and the construction of a dam across the lower Moulouya.—*W. A.*

4386. Miyabe, Naomi, Supplementary notes to the study of crustal deformation in the Tango district: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 15, no. 3, pp. 654–662, 1937.

The conclusions on the mode of crustal deformation in the Tango district are revised on the basis of a hypothesis in which the crustal deformation is believed to be discontinuous in the zone traversed by active faults. Horizontal divergence and rotation are calculated by using the data on horizontal displacements of the triangulation points distributed in the region. The distribution of the components of horizontal displacement, both perpendicular and parallel to the general trend of the Gomura fault, are shown in figures.—*W. A.*

4387. Postley, Olive C., Bibliography of geologic structure maps and cross sections of areas in oil and gas States east of the Mississippi River, and some producing States in the Mid-Continent region: Am. Assoc. Petroleum Geologists Bull., vol. 22, no. 4, pp. 431–482, 1938.

A list of structural maps and cross sections of areas that have been exploited for oil and gas in the following States is given: Alabama, Arkansas, Illinois, Indiana, Kansas, Kentucky, Louisiana, Michigan, Mississippi, Missouri, New York, Ohio, Pennsylvania, Tennessee, and West Virginia. The list is published for the convenience of those interested in the geology of oil and gas.—*W. A.*

4388. Reichenbach, Richard, A review of geophysical prospecting on the Witwatersrand: South African Jour. Sci., vol. 33, pp. 207–214, Johannesburg, March 1937.

The two main groups of the different methods used in geophysical prospecting are briefly described: the first based on the measurements of the "natural" physical constants of the various rock formations which

constitute the earth's crust (gravitational, magnetometric, radioactive, and geothermal), and the second based on measurements of "artificial" impulses applied to these rocks (seismic and electrical).

Before discussing the possibility of the application of geophysical methods to problems on the Witwatersrand, a brief summary of the stratigraphy is given as follows: On a wide-spread mass of granite rest the sedimentary formations of the Lower and Upper Witwatersrand systems, appearing on the surface over wide stretches of the West, Central, and East Rand. In other places, however, they are covered by rocks of the Ventersdorp, Transvaal, and Karoo systems. In some places one, in others two, and again in others all three of these younger formations are present.

The main problem of geophysical prospecting for the Witwatersrand gold-bearing conglomerates is the investigation of the differences in the physical characteristics of the various formations. During the last 6 years, the magnetometric method has been used on a large scale on nearly every portion of the greater Witwatersrand area where gold-bearing series were assumed to be present under a cover of younger formations. The gravitational method has been applied in the investigation of fault problems on the Witwatersrand. Investigations by seismic methods have established several faults in the dolomite-covered area of the Far East Rand. The resistivity method has been employed for investigating ground-water conditions and for locating water fissures, moist zones, and faults occurring within the Dolomite series and in Upper Witwatersrand formations under a relatively thin cover of Karoo sediments. The magnetometric method has proved to be of great assistance in solving geological problems in these fields and thus will probably be used in future on an even larger scale.—*W. A.*

4389. Rosaire, E. E., On the strategy and tactics of exploration for petroleum, II: Geophysics, vol. 3, no. 1, pp. 22–29, Houston, Texas, 1938. (For part I see Geophys. Abstracts 77, no. 1563.)

The need for statistics relative to the cost of finding oil in the ground has been recently stressed by De Golyer. In the absence of such statistics it is suggested that the study of outstandingly successful exploration campaigns will permit the deduction of principles which can be used for general guidance. By showing the parallelism between recent successful exploration campaigns and pertinent illustrations from military history, three of the fundamental Principles of War, relating to Offensive, to Surprise, and to Security, are found to be applicable to exploration strategy. In conclusion, the present status of exploration in the Gulf Coast is discussed by analogy to a similar period in 1929 and 1930.—*Author's abstract.*

4390. Schander, Johannes, Bemerkungen über die geologische Auswertung geophysikalischer Messungen [Remarks on geological interpretation of geophysical measurements]: Bohrtech. Zeitung, vol. 55, no. 6, pp. 164–165, Vienna, 1937.

The accuracy of the interpretation of geophysical measurements depends on the geophysicist's knowledge of the stratigraphy and tectonics of the region in which the measurements are made. The knowledge of the lithology of the layers in making seismic surveys and the knowledge of the volumetric density for gravimetrical measurements are necessary. In completely unknown areas a test boring is recommended before

starting geophysical measurements. Where geologic data cannot be obtained, the geophysicist should limit himself to giving the results of his measurements. The final test of any theory is the drill and based on the results of this, the geophysical evidence must be reviewed if necessary.—*W. A.*

4391. Schlumberger, Marcel, and Maillet, Raymond, L'évolution des problèmes et des méthodes géophysique appliquée [Evolution of the problems and methods of applied geophysics]: 1e Cong. Mondial Pétrole, Paris, June 1937; 9 memoirs on geophysical prospecting, 18 pp.

Evolution of applied geophysics in the last 20 years has been marked by a change from the direct prospecting for useful minerals, based on their specific physical properties, to indirect prospecting with the purpose of indicating the structural and lithological conditions of the subsoil, leaving it to the geologist to decide whether the mineral sought is likely to be present.

There are two aspects of geophysical investigation: tectonic geophysics, whose aim is to get an idea of the outlines of the different formations, and stratigraphic geophysics, where the age of the formations and the facies have to be considered.

The problem set before geophysicists is to determine the law of distribution, in a three-dimensional underground volume, of a certain physical parameter in function of measurements made at the surface on the corresponding field. As the direct solution of the problem is generally impossible, the usual procedure consists in supposing a certain number of subterranean distributions of the parameter utilized, of deducing the different fields that would correspond at the surface to each of these, and of seeking coincidences between one of these calculated fields and the experimentally observed field. The question is discussed whether a superficial and single distribution of the field could not correspond to several different spacial distributions of the parameter, in which case the geophysical results would remain undetermined, and the intervention of the geologist, and, if necessary, of the driller, becomes necessary.—*From the English abstract, condensed by W. A.*

4392. Schmerwitz, Gerhard, Das abweichende Verhalten der Dämpfungskopplung von den bekannten Kopplungserscheinungen [The irregular behavior of damping-coupling as compared with the known coupling phenomena]: Annalen der Physik, 5 Folge, vol. 30, no. 3, pp. 209–223, Leipzig, 1937.

