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JULY–SEPTEMBER 1941

COMPILED BY
W. AYVAZOGLOU

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CONTENTS

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GEOPHYSICAL ABSTRACTS 106, JULY–SEPTEMBER 1941

Compiled by W. AYVAZOGLOU

1. GRAVITATIONAL METHODS

6127. Gibson, M. O., Network adjustment by least squares—alternative formulation and solution by iteration: Geophysics, vol. 6, No. 2, pp. 168–179, Menasha, Wis., 1941.

Given a network, as in a gravity survey, comprising observed differences in the values of adjacent points, any adjustment of the network, however obtained, is shown to be a least-square adjustment if (1) the sum of the corrected observations around any circuit is zero and (2) the sum of the weighed corrections at any junction is zero. This principle provides a means of controlling necessary approximations, such as the subdivision of a large network, and simplifies subsequent adjustments made necessary by extension or revision of the observations. It also serves in some cases to reduce the number of equations and in others to eliminate the equations entirely. The paper outlines a time-saving trial-and-error method of solving network equations, applicable to electric circuits as well as observational network problems.—*Author's abstract.*

6128. Gulatee, B. L., Gravity anomalies and the figure of the earth: India Geol. Survey Prof. Paper 30, 116 pp., 10 figs., Dehra Dun, 1940.

This publication provides an introduction to the fundamental problems concerning the figure of the earth, with special reference to recent investigations and to practical applications. It deals with various gravity formulas and gives brief proofs, reviews practical derivation of the empirical formulas, gives an account of Clairaut's, Darwin's, and de Sitter's theories of the figure of the earth, deals with gravity anomalies, summarizes the application of such anomalies to the elucidation of the geologic structure and history of those regions where they have been specially studied, discusses another application of gravity anomalies in the derivation of the form of the geoid, defines various types of reference surfaces, and shows the need for distinguishing a triangulation reference spheroid from one based on gravity anomalies.—*From a review in "Nature," vol. 147, No. 3722, London, condensed by W. A.*

6129. Gutenberg, Beno, Changes in sea level, postglacial uplift, and mobility of the earth's interior: Geol. Soc. America Bull., vol. 52, No. 5, pp. 721–772, Washington, D. C., 1941.

Records of tide gages indicate that sea level generally is rising at an average rate of about 10 cm. per century. The uplift in Tennoscandia and North America is investigated, and maps showing the rate of uplift are given. A discussion of the new material and historic evidence leaves no doubt that the uplift is a consequence of isostatic readjustment of the

equilibrium disturbed by the postglacial melting of the ice. The remaining uplift is about 200 m. in Tennoscandia and possibly more in North America, where the present rate of uplift has its maximum of about 2 m. per century in the region of Hudson Bay. Originally, the time needed to reduce the defect in mass to one-half under the regions of uplift was less than 10,000 years, but it has been increasing with time and now exceeds 20,000 years.

Theoretical investigations on the plastic flow in the interior of the earth connected with the uplift are critically discussed and extended. The movements affect the whole interior of the earth below the regions of uplift; their amplitudes decrease slowly in the upper 1,000 km. If one assumes a strong lithosphere with a thickness of about 70 km. and below the asthenosphere with a viscosity of the order of 10^{22} poises, with but little or no strength to prohibit plastic flow, there is no disagreement with observations related to isostasy of deep-focus earthquakes. Tectonic processes connected with isostatic anomalies larger than those in the regions of postglacial uplift must be connected with plastic flow at least down to the core. The importance of the effects of small forces acting during long periods is pointed out.—*Author's abstract.*

6130. Heiskanen, W., Über die Struktur und Figur der Erde [On the structure and figure of the earth]: Gerlands Beitr. Geophysik, vol. 57, No. 2, pp. 132–170, Leipzig, 1941.

The author describes the great strips of negative gravity anomalies and the zones of positive gravity anomalies on oceans and inland seas, as well as the discontinuities in anomalies at the coasts of the oceans. He shows that the Vening-Meinesz theory of folding is in accord with the strips of negative gravity anomalies and with laboratory tests made by Kuenen; that convection currents are produced and may exist inside the earth; that they may cause horizontal displacements of masses within the earth and in the earth's crust; and that, if we assume, according to Griggs, the periodicity of convection currents, the following three cycles of the formation of mountains may be explained: The geosynclinal subsidence, the accumulation of masses with simultaneous formation of roots, and the gradual raising of the earth's crust to isostatic equilibrium. He describes and illustrates Griggs' experiments confirming the hypothesis of periodic convection currents; investigates the possible three-axiality of the earth; shows that regional geoid undulations may be determined; mentions similar work conducted in the International Isostatic Institute; and discusses arguments against the certainty of isostatic gravity anomalies.—*Author's abstract, translated by W. A.*

6131. Jeffreys, Harold, The determination of the earth's gravitational field: Royal Astron. Soc. Monthly Notices, Geophys. Suppl., vol. 5, No. 1, pp. 1–23, London, 1941.

Estimation of the earth's ellipticity from observations of gravity is much complicated by the fact that the residuals against any formula including only low harmonics are far from independent. The existing observations have been treated by forming summaries of the free-air anomalies over 10° squares and reducing them to the mean height of the square, so as to eliminate the correlation of the free-air anomaly with height. There is a variation of the means so re-

duced amounting to about 22 milligals in mean square in addition to the sampling error, and this must be taken into account. The results for 10° squares are combined to give estimates for the contributions from the low harmonics over 30° squares, and hence to estimate the harmonics up to order 4. There is good evidence that some harmonics other than the main ellipticity form are present, but the data are not adequate to separate them, mostly on account of the lack of data for the South Pacific and high southern latitudes. There are signs that more of the variation is due to harmonics of degree about 6. An estimate is found for the ellipticity term, which agrees well with the international formula and with the astronomical estimate, but its standard error is over twice that found by Heiskanen, mostly on account of the allowance for the correlation between residuals within the same 10° square.—*Author's abstract.*

6132. Lawson, A. C., Isostatic control of fluctuations of sea level: Science, vol. 92, No. 2382, pp. 162–164, Lancaster, Pa., 1940.

It is shown that, because of isostasy, an increase of thickness of an ice sheet will involve a transfer of rock mass by plastic flow to the ocean with a decreased depth of water. Calculations regarding the Pleistocene Labrador ice sheet when in retreat and the raising of the level of the sea bottom are based on this view.—*R. S. R., Sci. Abstracts, vol. 44, No. 518, 1941.*

6133. Levine, S., The calculation of gravity anomalies due to bodies of finite extent: Geophysics, vol. 6, No. 2, pp. 180–186, Menasha, Wis., 1941.

A new method for calculating the gravity anomalies due to mass distributions of finite extent and simple geometrical form has been developed. The principle of the method is the construction, in a plane, of curves which represent the boundaries of the body, such that the gravity effect is directly proportional to the area enclosed by such curves. The advantage of this method for bodies of considerable extent is emphasized. This approach is more rapid than that of the sector of graticule diagrams commonly employed.—*Author's abstract.*

6134. McCollum, E. V., Water prospecting with the gravity meter: World Petroleum, vol. 12, No. 6, pp. 74–75, New York, 1941.

The writer describes several new techniques for prospecting with the gravity meter in swamps and deeper waters to 50 feet, and he mentions especially the usefulness of the underwater gravity meter, an instrument that is manufactured and used by the Mott-Smith Corporation and that is leveled and read electrically on a control panel located in the cabin of the boat in which the meter is transported. The instrument weighs approximately 350 lbs. and is lifted by a power winch and boom over the side of the boat. An observation requires only a few minutes under favorable working conditions.—W. A.

6135. Nettleton, L. L., Relation of gravity to structure in the northern Appalachian area: Geophysics, vol. 6, No. 3, pp. 270–286, Menasha, Wis., 1941.

A series of gravity stations at approximately 1-mile intervals has been established eastward from Pittsburgh and extending across the Appalachian Mountains and onto the pre-Cambrian outcrops of the Piedmont. The large folds and faults of the steeply folded region have small or negligible gravity anomalies. This is attributed to a uniform density of the rocks involved, which is verified by "density profiles."