Close investigation of damping-coupling of two systems, which has not heretofore been made in detail, was instigated by an example in geophysics, that of coupling a seismometer with a galvanometer. It was proved that the new couple-frequencies manifested in the two systems were not moved apart as in the known cases of coupling of force and acceleration, but, on the contrary, they approached a common intermediate value depending on the coupling-factor. When the original frequencies were equal they remained unchanged even when the coupling was most rigid; this also is in contradiction with coupling phenomena so far known.

The damping constants here showed a behavior almost similar to that displayed by frequencies in other cases, by moving, depending on the degree of coupling, far apart also in the case of a common original value; that is, the system became almost undamped.

This kind of coupling prevailed also in all electrical circuits in which two measuring instruments of the galvanometer type were inserted at the same time, for example, an ammeter and a voltmeter. If preliminary conditions of close coupling are observed, considerable changes in the function of measuring instruments may appear under certain conditions, when measurements and registrations are made during short periods of time.

Careful consideration of damping-coupling is absolutely necessary not only in the geophysical case mentioned and in a general phys cal case, but also, as it is shown, in other important technical applications.—*Author's abstract, translated by W. A.*

4393. Smit-Sibinga, G. L., On the relation between deep-focus earthquakes, gravity, and morphology in the Netherlands East Indies: Gerlands Beitr. Geophysik, vol. 51, no. 4, pp. 402–409, Leipzig, 1937.

The irregularities in the distribution of deep earthquake foci in the Netherlands East Indies remarkably coincide with gravimetric and morphologic discontinuities in higher parts of the earth's crust, giving evidence of an intimate mutual relation and consequently a very great youth of the whole complex of phenomena. It appears that an Asiatic and an Australian deep-focus plane, each with increasing focal depth continent-inward, interfere where the youngest crust movements have been strongest.—*Author's abstract.*

4394. Sokolov, V. A., Contribution to the question of the interpretation of gas surveys [in Russian]: Neftianoe Khoziaistvo, vol. 18, no. 12, p. 67, Moscow, 1937.

Some additional considerations in interpreting the results of gas surveys and in determining the location of the borings are given. (See also Geophys. Abstracts 79 and 87, nos. 2863 and 3463.)—*W. A.*

4395. Takahasi, Ryutaro, and Nagata, Takesi, Geophysical studies of volcano Mihara, Oosima Island; the general aspect of physical conditions in the crater: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 15, no. 4, pp. 1047–1053, 1937.

The results of a topographic survey of the crater of the Mihara volcano were reported in a previous paper (see Geophys. Abstracts 92, no. 4136). A re-survey of the topography of the interior of the pit made in August 1937 is described in the present paper, as the changes in the interior of the pit, especially those in deeper parts, reflect clearly the activity of the volcano. The results of the re-survey are given in three tables and a vertical section of the crater.—*W. A.*

4396. Visser, S. W., Deep focus earthquakes and anomalies of terrestrial magnetism and gravity: Terres. Magn. and Atmos. Electr., vol. 42, no. 4, pp. 361–362, Baltimore, Maryland, 1937.

A map of the world contains data of the anomalies of the vertical component and the principal deep-focus regions. Anomalies of gravity are also noted. It is suggested that the three effects may have a common origin in the current systems of the inner earth. Large current systems must be present in the earth's interior, downwards below the oceans and upwards below the continents.—*G. E. A., Sci. Abstracts, vol. 41, no. 483, 1938.*

4397. Weiss, Oscar, The theory of rock bursts and the possibilities of geophysical methods in predicting rock bursts on the producing mines of the Wit-

watersrand: Chem., Met., Min. Soc. South Africa Jour., vol. 38, no. 7, pp. 273–329, Johannesburg, January 1938.

The paper is the first attempt in applying the mathematical theory of elasticity to problems of deep-level mining. The present treatment of the problem being mostly new, the writer had to start his explanations with the elementary principles of the theories; for the same reason it was also thought advisable to present fully the most important data supporting statements of practical significance.

It is proved that the behavior of rocks under a given load depends on the instantaneous values of the moduli of elasticity (Young modulus, rigidity and Poisson's ratio) and on the time factor. The values of these moduli vary with the pressure; therefore, if the normal values are known, it is possible to obtain information about the internal stresses of rock masses through the determination of the variation of the moduli of elasticity as a function of the pressures and of the time. As the elastic moduli decrease with increasing pressures, the behavior of the same types of rocks must be different at greater depths as compared with shallower horizons. Adams' and Coker's experiments show a decrease of about 40 percent in the elasticity and rigidity of certain rocks in the pressure range of 2,000 to 5,000 pounds. Thus the rocks are more brittle and less rigid in deep mines, resulting in lower costs in the breaking of rocks. At the same time the lower values of elasticity and rigidity have to be considered in the designing of pillars and handling of remnants. The same rocks may behave as rigid or as plastic solids, depending on the distribution of the pressures. Therefore, instead of speaking of rigid or plastic rocks, it is more correct to refer to the rigid or plastic state of rocks. Plastic state can only be produced by differential pressures, and the existence of "flow" in rocks is the proof of the presence of lateral pressures in deep mines. If the maintenance of plastic state is desired, and if sufficient vertical pressures existed, it is necessary to encourage the development of lateral pressures through methods of support and through the arrangement of excavations.

Elastic hysteresis is a further important factor governing the behavior of rocks, especially in connection with the accumulation of internal stresses. During the loading of rocks a certain amount of energy is put into the material, but during unloading a portion of the energy remains unrecoverable. This means the modification of Hook's law, because although a greater part of the strain occurs almost instantaneously, as soon as the force is applied the total amount gradually increases with time. If loads are repeatedly applied, at intervals much shorter than that required for the dissipation of the residual stresses of hysteresis, internal stresses will gradually accumulate and reach very high values. Rock bursts only release a portion of the stresses, and the accumulative effect of hysteresis is one of the most important factors in preventing the elastic equilibrium in mine workings.

Temperature variations produce minute fissuring in the surface of the rocks, while at the same time humidity penetrating into this weakened portion decreases the elasticity of the "skin" of the rocks. It is shown that in sandstone, with a water content of 2 percent by weight, the Young modulus may decrease by as much as 65 percent. It is thought that the use of a water- and air-tight elastic paint would prevent the penetration of moisture and may reduce much of the "flaking" and "spitting" of rocks.