There has been much speculation as to the relation of gravity to tectonics and present geology in the northern Appalachian area. This speculation is reviewed briefly and some relations not previously mentioned are pointed out. The major and more continuous gravity features correspond closely with the trends of Appalachian folding, as shown by a map of gravity contours superposed on the relief map of the northern Appalachian area. However, it seems probable that the source of the primary gravity features is in mass distributions rather deep within the earth's crust, which must have their origin in the tectonic forces which caused the Appalachian uplift but are not superficially evident from the surface geology of the area. Some smaller features may be related to structural or lithologic units indicated by the surface geology.—*Author's abstract.*

6136. Ruffet, Jean, Sur l'aplatissement terrestre calculé en seconde approximation [Second approximation in calculating the ellipticity of the earth]: Archives sci. phys. nat., vol. 22, Suppl. 2, pp. 115–117, Geneva, July–August 1940.

Wavre's method of uniform procedure in theoretical geodesy is used to calculate the ellipticity of the earth to the second approximation. All relevant functions—in particular the polar radius and the mass of the earth—are expanded as power series of the angular velocity. The most probable value for the ellipticity is 1/296, though the values 1/295 and 1/297 are also compatible with the calculated results.—*G. C. M., Sci. Abstracts, vol. 44, No. 519, 1941.*

6137. Tesch, H., Der Einfluss der Elastizität der Schneide und Unterlage eines Pendels auf die Schwingungszeit [Influence of the elasticity of the knife edge and of the bearing of a pendulum on the duration of oscillation]: Zeitschr. Geophysik, vol. 16, No. 6/7, pp. 289–309, Brunswick, 1940.

The author discusses the influence of the elasticity of the knife edge and of the bearing of a pendulum on the duration of oscillation. Tests have shown that pendulums with rubber knife edges and rubber bearings with different forms of knife edges decrease in the duration of oscillations in comparison with rigid knife edges and bearings. The duration of oscillations decreased inversely with the amplitude. The author explains the result by the influence of an elastic moment of disturbance. He gives the theory of the experiments and explains the results that he obtained from them.—*Author's abstract, translated by W. A.*

6138. Tsuboi, Chuji, Isostasy and maximum earthquake energy: Imp. Acad. Japan Proc., vol. 16, No. 9, pp. 449–454, Tokyo, 1940.

Two factors determine the state of isostasy: (1) The thickness of the isostatic earth's crust d, and (2) the degree of regionality R; that is, the horizontal extent of the smallest topographic feature that is supported isostatically. Although, in the study of isostasy, both d and R should be evaluated for as many regions of the world as possible, the complex trial-and-error method of computation hitherto used has been a great obstacle. A mathematical discussion by the writer shows that this obstacle may be overcome by using a method that, with the aid of the Fourier series, can estimate directly both quantities. Some of the difficulties in estimating the energy of an earthquake may be removed with the help of the instrumental earthquake-magnitude scale proposed by Richter (see Geophys. Abstracts 79, No. 2847). A table gives esti-

mates of the energies of some of the major earthquakes that have been observed by Richter and Gutenberg with the aid of this scale (see Geophys. Abstracts 87, No. 3316). From these estimates, it would seem that the maximum energy of an arthquake is 10^{25}e.—*W. A.*

6139. von Zwerger, Rudolf, Gravimetrische Untersuchungen und Probleme in rumanischen Erdölgebieten [Gravimetric investigations and problems in Rumanian oil-bearing regions]: Oel und Kohle, vol. 37, No. 5, pp. 83–91, Berlin, 1941.

After outlining briefly the beginnings of gravimetric investigations in Rumania, the writer discusses the essential results of these investigations, such as: (1) Determination of regional gradients; (2) petrographic character and density of salt formations; (3) anticlines of the Boldesti type and their connection with the time and mode of ascent of the salt; (4) anticlines of the southern foreland as an intermediate type; and (5) conclusions with regard to interpretation of minus and plus axes at other places (Ditesti).

The writer illustrates his article by gravimetric profiles, a schematic representation of gravimetric relations, and gravimetric sections of the main types of Rumanian oil structures.—*W. A.*

6140. Weiss, Oscar, Gravimetric and earth-magnetic measurements on the Great Dyke of Southern Rhodesia: Geol. Soc. South Africa Trans., vol. 43, pp. 143–151, Johannesburg, 1941.

Gravimetric and earth-magnetic measurements were carried out by the writer's organization for discovering the hitherto unknown geologic structure of the Great Dyke of Southern Rhodesia. The gravity anomalies are the largest ever published over similarly narrow widths on any continent, their maximum being 46.7 and 54.0 milligals on the two respective traverses. The interpretation of the gravity anomalies proves the existence of a heavy, slowly tapering, and very deep linear core below the exposed rocks of the Great Dyke. The average density of this core is about 3.3, and it is considered to be peridotite or possibly pyroxenite. It is suggested that the name "Dyke" is not quite correct and that the term "Abyssolith" would more accurately describe this bottomless mass of injected rocks. The magnetic results show that the contact between the granite and the Great Dyke can be located with the magnetometer. The absence of major magnetic anomalies from deep-seated sources proves that the heavy core contains little or no magnetic minerals, and therefore the iron content of the core must be in the form of silicate and not magnetite. The weak magnetic anomalies support the idea that serpentinization has not penetrated into the core of the Great Dyke and that the hydration was caused by water of meteoric origin.—*Author's abstract.*

6141. Welch, G. J., Geophysical study of the Douglas fault, Pine County, Minn.: Jour. Geology, vol. 49, No. 4, pp. 408–413, Chicago, 1941.

A gravity-meter traverse across the Douglas fault, in Pine County, Minn., has been run. Assuming the fault to be sandstone against basalt, the throw of the fault has been shown to be about 11,000 feet.—*Author's abstract.*

6142. Wilson, J. H., Gravity-meter survey of the Wellington field, Larimer County, Colo.: Geophysics, vol. 6, No. 3, pp. 264–269, Menasha, Wis., 1941.

The results of a gravity-meter survey across the Wellington field, Larimer County, Colo., both before and after elimination of the regional effect, is presented in relation to the subsurface structure of the field. The method of eliminating the regional effect is shown. This information is presented as a "case book" type, illustrating an anomaly related to local structure that is almost obscured by strong regional gradients.—*Author's abstract.*

2. MAGNETIC METHODS

6143. Anderson, C. N., Time relation between solar emission and terrestrial disturbances: New York Inst. Radio Eng. Proc., vol. 28, pp. 503–511, November 1940.

Although the correlation between general solar activity and terrestrial disturbances is quite evident, the association of individual storms with specific sunspot groups has never been very satisfactory. Disturbances sometimes have occurred when no sunspots were visible, and at other times large sunspots have been unaccompanied by any abnormal disturbances. A possible explanation of such anomalies may lie in longer transit times for the disturbing solar emission than is usually assumed. Some indication is given in this paper that these transit times may range from periods as short as only 1 or 2 days to as much as 3 months. The corresponding velocities for the above transit times are of the order of 2,000 and 20 km./sec. Curves show the approximate relation between the angle of emission, velocity, day of emission, and the days intervening between the passage of a spot through the central meridian of the sun and the corpuscular encounter with the earth,—*Author's abstract.*

6144. Chapman, S., Notes on isomagnetic charts, Part 5, The occurence of local dipoles: Terres. Magn. and Atmos. Electr., vol. 46, No. 2, pp. 163–172, Baltimore, Md., 1941.

It is shown that local magnetic dipoles occur in pairs or groups of pairs, and the nature of the isomagnetic lines and magnetic meridians is illustrated in the simpler cases. It is also shown that a local magnetic disturbance due to a single magnetic pole, if sufficiently intense, can produce one pair of dipoles and that if the disturbance is due to the field of a sufficiently intense local dipole, there may be either one or two local pole pairs, according to the orientation of the dipole. If the dipole field is due to magnetization induced in a roughly spherical mass of magnetite or iron pyrites by the existing normal field, the necessary susceptibility of the mineral, if it is to produce local dipoles, is shown to depend on the ratio of its radius to its depth, and on the local value of the normal horizontal intensity H. A classification of pole pairs according to this value of H and the distance between the poles of a pole pair is suggested.—*Author's abstract.*

6145. Commemoration of the life and work of Alexander Dallas Bache and Symposium on Geomagnetism: Am. Philos. Soc. Proc., vol. 84, No. 2, pp. 125–351, Philadelphia, Pa., 1941.