The determination of the strength of rocks has to be fully investigated. Ordinary crushing tests furnish very little useful data as to the behavior of rocks at great depth. It is shown that a limestone of the ordinary crushing strength of about 33,000 pounds withstood 100,000 pounds of pressure in experiments when lateral support was available. At the same time a granite of the crushing strength of about 27,000 pounds withstood pressure of about 200,000 pounds. It can thus be seen that the strength of these rocks in resisting the deformation of inside cavities was many times greater than the crushing strengths. Based on this and other experimental data, it can be stated that excavations in the hard and compact Witwatersrand quartzites are likely to resist pressures much higher than those generally accepted.

The rupture of rocks is governed by the instantaneous values of the moduli of elasticity. The surfaces of maximum shear are the surfaces of weakness along which the rocks break. The shape of these surfaces can be determined from the values of the moduli of elasticity. If the difference between the radial and axial stress is the maximum principal stress difference, then the surfaces of maximum shear consist of two systems of cones of 45°, cutting each other orthogonally. One such system can be imagined as a pile of glass funnels fitting into each other. If the maximum principal stress difference is due to that between the radial and transverse stress, the surfaces of maximum shear are formed by two systems of orthogonal cylindrical surfaces, the cross section of which shows equiangular spirals cutting the radii at 45°. And finally, the maximum principal stress difference of the transverse and axial stress produces helicoidal surfaces, the traces of which are known as the Lüders' lines.

The phenomena of "arching" are due to large radial and transverse stress differences. The rocks are sheared between intersecting cylindrical surfaces, showing in cross section intersecting equiangular spirals. The rocks break loose between the surfaces of maximum shear producing the shape of arching. In the hanging wall the gravity will assist the breaking of the sheared blocks and arching will easily develop, but according to the nature of anisotropy of rocks, arching may develop in different directions.

The existence of extra stress surrounding excavations is shown in the case of cylindrical and spherical cavities. The extra stress on the wall of a cylindrical cavity is double the normal pressure which may exist in the surrounding rocks. For a spherical excavation the extra stress is one and a half times the normal pressure in the rocks. The pressure and the dimensions of the excavations, together with the moduli of elasticity of the rocks, determine the conditions of equilibrium of underground excavations. It is proved that spherical cavities can stand considerably higher pressures than cylindrical holes.

The phenomena of "doming" are explained on the basis of the conditions of equilibrium of the mathematical theory of elasticity. The equations of critical pressures demonstrate that if the radius of an excavation is enlarged, the critical pressure is lowered; therefore, if the outside pressure was already too high for the original size of the cavity, equilibrium in homogeneous material cannot be reestablished through the enlargement of the cavity, unless the shape of the excavation is changed to one approaching the sphere. Thus the "doming" is the tendency of the collapsing excavation to take up spherical shape under outside pressures higher than the critical pressure of the original cavity.

The phenomena of strain bursts are caused by stress differences produced in the immediate wall of the rocks. The causes are the extra stress of cavities, breaking of rocks along the surfaces of maximum shear, minute fissuring through temperature changes and blasting, coupled with the effects of humidity. The result is that portions of the "skin" of the rocks have much lower elasticity than that inside the rocks, thus breaking, "flaking," and "slabbing" of the exposed surfaces of rocks take place.

In crush bursts, the potential energy accumulated through elastic hysteresis changes into kinetic energy. In the major crush bursts terrific forces, accumulated outside the excavations in the solid rocks, act upon the excavations as an earthquake acts upon buildings. In minor crush bursts the stresses accumulate inside solid pillars and remnants, and these internal forces destroy or damage the rock bodies inside mine excavations. Stresses of hysteresis, produced by mining activities, are responsible for the crush bursts in the Rand; elastic hysteresis caused by orogenetic forces is responsible for great tectonic earthquakes in other parts of the world. Owing to the common cause the theoretical deductions regarding hysteresis and results of observations on tectonic earthquakes can be applied to the problem of crush bursts. From the theory of the hysteresis so obtained, it can be seen that certain accessory phenomena take place before and after every crush burst. Through the proper understanding of the nature of the premonitory phenomena, it may be possible to achieve the prognostication of crush bursts. For this reason, measurements of several of the most important accessory phenomena are suggested by the writer, together with important modifications in the methods and instruments. The measurements are carried out inside diamond drill holes. By so doing, observations can be made directly inside the immediate walls and in the solid rocks of the main walls. Their behavior can be studied independently, and it is also possible to study differential phenomena (differential movements, differential velocities, etc.), between the solid rocks and immediate walls. Up to now, all the measurements were limited to observations on the immediate walls. This being composed of more or less independent blocks (sheared and fissured rocks), their behavior often varies from block to block. The new method of measurements has obvious advantages. The instruments are of electrical type. The use of seismographs and new types of strain-meters is suggested. These instruments are enclosed in strong steel tubes, which can be inserted into the small boreholes. The instruments are water- and air-tight. The electrical impulses into which the accessory phenomena are converted are conducted to a central recording station in the mine. It is possible to control several instruments, set up in different portions of the mine, from the same recording station. It is thus possible to obtain records of the variations of the following premonitory phenomena:

1. The velocity of artificial seismic waves inside the rocks. The instantaneous value of this velocity is a simple function of the elastic constants. Therefore, from the values of the former, the variations of the latter can be obtained. The analysis of the frequency and amplitude of seismic waves will provide further measures as to the development of internal stresses in rocks. It is possible to locate zones of abnormal low velocity, which are the zones of maximum stress.

2. To each zone of maximum internal stress belong zones in the mine within which stopes, pillars, and remnants will suffer maximum damage

from major crush bursts of given foci. Methods and instruments for the determination of this mechanical coupling are suggested by the writer.

3. The fundamental period of pillars and remnants can be measured. If minor crush bursts occurred without destroying pillars and remnants, subsequent measurements will show abnormal increase in the periods, if the rock mass has suffered serious damage.

4. The theory of hysteresis proves characteristic variations in the frequency of occurrence of accessory tremors preliminary to crush bursts. The recording of these data by means of special automatic instruments is explained.

5. From the results of theory and evidence of observations, it is pointed out that the final stage of a crush burst consists of differential movements between the collapsing immediate walls and the solid rocks of the main wall. It follows that the study of these differential movements would be of the utmost importance in the prognostication of crush bursts. A new instrument, the linear strain-meter, is fully described.

6. Amongst the accessory phenomena, the recording of temperature changes inside the rocks deserves attention. It can be expected that characteristic temperature changes take place when the state of rocks changes from isothermal into adiabatic conditions; in other words, when the slow accumulation of potential energy gives way to more rapid kinetic phenomena. The measurements can be done by means of thermocouples, or electric resistance thermometers.

7. It may be possible that the variation of internal stresses may modify the distribution of an electrical field in the rocks. It is explained that by measurements of potential drops between two fixed electrodes, changes in the electrical field may be detected.

The theoretical study of the behavior of rocks in deep mines resulted in new explanations concerning various important phenomena observed in mines. This knowledge, together with the now available improvements in technique and instruments open up definite possibilities for the studying of rock burst phenomena, and for the prediction of the moments and intensity of crush bursts in deep mines.—*Author's abstract.*

4398. Weiss, Oscar, Rock bursts on the Rand: South African Min. Eng. Jour. vol. 48, no. 2349, pp. 741–743, Johannesburg, 1938.

Possibilities of geophysical methods in predicting rock bursts on the producing mines are discussed as an interesting new field for further research. For the detailed summary of the paper, see abstract no. 4397, above.—*W. A.*

8. GEOLOGY

4399. Basgan, I., Bohrungen im Vorlande des Oelgebietes von Rumänien [Borings in the foreland of the Rumanian oil region]: Bohrtech. Zeitung, vol. 55, no. 11, pp. 309–313, Vienna, 1937.

There are a number of promising areas. In the Siebenbürger (Transylvanian) Basin it is hoped to find oil below the gas horizons. The Marmaross district in the north and the Carpathian foreland in Moldavia are other prospective regions. In the Flysch zone the oil horizons are principally in the Eocene, in the marginal zone of the Flysch they are in the Eocene and Oligocene, whilst to the south of the central Carpathians the Miotic and Dacic (Miocene) are the most productive horizons in Rumania. Their continuation southward forms the foreland which

reaches to the Danube. Recently, two new areas have become noteworthy, Buçsani and Margineni-Olari. Both fields are some 6 to 10 km south of Moreni-Gura Ocnitzei. The Buçsani anticline has a diapiric form with Helvetian and salt in the core, and Meotic, Pontic, and Dacic above. There are three oil sands in the Meotic. The anticline has a general east-to-west trend, with a slight swing to the northeast, and plunges to the west. The Buçsani crude has a paraffin base and a specific gravity varying between 0.806 to 0.850.

The Margineni field is not so well known, and the possibility exists that it may extend beyond its present limits.

Gravity surveys made by the Geological Institute, and supplemented by the work of the oil companies, have shown several anticlines in the foreland of the oil region, along a zone south of the line Ploesti-Targoviste. A number of test wells have as yet given no positive results.—*S. E. C., Inst. Petroleum Technologists Jour., vol. 24, no. 173, 1938.*

4400. Bornhauser, Max, and Bates, F. W., Geology of Tepetate oil field, Acadia Parish, Louisiana: Am. Assoc. Petroleum Geologists Bull., vol. 22, no. 3, pp. 285–305, 1938.

The Tepetate field, located in the Gulf Coast area of Louisiana, was discovered by the Continental Oil Co. in July 1935. The presence of a structure was first indicated by a gravity minimum found by the Tepetate Oil Co. The producing sand, encountered at an average depth of 8,300 feet, occurs in the lower Marginulina zone. This zone has been assigned to the Middle Oligocene, but more recently considered to be of Lower Miocene age. The Tepetate field is a deep-seated salt dome structure, with at least 250 feet of closure at the producing level. No faults have been found crossing the field proper; however, faults with considerable displacement were established north and east of the field, thus indicating that the present outline of the dome may be only a part of a much larger structure. The productive area embraces approximately 1,200 acres.—*Authors' abstract.*

4401. Croll, I. C. H., Prospecting for oil in Australia: Min. and Geol. Jour., Government of Victoria, vol. 1, no. 2, pp. 57–65, Melbourne, 1938.

General outline of the work done or in progress in Australia in prospecting for oil is given. In discussing the general principles for determining areas suitable for oil prospecting, the following five conditions are mentioned which must be fulfilled before a commercial supply of oil can be accumulated in reservoir beds: (1) The rocks must have a good effective porosity; (2) the permeability must be high enough to allow the oil to flow through the rock when the reservoir is tapped by boring; (3) there must be an impervious layer over the reservoir rocks to prevent the escape and dissipation of the oil; (4) structural, stratigraphic, or physical conditions must be favorable for the accumulation of oil within a circumscribed area; (5) there must be little or no igneous activity or violent crustal movement following the accumulation of oil in a reservoir. From these requirements ideal conditions for locating oil fields are derived.

After discussion of the prospecting methods (geological and geophysical), and of the developmental work, it is concluded that the formations in Australia most likely to be oil bearing are those younger than Carboniferous.

Investigations and possibilities of finding oil in Victoria, South Australia, Western Australia, New South Wales, and Queensland, are described.—*W. A.*

4402. Hake, B. F., Geologic occurrence of oil and gas in Michigan: Am. Assoc. Petroleum Geologists Bull., vol. 22, no. 4, pp. 393–415, 1938.

The age of the oil- and gas-bearing rocks in Michigan ranges from Mississippian to Ordovician, and one gas occurrence is doubtfully in the Pennsylvanian. Gas is also locally present in the glacial drift where it has presumably accumulated from immediately underlying Paleozoic rocks. Oil is known to occur in eleven distinct horizons of which nine have proved productive, and gas occurs at nine separate horizons of which five are being actively exploited.

Deep wells have disclosed the general features of the stratigraphy of the State. The results of drilling indicate that in the deepest parts of the Michigan basin the oldest known sediments likely to contain oil and gas will be found at depths not exceeding 10,000 feet.

Examination of samples has shown the presence of several types of porosity, most of which are in some manner associated with dolomite. It is suggested that adequate knowledge of the manner in which dolomite has been formed would probably provide some valuable clues to the origin of petroleum.—*Author's abstract.*

4403. Willis, Bailey, Asthenolith [melting point] theory: Geol. Soc. America Bull., vol. 49, no. 4, pp. 603–614, 1938.

An asthenolith is defined as a body of magma locally melted anywhere, at any time during geologic past and present, within any solid portion of the globe. Melting is attributed to generation of heat by atomic (radioactive) disintegration. The author describes: (1) The theory; (2) Factual background; (3) Energy source; (4) Growth and ascent; (5) The time factor; (6) Varied conditions of origin; (7) Some suggested effects (epeirogeny, isostasy, metamorphism, orogeny, volcanoes); (8) A tryout. A list of works to which reference is made is added.—*W. A.*

9. NEW BOOKS

4404. Bubnoff, Serge von, editor, Geologische Auswertung einer erdmagnetischen Vermessung in Vorpommern [Geological interpretation of earth magnetic measurements in southwestern Pomerania]: Mitt. Geol.-pal. Inst. Univ. Greifswald, Bergr. v. O. Jaekel, no. 11, 48 pp., 5 figs., Greifswald, L. Bamberg, 1937, RM. 1.50.