Part 1 of this volume contains six articles written by several authors on the life and work of Alexander Dallas Bache.

Part 2, a symposium on geomagnetism, includes the following articles: (1) Terrestrial electricity in relation to geomagnetism, by

O. H. Gish; (2) Magnetic survey of the United States, by N. H. Heck; (3) The significance of fossil magnetism, by A. G. McNish; (4) Geomagnetic observatories and instruments, by H. E. McComb; (5) Magnetic work at sea, by H. F. Johnston; (6) Geomagnetism: World-wide and cosmic aspects with special reference to early research in America, by J. A. Fleming; (7) Aurora and geomagnetism, by C. W. Gartlein; (8) Contributions of ionospheric research to geomagnetism, by L. V. Berkner; (9) Correlations of short-wave radio transmission across the Atlantic with magnetic conditions, by H. E. Hallborg; and (10) Magnetism and its uses, by P. R. Heyl.—*W. A.*

6146. Inglis, D. R., and Teller, E., Theory of terrestrial magnetism [abstract]: Phys. Rev., vol. 57, No. 6, p. 568, Lancaster, Pa., 1940.

The theory based on electric currents within the earth, caused by material convection guided by Coriolis forces, is discussed and extended. The present heat flow through the crust does not permit as large speeds and temperature differences as inferred by Elsasser (see Geophys. Abstracts 97, No. 4903). As it seems unlikely that the matter in two parts of a turbulent fluid, at the same level, is so different as to have a thermoelectric power comparable with that of two different metals at laboratory pressures, the ordinary thermoelectric effect seems inadequate. Other mechanisms, also depending on past or present Coriolis-guided convection, are proposed and seem to be more nearly adequate: (*a*) The convection within the core may make an undulatory surface of the core and at the same time maintain temperature differences between the junctions of the core and surrounding material; (*b*) upward and downward convection streams constitute hot and cold junctions between regions of high and low pressure and thereby form a pressure couple to provide the required current.

6147. Jones, W. M., Magnetic observations of north Auckland serpentinites: New Zealand Jour. Sci. Technology, General Section, vol. 22, No. 2B, pp. 117b–123b, Wellington, 1940.

Anomalies of vertical magnetic intensity have been mapped over some of the serpentinite outcrops in the Silverdale-Warkworth district and deductions made as to the size and shape of the outcropping bodies. At Whitehills, near Silverdale, a belt of anomaly extending for at least half a mile, with a range of 1,500 gammas, was found adjacent to two small outcrops of serpentinite. A bore of 8 ft. encountered a contact alteration of the clays; and the rock responsible for the anomaly is probably only about 10 ft. from the surface at this point.—*Author's abstract.*

6148. Kato, Yosio, The changes in the earth's magnetic field accompanying the volcanic eruption of Miyake-zima: Imp. Acad. Japan Proc., vol. 16, No. 9, pp. 467–472, Tokyo, 1940.

The author observed the magnetic dip after the volcanic eruption of Miyake-zima, which was most active July 25, 1940, and which became quiet August 5, 1940. He gives details of the observations. He compares the values obtained with those obtained in 1930 and finds an intimate relation between the magnetic secular variation and the volcanic activity. He accounts for the anomaly in the secular variation of the magnetic dip by assuming that a molten mass 1,000 m. wide and of indefinite extent intruded upward to less than 500 m. from the sur-

face of the earth, and he assumes that the differences in susceptibility between the mass and the surrounding mass is 0.005 e. m. u. and that each of the values of the normal vertical and horizontal intensities is 0.31 gauss. He examines the change of magnetic element after the cooling of the volcanic lava flow and gives diagrams of the observed values.—*W. A.*

6149. Narayanaswami, R., The daily variation of irregular disturbances of the earth's magnetic field at Bombay: Terres. Magn. and Atmos. Electr., vol. 46, No. 2, pp. 147–162, Baltimore, Md., 1941.

In addition to the quiet-day solar-diurnal variation and to variations associated with magnetic storms, the intensity of the earth's magnetic field at any place is subject to many irregular, short-period fluctuations. This paper contains an analysis of the diurnal variation of these irregular fluctuations during the 11-year period 1923–33. As a measure of the disturbance, the author uses the departures of the hourly ranges of horizontal forces from the mean hourly range on the five international quiet days in a particular month. In calculating the disturbance, he pays due regard to the sign of the change of the element during the hour. As diurnal variations of the irregular disturbances depend on the season of the year and on sunspot activity, he analyzes these variations and compares them with the results of disturbances in diurnal variation in higher latitudes. He gives the main conclusions that emerge from his analysis.—*Author's abstract, condensed by W. A.*

6150. Reich, Hermann, Über die Grundlage der magnetischen Bohrkernorientierung [On the basic principles of the magnetic orientation of well cores]: Oel und Kohle, vol. 37, No. 13, pp. 213–217, Berlin, 1941.

The author discusses the technical methods for investigating magnetic orientation of well cores in the United States. These methods are based on the assumption that the remanent magnetization is not changed by drilling or by transporting the core; but, according to investigations on the magnetization of rocks, this assumption is incorrect for deposits in the German oil-bearing regions. The thorough determination of magnetic properties of deposits in German oil-bearing regions cannot be reliably based on the general application of the magnetic orientation of cores, especially where the magnetic remanence of these deposits is in weak fields.—*Author's abstract, translated by W. A.*

6151. Strona, A. A., Magnetic anomalies and problems of geophysics in connection with the study of deep structure and deposits in the northern region [in Russian]: Sovietskaia Geologiia, vol. 8, No. 12, pp. 75–85, Moscow, 1940.

The writer summarizes data obtained from magnetic surveys of the territory between longitude 36° and 54° E. and latitude 58° and 63° N. He gives a schematic map of magnetic anomalies that was compiled from materials obtained during the period 1896–1937. The accuracy of determining Z_a may be assumed to be 50γ. He describes magnetic anomalies according to their location and gives contours of them in diagrams. As far as geologic interpretation of the magnetic anomalies is concerned, he gives only a general orientation and explanation of their causes. Although the magnetic surveys determined the directions of the tectonic lines with sufficient reliability, he recommends further study of the region.—*W. A.*

6152. Wasserfall, K. F., Magnetic horizontal intensity at Oslo, 1843–1930: Terres. Magn. and Atmos. Electr., vol. 46, No. 2, pp. 173–218, Baltimore, Md., 1941.

Mr. Wasserfall's article deals with data left by Professor Hansteen, who founded the Oslo Magnetic Observatory, and with the work of his successors.—*W. A.*

Weiss, Oscar, Gravimetric and earth-magnetic measurements on the Great Dyke of Southern Rhodesia. *See* Geophys. Abstract 6140.

3. SEISMIC METHODS

6153. Biot, M. A., A mechanical analyzer for the prediction of earthquake stresses: Seismol. Soc. America Bull., vol. 31, No. 2, pp. 151–172, Berkeley, Calif., 1941.

The earthquake stresses in a structure are generally greater than those which would be produced by a constant acceleration equal to the maximum value reached during the earthquake; there is an amplification due to resonance. This effect depends on the period of the structure and is measured by a function of the period, designated here as the spectrum of the earthquake. A mechanical analyzer is described by which the spectrum curves for several strong-motion earthquakes have been plotted. It is shown how the spectrum can be used for the evaluation of earthquake stresses in complicated structures, and the particular example is treated of a multistory building with an elastic first story.—*Author's abstract.*

6154. Born, W. T., The attenuation constant of earth materials: Geophysics, vol. 6, No. 2, pp. 132–148, Menasha, Wis., 1941.

This paper discusses briefly the nature of viscous losses and solid friction losses, both of which may cause sound waves to be attenuated as they travel through a physical medium. A simple experimental technique for determining the nature and magnitude of the loss factor in small rock samples is described, and data are given which indicate that solid friction losses are primarily responsible for the observed attenuation of the seismic waves employed in the seismic-reflection method. A method of estimating the attenuation factor of earth materials from seismic-reflection records is outlined, and it is shown that the values so obtained are not inconsistent with the laboratory data. Frequency characteristic curves of seismic-wave paths are derived on the basis of the experimental data.—*Author's abstract.*

6155. Bradford, D. C., The seismological station of the University of Pittsburgh: Seismol. Soc. America Bull., vol. 31, No. 2, pp. 101–106, Berkeley, Calif., 1941.