Magnetic vertical intensity Z was measured by Schlomka, Schmücking, Stehmann, and Sörensen in 1935–36, at 357 stations in the vicinity of the University of Greifswald in the triangular area covering 1,748 square kilometers, which is bounded by the Baltic Sea and a line through Stralsund, Grimmen, Demmin, Treptow, Zussow, and Wolgast. The main results are given.—*W. A.*

4405. Handbuch der Geophysik [Handbook of geophysics]: Verlag von Gebrüder Borntraeger, Berlin, W. 35 Koester Ufer 17.

The 10 volumes listed below have been issued thus far.

Vol. 1, Die Erde als Planet [The earth as a planet].

Part 1: Introduction, by Beno Gutenberg; Development of the solar system and of the earth, by F. Nölke; Position and movement of the

earth in the universe, by Dr. Milankovitch; Figure of the earth, density, and pressure inside of the earth, by F. Hopfner. vii, 308 pp., 41 figs. 1931. Price, RM. 45.

Part 2: Tidal forces, by J. Bartels; Tides of solid earth's crust, by F. Hopfner; Rotatory movements of the earth, by Dr. Milankovitch. Secular pole displacements, by Dr. Milankovitch. v. 191 pp., 35 figs. 1933. Price, RM. 30.

Part 3: Variations of latitude, by W. D. Lambert; Theory of terrestrial field of gravity, by E. A. Ansel. iv, 230 pp., 13 figs. 1934. Price, RM. 31.

Part 4: Gravity observations; Plumb line deviations; Problem of isostasy; by W. Heiskanen. xv, 240 pp., 84 figs. 1936. Price, RM. 31.

Reduced price for the four parts stitched together, RM. 110.

Vol. 2, Aufbau der Erde [Structure of the earth].

Part 1: Cooling and temperature of the earth, by B. Gutenberg; Chemistry of the earth, by Georg Berg; Age of the earth; Geological periods, by A. Born; Physical structure of the earth, by B. Gutenberg. 564 pp., 183 figs. 1931. Price, RM. 85.

Part 2: Geological structure of the earth, by A. Born. 303 pp., 221 figs. 1932. Price, RM. 57.50.

Part 3: Surface of the earth, by Erwin Kossinna; Petrographic structure of the earth's crust, by S. Rösch; Chemistry of meteors, by G. von Hevesy. xvi, 237 pp., 62 figs. 1933. Price, RM. 35.

Reduced price for the three parts stitched together, RM. 142.

Vol. 3, Veränderungen der Erdkruste [Changes in the earth's crust].

Part 1: Forces in the earth's crust, by B. Gutenberg; Plutonism and volcanism, by F. von Wolff; Movements of the earth's crust, by A. Born; Geotectonic hypotheses, by B. Gutenberg; Mechanical effects produced by ice on the earth's crust, by Hans Hess. 570 pp., 207 figs. 1930. Price, RM. 60.

Part 2: Expected: Mechanical effect produced by water and wind; Sandy beaches; Knowledge of the soil; Disintegration; by Ernst Kraws.

Vol. 4, Erdbeben [Earthquakes].

Part 1: Theory of earthquake waves; Observations; Disturbance of the ground; by B. Gutenberg. 298 pp., 146 figs. 1929. Price, RM. 27.50.

Part 2: Seismometer; Evaluation of diagrams; by H. P. Berlage, Jr.; Geology of earthquakes, by A. Sieberg. 387 pp., 255 figs. Price, RM. 37.50.

Part 3: Geography of earthquakes, by A. Sieberg. iv, 319 pp., 113 figs. 1932. Price, RM. 70.

Part 4: Temporal succession of earthquakes and causes of release of earthquakes, by Dr. Conrad. xii, 179 pp., 49 figs. 1932. Price, RM. 32.50.

Reduced price for the four parts stitched together, RM. 134.

Vol. 5, Magnetische und elektrische Erscheinungen [Magnetic and electrical phenomena].

Expected: Terrestrial magnetism, by J. Bartels; Aurora borealis, by C. Störmer; Earth currents; Atmospheric electricity; Radiation, by O. H. Gish and members of the Department of Terrestrial Magnetism, Washington, District of Columbia.

Vol. 6, Geophysikalische Aufschlussmethoden [Geophysical methods of prospecting].

Part 1: Properties of rocks, by H. Reich; Electrical methods of prospecting, by H. Hunkel; Theory of gravimetrical methods of prospecting, by E. A. Ansel; Instruments of gravimetrical methods of prospecting, part 1, by O. Meisser. 312 pp., 134 figs. 1931. Price, RM. 52.50.

Part 2: Conclusion of O. Meisser's article; Magnetic methods, by Dr. Heiland. (In preparation.)

Part 3: Expected: Other methods, by Dr. Heiland; Utilization of the methods, by H. Reich.

Vol. 7. Physik der Hydrosphäre [Physics of hydrosphere].

Part 1: The ice of the earth, by Hans Hess; Seas, by William Halbfass; The underground water, by W. Koehne. 252 pp., 54 figs. 1933. Price RM. 35.

Part 2: Physics of the rivers, by Eng. P. Nemeny; Methods and instruments of oceanography, by Georg Wüst; Tides, shoals, by Albert Defant. (In preparation.)

Vol. 8. Physik der Atmosphäre, I [Physics of atmosphere, I].

Expected: Aerological methods of observation, by Dr. Duckert. Meteorological optics, by Dr. Meyer; Twilight phenomena, by Dr. Gruner; Theory of diffuse reflection and polarization, by Anna Schirmann; Radiation measurement instruments and extinction of radiation, by Dr. Linke; Short wave radiation; Ozone; by Dr. Götz; Periodical processes and tides in the atmosphere, by Dr. Weickmann.

Vol. 9. Physik der Atmosphäre, II [Physics of atmosphere, II].

Part 1. Expansion of atmosphere; Propagation of sound; by B. Gutenberg; Heat content of the stratosphere, by Dr. Tichanowski, with supplements by Dr. Mügge. v. 172 pp., 73 figs. 1932. Price, RM. 30.