A description is given of the new seismological station at the University of Pittsburgh. The station includes not only new equipment but also a library of seismological literature. A long-range research program is planned.—*W. A.*

6156. Bullard, E. C., and Gaskell, T. F., Submarine seismic investigations: Royal Soc. London Proc., ser. A, vol. 177, No. 971, pp. 476–499, 1941.

The refraction-seismic method has been used to investigate the form of the surface of the hard rocks underlying the sediments on the continental shelf to the west of the English Channel. This surface is found to slope steadily downward on receding from the land and to reach

a depth of over 8,000 ft. at the 100-fathom line. The velocity of elastic waves in the sediments is about 6,000 ft./sec. near the surface and up to 9,700 ft./sec. lower down, compared to 16,000–22,000 ft./sec. in the basement. The bearing of these results on the structure and history of the shelf is discussed.—*Authors' abstract.*

6157. Bullen, K. E., Elastic constants of the earth's mantle: Royal Soc. New Zealand Trans. and Proc., vol. 70, pt. 2, pp. 137–139, Wellington, 1941.

The determination of the values of the elastic constants at various depths below the crustal layers becomes possible as a result of the recent accurate determination by Jeffreys of the velocities α and β, respectively, of P and S seismic waves throughout the mantle of the earth (see Geophys, Abstracts 99, No. 5199), combined with the work by Bullen on the density variation (see Geophys. Abstracts 103, No. 5744). These values are shown in two tables.—*W. A.*

6158. Comrie, L. J., The correction of epicenters by least squares: Royal Astron. Soc. Monthly Notices, Geophys. Suppl., vol. 5, No. 1, pp. 27–29, London, 1941.

The problem discussed here is that of correcting by least squares the time of an earthquake and the position of its epicenter when these elements are known approximately. The novelty that has given rise to these notes is the avoidance of the direct calculation of the azimuth of the observing station.—*Author's abstract.*

6159. Hayes, R. C., and Thompson, R. D., Ground tilt at Wellington, New Zealand: New Zealand Jour. Sci. Technology, General Section, vol. 22, No. 3B, pp. 166b–182b, Wellington, 1941.

Tiltmeter records made at the Dominion Observatory, Wellington, during the periods 1930–34 and 1937–39 are analyzed, and possible causes of the various movements are discussed. Most of the prominent movements recorded can be traced to meteorological causes, particularly temperature. The E.-W. component exhibits a marked diurnal wave, which appears to be closely related to local ground-temperature changes at a depth of 1 ft. Normal day-to-day changes are controlled mainly by temperature but appear also to be influenced to some extent by local precipitation. Occasional large tilts appear to be associated with abnormal meteorological conditions, particularly falls of snow or hail in the surrounding region. Some of these occurrences are discussed in detail. Other movements recorded consist of (1) a somewhat doubtful seasonal variation with a period rather less than 12 months, and (2) a general drift westward or southwestward during most of the periods concerned. No satisfactory explanations are offered for either of these movements, but evidence points to the westward or southwestward drift being a local movement, possibly due to settling of the observation building. No evidence of tilt due to tidal loading has been found. The relation between tilt and local earthquakes is discussed. The value of tilt observations is briefly discussed, and attention is drawn to their special value in volcanic regions. Ideas for future tilt recording in New Zealand are outlined.—*Author's abstract.*

6160. Housner, G. W., Calculating the response of an oscillator to arbitrary ground motion: Seismol. Soc. America Bull., vol. 31, No. 2, pp. 143–150, Berkeley, Calif., 1941.

The writer discusses mathematically some methods that have been used by the California Institute of Technology and the United States Coast and Geodetic Survey for computing the responses of oscillators.—*W. A.*

6161. Kendall, J. M., The range of amplitudes in seismic-reflection records: Geophysics, vol. 6, No. 2, pp. 149–157, Menasha, Wis., 1941.

Curves are presented which show the amplitudes of some reflection records, plotted as a function of time, for several widely separated areas. It is shown that amplitude ratios of the order of 1,000:1 occur on records in a time interval of 2 sec. After correcting for divergence of the recorded waves, it is found that their amplitude decreases exponentially with time. The usable length of record as a function of the size of charge was investigated for one shot hole.—*Author's abstract.*

6162. Kornfeld, J. A., Core drill and seismograph: Oil Weekly, vol. 102, No. 8, pp. 32–38, Houston, Tex., 1941.

The writer discusses the general procedure in exploration technique with the core drill and reflection seismograph in western Kansas. A survey of the pools discovered in western Kansas between 1925 and 1940, arranged in groups of 5-year periods, discloses a sharp increase in the number discovered by surface-structural methods and by the core drill and reflection seismograph. The writer graphically illustrates and tabulates the discoveries by individual years and by 5-year periods.—*W. A.*

6163. Kruger, F. C., and Linehan, Daniel, Seismic studies of floored intrusives in western New Hampshire: Geol. Soc. America Bull., vol. 52, No. 5, pp. 633–648, Washington, D. C., 1941.

Geologic mapping in western New Hampshire has delineated bodies of orthogneiss lying in structural basins of quartzite and schists. The object of the present investigation was to test the utility of seismic-reflection methods for determining the depths of the lower contact with the gneiss at various points and to correlate these data with deductions made from geologic observations at the surface. In one of the basins the seismic investigations were confined to one locality; in a second basin four localities were studied. The surface velocity of the seismic waves in the orthogneiss varied from 11,000 ft./sec. to 25,250 ft./sec., and at one locality it was possible to calculate from the reflected waves an effective average velocity of 17,000 ft./sec. Reflections were obtained at all localities, except for one place where the records were illegible. In the basin where the studies were confined to one locality the discrepancy between the geologic and seismic data was 20 percent; in the second basin the average discrepancy was approximately 15 percent. The complete mapping of such a basin by seismic means would be difficult because of the nature of the terrain, which impedes the transportation of the equipment. The variation in the velocity of transmission of seismic waves introduces a factor of uncertainty. Moreover, the thickness of the glacial drift in many places is a complicating factor.—*Authors' abstract.*

6164. Lückenrath, H., Fortschritte der Reflexionsseismik [Progress in reflection seismics]: Oel und Kohle, vol. 37, No. 5, pp. 73–77, Berlin, 1941.

After outlining briefly the general procedure in reflection-seismic prospecting, the writer says that by using a new apparatus, improved by him in collaboration with B. Meyer and the Seismos G. m. b. H., he can increase greatly the efficiency of his seismic-prospecting work. He does not describe the apparatus but says that with it he can record oscillations of 14 seismographs simultaneously. The main improvement consists in obtaining with only one or two explosions results that formerly required four or five explosions. He achieved this improvement by using in the receiving apparatus a special technical arrangement that automatically adjusts the explosion energy. He reproduces in two seismograms the results of his work with the new apparatus and compares these results with those obtained from seven seismographs that were used with the old apparatus. He illustrates his article.—*W. A.*

6165. McFarland, Julian, A low-cost vertical-component seismograph with viscous coupling: Seismol. Soc. America Bull., vol. 31, No. 2, pp. 139–142, Berkeley, Calif., 1941.

The writer describes in detail a vertical-component instrument with viscous coupling that can be constructed at small cost. He illustrates in diagrams the parts of the instrument and gives copies of seismograms that were obtained by it.—*W. A.*

6166. Mukherji, S. M., and Rangaswami, M. R., On the very large Pacific earthquake of November 10, 1938: Seismol. Soc. America Bull., vol. 31, No. 2, pp. 121–128, Berkeley, Calif., 1941.

The epicenter of the large earthquake of November 10, 1938, in the Pacific was determined by the method of successive approximations, in which the first onsets of *P* were used at 12 stations. Analysis of *P* and *S* residuals revealed three successive shocks, of which the second and third occurred 7 sec. and 12 sec., respectively, after the first. Examination of seismograms recorded at stations in India points to a fourth shock, about 20 sec. after the first. This fourth shock reveals its multiple character more conspicuously when the observed times are compared with Jeffreys' surface-focus tables and corrected for ellipticity than when the observed times are compared with normal tables. The epicenters of the first three shocks were the same. The possibility of identifying the second movement of *P* with *sP* or *pP*, and that of *S* with *sS*, was considered but was untenable in view of the depth of focus and available noninstrumental observations. The hypothesis of "surface-focus" appears to fit best with the present series of observations.—*W. A.*

6167. Nelson, J. H., A "synchronous direct-current motor" for seismograph recorders: Seismol. Soc. America Bull., vol. 31, No. 2, pp. 129–138, Berkeley, Calif., 1941.