Part 2. Thermodynamics and dynamics of atmosphere; atmospheric circulation, by G. Stüve.

Part 3. Astronomical theory of the earth's historical climates, by Dr. Milankovitch; Climate of aerial layers close to the ground, by F. Steinhauser. (In preparation.)

Vol. 10. Allgemeines [Generalities].

Expected: Influence of geophysical phenomena on living beings, by N. N.; Determination and reality of periodicities; Correlations, Methods of calculation, by Dr. Pollack; Statistical methods, Functions, Formulas, Units, Tables, by J. Bartels.

Detailed prospectuses on single works may be obtained free of charge.

4406. Earthquake notes, Bodle, R. R., editor, vol. 9, no. 3, 12 pp., and no. 4, 8 pp., Seismol. Soc. America, Eastern section, Washington, December 1937 and March 1938.

Number 3 contains the following notes: (1) Concerning the vibrations of a layered earth [abstract], by L. B. Slichter; (2) Local earthquakes in northeastern America from July to December 1937, by L. D. Leet; (3) A résumé of local shocks around New York, by Joseph Lynch; (4) The Illinois Basin earthquake of November 17, 1937, by A. J. Westland; (5) Testing equipment for electromagnetic seismometers, by H. E. McComb; (6) Seismological tables and epicenter determination, from The Observatory, London, A monthly review of astronomy, no. 762, vol. 60, November 1937; (7) A useful invention, from San Jose Mercury for June 21, 1866, furnished by R. R. Lukens, Inspector-in-Charge, U. S. Coast and Geodetic Survey field station at San Francisco, California; (8) Deep-

focus earthquakes in the southwest Pacific, from Nature, London, no. 3550, vol. 140, Nov. 13, 1937; (9) Seismographs, from Seismological Investigations, Section A, Nottingham, 1937, British Association; (10) The new globe, from Seismological Investigations, Section A, Nottingham, 1937, British Association; (11) Idaho farm sinking, from Science News Letter, Aug. 28, 1937; (12) The exploration of the earth's crust—an address given by O. T. Jones at the anniversary meeting of the Geological Society of London on February 19, 1937; (13) Papers presented at the spring meeting of the Eastern section and printed in full in the Bulletin of the Seismological Society of America, vol. 27, no. 3, July 1937; Recent seismic activity in the Department de Narino, Colombia, South America, by J. E. Ramirez; Seismic activity in the St. Marys [Missouri] fault region since 1910, by R. R. Heinrich; Two recent earthquakes in the New Madrid region; and Evidences from deep-focus earthquakes for the crustal structure of Missouri, by Florence Robertson; (14) Aftershocks in Alaska, from a report made by Duane Hall, of the station at College, Alaska; (15) World map and seismograph stations, shown in the International aspects of oceanography, oceanographic data and provisions for oceanographic research, by T. W. Vaughan and others; (16) Earthquakes discussed at American Philosophical Society meeting; (17) New station; (18) State representatives for earthquake reporting; (19) Epicenters.

Number 4 contains: (1) The Hawaiian earthquake of January 23, 1938, from a report made by J. H. Peters; (2) Tilt observations at Buffalo, New York, by J. P. Delaney; (3) Improvements in the seismographic equipment for the San Juan magnetic observatory of the U. S. Coast and Geodetic Survey, by H. E. McComb and J. H. Nelson; (4) Local shocks around New York, by W. A. Lynch; (5) Epicenters.—*W. A.*

4407. Report of the committee appointed to direct and control the aerial, geological, and geophysical survey of Northern Australia, for the period ended December 31, 1936: Commonwealth of Australia, Canberra. 91 pp., 12 pls. 1937. Price, 4s. 3d.

The survey was organized for the purpose of making a geological and geophysical reconnaissance of the mineral-bearing regions of northern Australia. The results of the 2 years' work justify the survey in drawing attention to the areas in which further work should be undertaken.

The geophysical work of the survey is described on pp. 67–87. It includes general notes and reports on areas. Geophysical surveys were made in several areas in Northern Territory and Queensland, and the report is submitted under three headings: General notes, Northern Territory, and Queensland. The descriptions of the areas serve to outline the results of the surveys. Plates 5 to 12, showing plans and profiles, are attached and illustrate the description of most of the areas. Detailed reports, accompanied by maps and profiles illustrating all phases of the work, are being prepared as appendices to this report.

The following methods of geophysical surveying have been applied: Electromagnetic, potential, self-potential, resistivity, and magnetic.—*W. A.*

4408. Sammlung geophysikalischer Schriften [Collection of geophysical publications], Mainka, Karl, editor: Verlag von Gebrüder Borntraeger, Berlin, W. 35 Koester Ufer 17.

Vol. 1: Physik der Erdbebenwellen [Physics of earthquake waves], by C. Mainka. viii, 156 pp., 35 figs., 20 tables. 1923. Price, RM. 11.30.

Vol. 2: Geotektonische Hypothesen [Geotectonic hypotheses], by Fr. Nölcke, Bremen. viii, 123 pp. 1924. Price, RM. 6.

Vol. 4: Die Beobachtungsmethoden des modernen Meteorologen [Methods of observation of modern meteorologists], by Dr. Robitzsch, Lindenberg. v, 125 pp., 25 figs. 1925. Price RM. 8.50.

Vol. 5: Die Frage der Periodizität der Erdbeben [Question on the periodicity of earthquakes], by Ernst Tams, Hamburg. x, 128 pp., 15 figs., 49 tables. 1926. Price, RM. 12.

Vol. 6: Analyse periodischer Vorgänge [Analysis of periodical processes], by Karl Stumpff, Breslau. x, 188 pp., 41 figs., 14 tables, 1 pl. 1927. Price, RM. 17.

Vol. 7: Die magnetischen Verfahren der angewandten Geophysik [Magnetic methods of applied geophysics], by Hans Haalck. vii, 150 pp., 61 figs., 3 tables. 1927. Price, RM. 15.

Vol. 8: Elektrische Bodenforschung, ihre physikalischen Grundlagen und ihre praktische Anwendung [Electrical investigation of the ground, its physical foundation and practical application], by Walther Heine. viii, 222 pp., 117 figs. 1928. Price, RM. 22.50.

Vol. 9: Einführung in die atmosphärische Elektrizität [Introduction to the atmospheric electricity], by K. Kähler. viii, 244 pp., 16 figs. 1929. Price, RM. 22.

Vol. 10: Die gravimetrischen Verfahren der angewandten Geophysik [Gravimetrical methods of applied geophysics], by Hans Haalck. viii, 205 pp., 85 figs. 1930. Price, RM. 21.

A reduction of 20 percent in the prices of single volumes is made on subscriptions for the whole collection.

4409. Spitaler, Rudolf, Die Hauptkraft der geologischen Erdgestaltung [The leading force in geological formation of the earth], 38 pp., 5 figs., Reichenberg i. B., Franz Kraus, 1937. Price, RM. 1.50.

This is a brief presentation of the investigations previously made by the author on the geophysical and geological effects of oscillations of the poles.—*W. A.*

4410. Tams, Ernst, Grundzüge der physikalischen Verhältnisse der festen Erde, ihre Beziehungen zur geologischen Gestaltung des Erdantlitzes [Principles of physical conditions of continents, their relation to the geological formation of the surface of the earth], xvi, 377 pages, 8 tables, 34 figs., Verlag von Gebrüder Borntträger, Berlin. 1937. Two parts, price RM. 30.

Part 1: Size, form, and constitution of the earth, its thermal and gravimetric relations.

Contents: Size and form of the earth; Horizontal and vertical structure of the earth's surface; Constitution of the earth in general; Density, pressure and elasticity conditions; Chemical composition of the earth; Constitution of the earth's crust; Density and distribution of pressure; Seismo-physical conditions; Material constitution of the outer envelope; Thermal conditions of the earth; Age of the earth; Temperature conditions inside of the earth; Heat content of the earth; Absolute periods of time of the geological development of the earth; Gravity distribution on the earth and mass-stratification of the earth's crust; Normal distribution of gravity on the earth; Mass stratification of the earth's crust.

Part 2: Endogenous processes of movement and their manifestation, and Geological structure and terrestrial magnetism.

Contents: Nature of the endogenous processes of movement; Endogenous processes based on the heat movement in the earth; Horizontal forces of displacement; Pole-movements; Other physically and chemically produced endogenous processes; Special conditions for development of large forms of the earth's surface; Manifestations of the endogenous processes of movement (volcanism, earthquakes, horizontal displacements); Causes of volcanism; Causes of earthquakes; Frequency and intensity of volcanic and seismic manifestations; Horizontal displacements; Geological structure and terrestrial magnetism; Principles of terrestrial magnetism; Relation of the terrestrial magnetic field to the constitution of the underground.—*W. A.*

4411. Tolman, C. F., Ground water, 593 pp., 189 figs., New York, McGraw-Hill Book Co., 1937. Price $6.

A detailed review of the book is given by O. E. Meinzer, of the U. S. Geological Survey, in the Bulletin of the American Association of Petroleum Geologists, vol. 22, no. 4, pp. 490–494, 1938. He writes: "Professor Tolman's volume fills a need that has long been recognized for a comprehensive textbook in this country on the subject of ground water. It should be of distinct value in making available the results of the large amount of scientific study and investigation that has been given to this important subject, and should speed the day when it will be included among the essential courses in the departments of geology in the large universities and institutes of technology."

Discussions on geophysical methods of prospecting for ground water, by J. J. Jakosky and C. A. Heiland, are included.—*W. A.*

10. PATENTS

4412. Gravitational instrument; Stephan Baron von Thyssen-Bornemisza, The Hague, Netherlands: U. S. patent 2,108,421, issued February 15, 1938.

This invention relates to a measuring instrument for the determination of variations of the gravitational acceleration having a lever system comprising a beam comprising one part lying substantially horizontal and a second part extending obliquely upwards, a mass attached to the end of the horizontal portion, a spring attached to the end of the obliquely positioned portion, a knife edge upon which the beam is pendulating, and a connection for the lower end of the spring. Claims allowed, 3.

4413. Apparatus for electrical prospecting; Theodor Zuschlag, West Englewood, New Jersey, assignor to Hans T. F. Lundberg, Montreal, Quebec, Canada: U. S. patent 2,108,463, issued February 15, 1938.

This invention relates to apparatus comprising a plurality of pick-up coils, a plurality of potentiometers, and a plurality of phase transformers, said elements being electrically connected in such a way that current induced in the coils produces a potential across the potentiometers and energizes the transformers, and the sliders of said potentiometers being connected with each other and movable in such a way that the impedance of each of the two coil circuits as a whole remains constant. Claims allowed, 4.

4414. Apparatus for making geophysical measurements; Franz Julius Gerhard Neumann and Werner Rudolf Haubold, Houston, Texas, assignors to the Salt Dome Oil Corporation, Houston, Texas, a corporation of Delaware: U. S. patent 2,110,577, issued March 8, 1938.

This invention relates to a float for access to a geophysical instrument, said instrument being supported from the bottom underlying a body of water upon the earth's surface which comprises a plurality of elements of wood capable of floating, said elements being framed together substantially evenly to distribute the mass of the wood in the horizontal plane and substantially symmetrically about a central opening in the float, said central opening being so formed as to provide space for support therein of said instrument clear of said float, said central opening and the spaces between said elements being clear at the bottom side of the elements for the water to rise to a common level in said spaces and in the central opening when said float is floating upon the water. Claims allowed, 13.

4415. Seismometer; Henry Salvatori, Hollywood, California, assignor to Western Geophysical Co., Tulsa, Oklahoma, a corporation of Delaware: U. S. patent 2,111,643, issued March 22, 1938.

This invention relates to a device for detecting the movement of material in contact therewith, including a frame, means carried by said frame defining a magnetic circuit of variable reluctance, said means comprising a first member of magnetic material adjacent to said first member, at least one of said members comprising a magnet, means causing said first member to move in unison with said frame, said members having spaced, juxtaposed substantially parallel faces each overlapping the other and defining at least one gap there between, and means effective to constrain said inertia member to a path causing the spaced juxtaposed overlapping faces to move substantially parallel to each other in response to the movement of material in contact with said frame thus causing said gap to vary in area without varying in length to produce a change in the reluctance of said gap, and an electric circuit coupled with said magnetic circuit. Claims allowed, 17.

4416. Method and apparatus for comparing electrical transients; Louis Statham, Houston, Texas, assignor to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,113,749, issued April 12, 1938.

This invention relates to the method for the determination of electrical properties of matter which comprises initiating a difference in potential between each pair of at least two pairs of spaced electrodes on the matter whereby a transient is obtained for each pair of electrodes and observing a resultant of the several transients. Claims allowed, 20.