The writer describes briefly several types of seismograph recorders used by the United States Coast and Geodetic Survey at seismograph stations and discusses their advantages and disadvantages. He illustrates in detail the operating principle of a "synchronous direct-current motor" for seismograph recorders by showing (1) a wiring diagram of the direct-current motor and its control equipment; (2) two views of the motor; (3) the recorder drum and special gear box to drive the

paper 20 mm./sec.; (4) a small part of a record used to determine variations in speed, with the paper driven at 20 mm./sec.; (5) scaling error computed for a 10-sec. interval; and (6) a small part of a record made at a paper speed of 30 mm./min. The average current required to operate the motor and its associated equipment is estimated to be: Motor, 1.5 a.; relay, 0.01 a.; and magnetic brake, 0.10 a. The total power consumed is les than 10 w.—*W. A.*

6168. Ransone, W. R., Effectiveness of exploration methods: World Petroleum, vol. 12, No. 6, pp. 68–69, New York, 1941.

This article discusses the effectiveness of seismic methods of prospecting and gives some ways in which to increase this effectiveness. One way in which to increase the economic effectiveness of exploration is to search for stratigraphic traps by means of geochemistry. A map that shows the development of a geochemical survey at La Rosa field, Refugio County, Tex., illustrates the exploration method.—*W. A.*

6169. Ransone, W. R., and Romberg, Frederick, Average vertical velocities from refraction and reflection profiles: Geophysics, vol. 6, No. 2, pp. 158–167, Menasha, Wis., 1941.

This paper presents data from a combined refraction and reflection profile, from which vertical velocities are calculated. The accuracy of velocities so obtained is brought out by checking them with velocities obtained from shooting a well drilled 2 years after the seismograph work. It is interesting to note that this method offers a means of identifying reflection horizons with refracting horizons, permitting better correlation between geologic and seismic markers. The method is of particular value in areas where little exploration has been done.—*Authors' abstract.*

6170. Rosenblatt, Alfred, Sur la propagation des ondes de Rayleigh dans les milieux transversalement isotropiques (milieux de Rudzki) [Propagation of Rayleigh waves in transversely isotropic media (Rudzki's media)]: Rev. Cien., vol. 42, No. 434, pp. 901–916, Lima, 1940.

The writer discusses mathematically Rudzki's studies of elastic waves propagated in infinite media and Rayleigh waves propagated on the surface and emphasizes some points concerning Rayleigh waves that have not been considered by previous investigators.—*W. A.*

6171. Ulrich, F. P., Progress report for 1939 of the seismological field survey of the United States Coast and Geodetic Survey: Seismol. Soc. America Bull., vol. 31, No. 2, pp. 107–120, Berkeley, Calif., 1941.

This report, which contains a summary of the seismic work of the United States Coast and Geodetic Survey during 1939, includes (1) the questionnaire program, (2) seismic field investigations, (3) sensitive-seismograph work, (4) strong-motion work, (5) tiltmeter work, (6) seismic acoustics, (7) vibration work, and (8) instrument work.

The following work directly related to the seismological field survey was done in 1939 at the Washington office of the Coast and Geodetic Survey: (1) Mimeographing and distributing "Abstracts of earthquake reports," (2) analyzing strong-motion records and publishing the information in the quarterly progress report, and (3) cooperating with the Massachusetts Institute of Technology in studying shaking-table tests and the double-integration method in the interpretation of strong-motion records.—*W. A.*

6172. von Thyssen-Bornemisza, Stephan, Geophysikalische Arbeiten im ungarischen Raume östlich der Donau unter besonderer Berücksichtigung von Reflexionsmessungen [Geophysical work in the Hungarian region east of the Danube, with special consideration of reflection measurements] : Oel und Kohle, vol. 37, No. 5, pp. 77–83, Berlin, 1941.

The writer briefly outlines the geophysical work from 1884 to 1936 in the Hungarian region east of the Danube. Of special interest are the seismic measurements that were made from 1936 to 1940 by the Eötvös Institute, as almost all of them have geologic importance. The writer summarizes them in a table and describes the apparatus that was used. He illustrates the article by maps and profiles.—*W. A.*

6173. Wadati, K., and Yamamoto, T., On the construction of a long-period seismometer [in Japanese] : Meteorol. Soc. Japan Jour., vol. 18, pp. 117–125, Tokyo, 1940.

This is a report of a newly designed long-period seismometer that records the displacement of the ground by a two-step amplifier on a sheet of smoked paper. The potential difference proportional to the displacement is obtained by two insulated platinum wires moving in two long vessels of liquid in which the potential gradients are kept constant. The vessels are divided into three parts by two porous plates, and the electrodes are placed in the two end parts. The central part is filled with glycerin and the two end parts with glycerin and dilute nitrate of silver. The results obtained by this intrument are good, except that the magnification changes slowly with time.—*Y. Kodaira's English abstract.*

6174. Washburn, Harold, and Wiley, Harold, The effect of the placement of a seismometer on its response characteristics: Geophysics, vol. 6, No. 2, pp. 116–131, Menasha, Wis., 1941.

A group of experiments were performed to determine the effect of the plant of a seismometer on the motion imparted to it by the ground. It was found experimentally that a seismometer and the ground form a resonant system, the characteristics of which depend on the type and condition of the ground surface, the method of planting the seismometer, and the seismometer weight and base area. Methods were devised for obtaining a satisfactory seismometer plant in areas where ordinary surface plants introduce distortion into seismic records. The mathematical expression of seismometer response and ground admittance in terms of experimentally measurable quantities is given in the appendix.—*Authors' abstract.*

4. ELECTRICAL METHODS

6175. Armstrong, Paul, The exploration and development of the Calumet mine, Quebec: Canadian Min. Met. Bull. 351, pp. 396–412, Montreal, 1941.

Before the diamond-drilling program of the Calumet mine was started, an electrical survey of a large central part of the property was made by Schlumberger's self-potential method. A map shows the results as a series of equipotential contours covering an area of 2,400 feet in length and 600 feet in maximum width. Six inclined diamond-drill holes were put down at places recommended by the geophysicist, and each hole showed scattered pyrite and pyrrhotite mineralization characteristics of the injected biotite gneiss, but no ore. The southern part of the area surveyed, northeast of the Bowie pit, is underlain

by a compact 1,000,000-ton ore body that is less than 75 feet thick and that lies, at its southern edge, within 80 feet of the surface. An analysis of the negative results is given. In 1939, after drilling had outlined a good part of the Bowie ore body, a trial survey was made with horizontal and vertical Askania instruments. It was thought that the pyrrhotite content of the ore might be sufficiently high to give magnetic currents detectable by the Askania instruments, but the results again were negative. The contacts of amphibolite and biotite gneiss, however, were fairly accurately indicated. The results of the survey with Askania instruments are shown in a map.—*W. A.*

6176. Börner, Rudolf, Der gegenwärtige Stand spezifischer Braunkohlen Untersuchungen durch das Geoskop Verfahren (Stand Ende 1940) [State of specific lignite investigations by the geoscope method at the end of 1940]: Braunkohle, vol. 40, No. 12, pp. 133–136, and No. 13, pp. 146–151, Halle, 1941.

From the results of measurements made by the geoscope method in the central and eastern parts of the German lignite regions the author concludes as follows:

1. If the measuring apparatus is correctly applied in the existing boreholes, information valuable for mining purposes may be obtained from the measurements.

2. Higher geoscope values are observed in regions containing thick beds of lignite than in those with little or no lignite.

3. Definite decreases are observed on curves obtained from geoscope measurements at the borders of a lignite seam and over local areas where the lignite has been eroded.

4. Deflections of the geoscope may be greatly reduced by argillaceous deposits if the thickness of these deposits is greater than 60–80 percent of the total thickness of the cover.

5. Similar geoscope curves were obtained over lignite layers of equal thickness, where the overlying cover was the same.

6. No determinations of thicknesses of widely separated layers can be made by geoscope measurements.

7. Definite conclusions on the conditions of a lignite layer can be made only within the same measurement curve, provided that the area of investigation has approximately constant structure.

8. Positive results obtained in 11 different regions of investigation from measurements made during a period of 2 years must be accepted, notwithstanding the fact that incorrect results were obtained in two regions of investigation.—*Author's abstract, translated by W. A.*

6177. Gage, Maxwell, and McNeill, F. A., Geophysical investigations in the area between Waiuta and Merrijigs: New Zealand Jour. Sci. Technology, General Section, vol. 22, No. 3B, pp. 155b–165b, Wellington, 1941.

The primary object of the geophysical investigations in the area between Waiuta and Merrijigs, in which the potential drop-ratio method was used, was to trace the northward continuation of the Waiuta anticline in which the Blackwater lode occurs. The area may be considered electrically as a rock mass of uniform conductivity intersected by narrow north-striking belts of relatively low resistivity. The geologic evidence indicates that shear zones occur on or near the structural

axes. Altogether the axes of five folds in the lode-bearing strata were traced through the area. The net work that was done is outlined, the results are discussed, and ratiometer curves are shown.—*W. A.*

6178. Hayward, J. T., and Swift, L. M., Instruments for logging and sampling oil and gas wells while drilling: Instruments, vol. 13, No. 8, p. 155, Pittsburgh, Pa., 1940.

The "Bavoid Well-Logging Service" is described. Twenty instruments are mounted in a trailer and taken to the well, the necessary power for operating the equipment being obtained from the rig. The essential principle of the equipment is that a sample of the mud which has been flowing past the bit as it penetrated some known depth is abstracted from the mud return line and submitted to analysis for gas (by hot-wire detector), oil (by fluorescence), and salt (by electrical conductivity). The equipment also provides depth and drilling-rate measurement; and the method of assuring that the sample of mud tested corresponds to the depth allocated to it is described. The principle would be vitiated if there should be an inflow into the mud from the surrounding strata, but this is stated to occur only rarely. Equipment for core analysis and mud testing is also included.—*P. D., Inst. Petroleum Jour., vol. 27, No. 211, 1941.*

6179. Hummel, J. N., Die elektrische Transient-Methode [The electric transient method]: Oel und Kohle, vol. 37, No. 5, pp. 91–94, Berlin, 1941.

In his patent No. 1,911,137, issued in the United States in 1933, Blau gives the following definition of a transient: "The varying current from its zero value at the instant of closing the switch to its steady value sometime afterward or any curve representing such current is called a transient [Eltran]."

The writer describes the principles of this method and its application as developed in the United States and concludes that technically it is simpler than most of the other geoelectrical methods and that it can be used to measure extensive regions.—*W. A.*

6180. Marsch, Bruno, Das Schlamm-Messverfahren als geophysikalisches Hilfsmittel während des Bohrens [Mud-measuring method as a geophysical aid during drilling]: Oel und Kohle, vol. 37, No. 5, pp. 94–96, Berlin, 1941.

The writer mentions an apparatus developed by Hayward and Swift (see abstract 6178) for continuous investigation of the mud in a borehole during drilling. The basic instrument in the new apparatus is a special salt-content meter by which the amount of salt in the mud brought to the surface of the hole may be measured and thus the possible approach of the drill to an oil-bearing horizon determined. The writer gives a diagram of such a meter and describes the possibility of using the electrical technique in making measurements with it.

A special meter for measuring conductivity has been developed and is in operation, and in it the solution of the mud under investigation is brought between two electrodes, and the resistance between the electrodes is measured with a resistance bridge. Alternating current must be used to avoid polarization. The writer describes the design of the electrode. The influence of temperature—an *important factor*—on the electric resistance of electrolytic solutions is controlled by a resistance thermometer inserted in the Wheatstone bridge.—*W. A.*

6181. Müller, Max, Ergebnisse geoelektrischer Polarisationsmessungen [Results of geoelectric measurements of polarization].: Zeitschr. Geophysik, vol. 16, No. 7/8, pp. 274–284, Brunswick, 1940.

The author discusses methods of measurement developed by himself, by which polarization forces produced artificially in the ground may be determined by damping-coupling or by dynamic phase regulation. Examples show the high selectivity and great effect of depth of these methods of measurement.—*Author's abstract, translated by W. A.*

6182. Stick, J. C., Electrical logging of oil wells: The Compass of Sigma Gamma Epsilon, vol. 21, No. 4, pp. 271–280, Menasha, Wis., 1941.

The writer describes briefly electrical logging—its history, its uses, its future, problems of its design, and recent experiments with it. A typical electrolog shows characteristic formation responses and the method of presentation.—*W. A.*

6183. Wenholz, Manfred, Über die Bildung einer Bodensenkung im Bereiche der Buntsandstein-Tertiar-Verwerfung bei Reinsdorf in Braunschweig [On the formation of a subsidence of the ground in the region of the Bunter-Tertiary fault near Reinsdorf, in Brunswick]: Braunkohle, vol. 40, No. 21, pp. 269–275, Halle, 1941.

After a brief introduction on the geologic structure of the Hohnsleben depression (valley) of the Helmsted lignite basin, the writer describes a grabenlike subsidence of the ground between the village of Reinsdorf and the Wulfersdorf open-pit works. During the development of fissures and extensive ruptures, this subsidence joined the surface, which lies in the range of an old tectonic weak zone, namely a fault between the Bunter and the Tertiary. As a knowledge of the exact course of the disturbance became necessary for future mining, this course was established by several drill holes as well as by geophysical measurements with the geoscope. A comparison of profiles obtained by drilling and of measurement curves obtained with the geoscope shows good agreement. The causes of the subsidence are explained as the combined actions of the old tectonic weak zone of ground waters, and of the adjacent open-pit works.—*Author's abstract, translated by W. A.*

5. RADIOACTIVE METHODS

6184. Goodman, Clark, Evans, R. D., and Hurley, P. M., Helium age measurements [abstract]: Phys. Rev., 2d ser., vol. 59, No. 11, p. 920, Lancaster, Pa., 1941.

Following the discarding of the previous helium time scale because of invalidation of the radioactivity measurements (see Geophys. Abstracts 98, No. 5118), an attempt was made to establish a new scale from alpha-helium age determinations on a variety of rocks. Substantially lower helium age ratios were obtained for acidic rocks than for corresponding basic rocks, and both types gave values considerably lower than the equivalent lead age ratios for radioactive minerals. Mean age ratios of 103 million years for pyroxene separates and 36 million years for feldspar separates were obtained for six samples of Triassic diabase. This discrepancy between age ratios for geologically contemporaneous materials appears to be due to a difference in helium retentivity. Six samples of late Triassic magnetite from ore occurrences in West Virginia, Pennsyl-

vania, and Nova Scotia gave age ratios closely grouped about a mean value of 134 million years. The constant age ratio, despite widely varying contents of radium and thorium, suggests that magnetite retains essentially all of its radiogenic helium. Additional evidence on the high helium retentivity of magnetite is provided by specimens of differing geologic ages. Age ratios on some 30 magnetites show a sequence and spacing compatible with geologic knowledge, and the results are in fair agreement with corresponding lead age ratios.

6185. Kip, A. F., and Evans, R. D., Improved counting-rate meter for radioactivity detection [abstract]: Phys. Rev., vol. 59, No. 11, 2d ser., p. 920, Lancaster, Pa., 1941.

The design of the counting-rate meter (see Geophys. Abstracts 101, No. 5526) has been improved to give greater ease of operation, stability, range, and linearity. The output current, which is proportional to the average counting rate of the radioactive sample being measured, is fed through a vacuum-tube voltmeter, whose maximum output is 5 ma. This increased output current allows replacement of photographic recording, with its inherent delays, by a commercial 5-ma. pen-and-ink recorder, which is very easy to monitor visually. Use of the vacuum-tube voltmeter in the output circuit permits reduction of the integrating condenser from 100 uf. to 2 uf. Time constants of 15, 30, and 50 sec. are now used for the high, medium, and low counting-rate ranges. Seven output ranges are provided, varying from 200 to 20,000 counts per minute for full-scale deflection, and the amplifier is linear over the entire range. Continuously variable high voltage, from 500 to 2,000 v., is provided by a thermionic stabilizer. The amplifier is operated entirely by alternating current.