4417. Method for electrically investigating subterranean strata; Ralph W. Lohman, South Pasadena, California, assignor to Elliott Core Drilling Co., a corporation of California: U. S. patent 2,114,056, issued April 12, 1938.

This invention relates to the method of determining the character of subterranean formation adjacent to a bore hole which comprises: Maintaining a tunable electric circuit at the surface of the ground; supplying alternating current to said circuit; adjusting the capacitance of said circuit to tune the same to resonance; connecting said tunable circuit to a second circuit which includes a portion of said formation; and again adjusting the capacitance of the tunable circuit to tune the combination

of said first and second circuits to resonance, thereby obtaining a capacity measurement of that portion of earth formation included in said second circuit. Claims allowed, 5.

4418. Seismic surveying method; Shell Development Company, San Francisco, California, assignee of David Saville Muzzey, Jr., Houston, Texas, both in the U. S. A.: Canadian patent 370,861, issued December 28, 1937.

This invention relates to a seismic surveying system comprising a plurality of detectors electrically connected to a plurality of galvanometers, the steps of generating a disturbance in the ground, converting said disturbance into electrical impulses at each of the detectors, transmitting the impulses from all detectors to each of the galvanometers through lines having different electrical time lags for each galvanometer, and simultaneously recording the indications of all galvanometers. Claims allowed, 9.

4419. Method of detecting water intrusion in wells; Clarence R. Dale, Los Angeles, California, U. S. A.: Canadian patent 371,369, issued January 18, 1938.

This invention relates to the method of locating water bearing strata in a well comprising a uniform opaqueness in the liquid in said well, lowering a photo-electric opaqueness indicator into said well, moving said indicator through said liquid and recording variations in the opaqueness by said indicator during said movement. Claims allowed, 12.

4420. Seismic-electric prospecting system; The Standard Oil Development Co., Linden, New Jersey, assignee of Ludwig W. Blau, Houston, Texas, both in the U. S. A.: Canadian patent 371,842, issued February 8, 1938.

This invention relates to the method of ascertaining anomalies in the earth's sub-structure, which comprises creating period waves of a given frequency and sending them through the ground at a given point, receiving the waves from the ground at a point removed from the sending point, recording at said receiving point a characteristic indicative of the phase and amplitude of mainly those waves which arrive at said receiving point by reflection from sub-strata, independently recording at said receiving point a characteristic indicative of the phase of the waves at the sending point, whereby the phase relation between the created waves and reflected waves of the frequency employed may be observed, then changing the frequency of the created waves and repeating the recording operations to observe the phase relation between the created waves and reflected waves at the new frequency. Claims allowed, 13.

4421. Seismic-electric prospecting system; The Standard Oil Development Co., Linden, New Jersey, assignee of Ludwig W. Blau and Louis Statham, co-inventors, both of Houston, Texas, both in the U. S. A.: Canadian patent 371,843, issued February 8, 1938.

This invention relates to the method of geophysical exploration which comprises receiving over a continuous extended volume of the ground including sub-surface strata wave energy arriving throughout the volume from a source of propagation of seismic waves, and obtaining an indication due to the effect of this wave energy on the electrical properties of the volume of ground. Claims allowed, 26.

4422. Electrical impedance measuring apparatus; The Standard Oil Development Co., Linden, New Jersey, assignee of Ludwig W. Blau, Robert R. Thompson, and Whitman D. Mounce, co-inventors, all of Houston,

Texas, both in the U. S. A.: Canadian patent 371,844, issued February 8, 1938.

This invention relates to an apparatus for measuring changes in electrical impedance of the ground due to seismic disturbances, spaced electrodes in the ground, means for passing electric current of given frequency through an extended volume of the ground between the electrodes whereby change in the electrical impedance of the ground due to the disburbances varies the amount of current flowing through the volume, means for amplifying the variations in current, and means for recording the variations in current. Claims allowed, 10.

4423. Seismometer; The Western Geophysical Co., Los Angeles, assignee of Henry Salvatori, Hollywood, both in California, U. S. A.: Canadian patent 372,966, issued April 5, 1938.

This invention relates to a seismometer comprising a frame, a magnetic circuit, said magnetic circuit including a member rigidly mounted to move with said frame and an inertia member, means resiliently supporting said inertia member, each of said members having a face disposed adjacent to and substantially parallel to a face of the other of said members, said faces being separated by a gap, said resilient supporting means being constructed and arranged to permit relative motion between said two faces in a plane substantially parallel to said faces and to restrain relative motion between said two faces in a direction perpendicular to said plane, thereby producing a constant length, variable area gap, and an electrical circuit coupled with said magnetic circuit. Claims allowed, 17.

4424. Seismic prospecting method; G. A. Gamburtzev: Russian patent 51,819, issued September 30, 1937.

This invention relates to the method of seismic prospecting by reflected waves consisting of causing specified oscillations interfere one with another at 180° phase displacement with the purpose that only processes in the period of their appearing act on the apparatus registering oscillations while oscillations already in action be excluded. Claims allowed, 1.

GEOPHYSICAL PROSPECTING WORK IN AUSTRALIA

By J. M. Royner

About 90 percent of the geophysical prospecting work in Australia is being done by one or other of the Australian governments, under my technical direction. The geophysical section of the Geological Survey attached to the New South Wales Mines Department is engaged on a very extensive programme at Broken Hill. The major mining companies are cooperating in this work, which is investigating the extensions of the Line of Lode and also some outside mines in the district. A geophysical examination of brown coal deposits at Moorlands in South Australia, made jointly by the Commonwealth and South Australian Governments, is nearly complete, and I am at present working on the final report.

The most extensive geophysical survey operating in Australia at present is attached to the Aerial, Geological and Geophysical Survey of North Australia. The ultimate object of this Survey is an exhaustive examination of the mineral potentialities of the northern third of Australia. The three geophysical parties attached to this Survey, are operating at present at Herberton, Queensland, in the tin-bearing reefs and deep leads deposits; at Norseman, Western Australia, in the gold bearing quartz reefs in shear zones; and at Wiluna, Western Australia (tracing of shear zones and lava flows, as gold deposits are known to occur at the intersections). This Survey publishes bulletins covering each area examined and an annual report giving a summary statement with maps of the year's work.

INDEX

The figure in parentheses refers to the class in which the entry stands; see table of contents.