6186. Urry, W. D., Ionization chamber for counting alpha particles: Rev. Sci. Instruments, vol. 12, No. 5, pp. 289–290, Lancaster, Pa., 1941.

Radioactive problems in geophysics require the measurement of extremely small concentrations of the radio-elements. Some of these concentrations can best be determined by counting the alpha particles emitted from solid sources. Two factors govern the design of an ionization chamber for this purpose: (1) The rate of emission of the alpha particles, and (2) the necessity of measuring a large number of specimens. Compared with other designs, the ionization chamber described and illustrated in this article considerably shortens the time required to change sources and further minimizes the possibility of contamination from the source itself by placing it face up on the lower plate. The ionization chamber functions satisfactorily with a vacuum-tube electrometer and photographic recording but is equally adaptable to a linear amplifier.—*W. A.*

6. GEOTHERMAL METHODS

6187. Urry, W. D., Heat energy from radioactive sources in the earth: Washington Acad. Sci. Jour., vol. 31, No. 7, pp. 273–284, Menasha, Wis., 1941.

It has been shown that the determination of the quantity of heat generated by the disintegration of the radio elements in the materials of the earth's crust can be made by a single physical measurement for the majority of laboratory specimens. A large number of measurements are necessary, and too few are available because of the complexity

of older methods. A moderate degree of accuracy is sufficient, since variations among individual specimens are large and such variations can be studied and treated only with a volume of data. The analysis of this method indicates that an uncertainty of less than 5 percent is introduced by a lack of knowledge of the exact value of the Th/U ratio; if the potassium content is not measured the uncertainty increases to possibly 15 percent. The probable error, including the errors of measurement, is less than 25 percent except in a few isolated cases of relatively high potassium content and very low uranium and thorium values, such as may be encountered in a few ultrabasic specimens.

The ratio of the rate of production of radioactive heat in the past to that at present is very important in a consideration of geothermal problems. No equation for determining this ratio seems to have appeared in the literature. The ratio is relatively insensitive to a choice of the two independent variables, and guidance in their choice is afforded by the available radioactive measurements. No significant increase in heat production within the structure of the earth during the accepted age of the earth (2×10^9 years) may be inferred.

The possibility of the existence of radio elements hitherto undetected is explored from the point of view of their influence on the ratio of the heat production in the past to that at present. It is concluded that such elements could contribute an appreciable quantity of heat only before 1.5×10^9 years ago.—*Author's abstract.*

7. GEOCHEMICAL METHODS

6188. Merritt, J. W., Direct evidence required to discover stratigraphic traps: World Petroleum, vol. 12, No. 6, pp. 70–73, New York, 1941.

After a brief discussion of the indirect methods commonly used in geophysical prospecting for oil, the writer describes the theory of geochemical prospecting and mentions the objections that are raised with regard to the way in which geochemical prospecting gives direct evidence of stratigraphic traps. He examines several geochemical well logs that show how advance information can be obtained as to whether a formation that the drill is approaching carries oil, gas, or is barren. This information is useful to the driller in showing him how to drill and in helping him to decide whether to test the horizon, for by considering both the geochemical surface surveys and the geochemical subsurface examinations he may avoid unnecessary drilling.—*W. A.*

6189. Pirson, S. J., Geodynamic prospecting for oil or gas: Petroleum Engineer, vol. 12, No. 10, pp. 34–38, Dallas, Tex., 1941.

The geodynamic-prospecting method purports to measure the surface dynamism of hydrocarbons in the subsoil by determining, at the surface of the ground, the rate of gas leakage from subterraneous accumulations as well as from source beds yet in the process of forming oil and gas. The method is based on the fact that no rock, even though saturated with water, is completely impermeable to gas under pressure. Contrary to some printed statements, most sedimentary formations, even below the water table, are not fully saturated with water, and many horizons are almost dry.

The writer discusses theoretical considerations, shows a diagram of the theoretical leakage paths, gives a distribution curve, describes field procedure in geodynamic prospecting, and examines one example

of field results. He concludes that geodynamic prospecting holds great promise of being a fast reconnaissance tool, particularly for stratigaphic pools.—*W. A.*

6190. Pirson, S. J., Progress in geodynamic prospecting: California Oil World, vol. 34, No. 10, pp. 9–18, Los Angeles, 1941.

A new method of prospecting for oil and gas fields is proposed, whereby the rate of leakage of hydrocarbon gases and vapors through the surface of the ground is measured. Results of surveys can be expressed by various units, such as in cubic feet of gases per square mile per year and rate-pressure build-up of molecules of gas per unit area. Results of leakage measurements over the Music Mountain field of northern Pennsylvania are presented.—*Author's abstract.*

Ransone, W. R., Effectiveness of exploration methods. *See* Geophys. Abstract 6168.

8. UNCLASSIFIED METHODS

6191. Adler, J. L., New cycle of petroleum exploration: World Petroleum, vol. 12, No. 6, pp. 64–67, New York, 1941.

The writer mentions two factors that contribute to an enlarged campaign for exploration at home: (1) The restriction of foreign markets as a result of the European and Asiatic wars has caused a corresponding restriction in foreign exploration, which has released funds and personnel for exploration at home; (2) the increase in the demand for petroleum in connection with the defense movement accelerates the pace of the the new exploration program.

The general revival of older methods of exploration embraces surface geology, shallow subsoil sampling, core drilling, and magnetic, electrical, and gravitational methods. Seismic exploration, which had been on a decline for the past 3 years, showed a marked upturn during the first 4 months of 1941. Soil-hydrocarbon analysis, chemical well logging, and gamma-ray logging have passed through the preliminary experimental stages and will probably be used in the new exploration campaign. Electrical well logging and petrologic and paleontologic examinations will probably maintain their position as the principal well-correlation tools. Another new method not yet applied extensively is the vegetable-ash analysis. The writer briefly reviews all these methods.—*W. A.*

6192. Boardman, L. G., The geology of the manganese deposits on Aucampsrust, Postmasburg: Geol. Soc. South Africa Trans., vol. 43, pp. 27–36, Johannesburg, 1941.

The geological information gained from a study of recent workings, and of the core yielded by the borehole for water on the virgin manganese-bearing farm Aucampsrust, is the chief subject matter. Furthermore, the nature and origin of the ore deposits and the possibilities of geophysical investigations are discussed, and references are made to manganese fields in general.—*Author's abstract.*

6193. Born, W. T., and Kendall, J. M., Application of the Fourier integral to some geophysical-instrument problems: Geophysics, vol. 6, No. 2, pp. 105–115, Menasha, Wis., 1941.

This paper considers only the simple part of Fourier integral theory required for the work in hand. A special type of Henrici rolling-sphere harmonic analyzer has been built, which makes possible a large

reduction in the amount of labor involved in dealing graphically with Fourier integral operations. Examples of the use of this procedure as applied to several geophysical-instrument problems are given.—*Authors' abstract.*

6194. Brace, O. L., Technical evolution of petroleum geology: Oil Weekly, vol. 101, No. 4, pp. 31–34, Houston, Tex., 1941.

The constantly increasing demand for petroleum has forced the oil industry to encourage projects that will facilitate the search for new reserves of oil or that will assist in an accurate appraisal of many of the factors that are vital to geologic investigation. Geophysics thus becomes for the geologist one of the main sources of new structural information. A newer technical process, such as electrical well logging, combined with paleontology, is superior to any process that has been available in the past. Technical investigation designed to analyze cores represents a forward step in the geologic problem of appraising the potentiality of reservoir rocks. Geophysical measuring devices that are designed to study the structural characteristics of rocks not exposed at the surface, and devices that record the physical properties of rocks penetrated by a drill, add to the success of the geologist in the oil industry.—*W. A.*

6195. DeGolyer, Everette, New skill will determine future of oil prospecting: Oil Weekly, vol. 104, No. 4, pp. 22–24, Houston, Tex., 1941.

A decided step forward in the technique of prospecting for oil is, in the opinion of the writer, the procedure of (1) drilling to a predetermined depth without coring, (2) taking an electric log, and (3) sampling the wall of any formation that the electric log may indicate as a possible oil producer. This procedure reduces the cost of prospecting. The discovery rate depends on the skill that may be developed in searching for stratigraphic traps or on the success with new techniques, such as electrical methods or soil-gas surveys, or on both.—*W. A.*

6196. Eckhardt, E. A., Geophysical prospecting follows varied pattern: Oil Weekly, vol. 101, No. 4, pp. 45–58, Houston, Tex., 1941.

The following is a summary of the geophysical-prospecting work in the United States during 1940:

As in former years, seismograph operations represented the largest part of the geophysical campaign. The number of seismograph parties operating in the United States fluctuated from a minimum of 173 to a maximum of 203 and was greater than in recent years.

Gravimeter operations reached a new all-time high with a maximum of 66 parties reported at any one time and an average of 56 in continuous service during the year. Among the new geophysical instruments of the year were several kinds of underwater gravimeters.

The magnetometer work, although of relatively small volume, showed by its steady growth that the magnetic method may regain a place of respectability, to which it is entitled.

Information secured by geochemical methods, although of practical value in many ways, did not provide a sufficient basis for new methods of prospecting.

The use of radioactive properties of rocks as a basis for methods of well logging has been the subject of considerable development.—*W. A.*

6197. Krumbein, W. C., Influence of geophysics and geochemistry on the professional training of geologists: Am. Inst. Min. Met. Eng., Tech. Paper 1327, 11 pp., New York, 1941.

Geological problems are approached from a geometrical (space-relations) viewpoint, a kinematic (time-sequence) viewpoint, or a dynamical viewpoint. The first two require sound training in conventional geology and in field methods. The third approach requires a solid foundation of chemistry, physics, and mathematics. Modern training for geologists should include close integration of basic sciences with geological principles.—*Author's abstract.*

6198. Lundberg, Hans, New techniques in geoexploration: Mining and Metallurgy, vol. 22, No. 413, pp. 257–258, New York, 1941.

"War minerals," such as tin, vanadium, tungsten, antimony, manganese, chromium, and cinnabar, have no physical characteristics that are sufficiently different from the country rock to permit their direct location by magnetic and electrical methods—the methods that have been used mainly in prospecting for ores. More direct and truly qualitative methods, such as the geochemical, geobotanical, and radioactive methods, which have been brought recently into a useful and practical stage, are suggested by the writer for wider use in prospecting for war minerals of vital importance at the present time.—*W. A.*

6199. Monnett, V. E., Stratigraphic exploration and future discoveries: Oil Weekly, vol. 101, No. 4, pp. 26–30, Houston, Tex., 1941.

Petroleum geologists generally agree on the following points: (1) Most of the favorable surface structures in known oil areas have already been tested; (2) by means of core drilling and geophysical and other methods many subsurface structures without surface expression have been discovered and tested; (3) from 25 to 50 percent of the oil of the United States occurs in traps that do not come under the ordinary conception of structural traps; and (4) a large part of the future oil supply must therefore be obtained either from surface structures outside of present accepted oil areas, or from subsurface structures not yet recognized, or from the type of accumulation known as a stratigraphic trap.

The writer describes and illustrates types of stratigraphic traps and lists the methods to be employed in attempting to locate them.—*W. A.*

6200. Proudman, J., The effect of coastal friction on the tides: Royal Astron. Soc. Monthly Notices, Geophys. Suppl. 5, No. 1, pp. 24–26, London, 1941.

1. It is pointed out that the "age of the tide" is positive for the great majority of the places open to the oceans at which tides have been observed. In the past, various indications have been given that this phenomenon is due to the action of friction in shallow water.

2. A boundary condition for the deep ocean, which corresponds to a large dissipation of energy on the continental shelf, is derived.

3. This boundary condition is first applied to a particular case of the forced tides in a flat channel on a rotating earth, and it is shown that the "age of the tide" is predominatingly positive.

4. The condition is next applied to an ocean bounded by a circle of latitude and evaluated for a hemispherical ocean bounded by the

equator. Again, positive ages are obtained, and the pattern of cotidal lines is very different from that corresponding to zero dissipation.—*Author's abstract.*

6201. Sterrett, Elton, Analysis of mud returns locates oil and gas zones: Oil Weekly, vol. 101, No. 4, pp. 49–58, Houston, Tex., 1941.

Mud-analysis logging is particularly applicable in areas where production is from lime or where muds have a high saline content. Where coring is difficult, mud-analysis logging furnishes a means of obtaining corroborating data on those formations carrying oil or gas. The writer gives typical mud-analysis logs; illustrates an interior trailer-type mud-analysis laboratory showing fluoroscope unit, continuous strip chart, gas-detector dials, and controls necessary for an accurate check of the oil and gas content of the mud stream; and describes the method and the use of the instruments.—*W. A.*

9. NEW PUBLICATIONS

6202. Carnegie Institution of Washington, Yearbook 39, July 1, 1939–June 30, 1940, 326 pp., Washington, D. C., 1940.

The work of the Carnegie Institution during the fiscal year 1940 is reviewed under two main headings: Geophysical Laboratory and Department of Terrestrial Magnetism. Experiments conducted in the Geophysical Laboratory concern: (1) High-temperature studies of anhydrous systems and their presentation by equilibrium diagrams; (2) equilibrium in systems containing water of various pressures and temperatures; (3) radioactive elements in rocks and in sediments from the ocean floor; (4) physical properties of rocks and minerals; (5) exploratory and cooperative studies; and (6) high-pressure investigations. This part of the yearbook is concluded by summaries of articles published and by a bibliography.

General work by the Department of Terrestrial Magnetism is summarized by J. A. Fleming, director, and O. H. Gish, assistant director, in the following reviews: (1) Investigational and experimental work in (a) terrestrial magnetism and (b) terrestrial electricity; (2) investigations of the ionosphere and its relation to problems of terrestrial magnetism; (3) magnetism and atomic physics; (4) field-work and reductions; (5) observatory work; (6) reductions of Carnegie data; (7) instrument shop; and (8) miscellaneous activities. This part is likewise concluded by a bibliography.—*W. A.*

6203. Churchill, R. V., Fourier series and boundary-value problems, 206 pp., New York and London, McGraw-Hill Book Co., Inc., 1941. Price, $2.50.

This book discusses linear equations, the boundary-value problem, orthogonal functions; derives briefly the partial differential equations for gravity (Laplace's equation), heat, vibrating string, and vibrating membrane; introduces the Fourier series in a problem of the vibrating string; defines this series and gives the conditions for its convergence; discusses the differentiation and integration of the series and the definition and properties of the Fourier integral; deals with the solution of boundary-value problems by use of the series and integrals; discusses the uniqueness of the solutions with theorems for temperature

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and potential problems; gives the derivation and properties of Bessel functions; and defines and discusses Legendre polynomials. It gives many problems, with answers, and at the end of each chapter lists a bibliography.—*W. A.*

6204. De Vries, Louis, German-English science dictionary, 473 pp., New York and London, McGraw-Hill Book Co., Inc., 1939. Price, $3.

This dictionary of 48,000 entries was designed for students of the agricultural, biological, and physical sciences. Although no claim is made as to its completeness, its usefulness is evident from the list of scientists who collaborated in its composition.—*W. A.*

6205. Israel, Hans, Radioaktivtät I. Grundlagen und Messmethoden. Geophysik, Meteorologie, Astronomie [Radioactivity—Principles and methods of measurement, Part 1, Geophysics, meteorology, astronomy] : Beiträge zur Kosmischen Physik, vol. 2, 194 pp., Leipzig, Johann Ambrosius Barth, 1940. Price, 13.50 RM.

The author describes the general principles and geophysical importance of radioactivity, the methods of measurement, and the instruments used.—*W. A.*

6206. Lahee, F. H., Field geology, 4th ed., 853 pp., illus., New York and London, McGraw-Hill Book Co., Inc., 1941. Price, $5.

The new edition of this well-known book contains 23 chapters, with 10 pages of bibliography and an index. It deals with features of the rocks, field relations of igneous rocks, tilted and folded strata, fracture structures, metamorphic rocks, mineral deposits, topographic forms, topographic maps and profile sections, geologic surveying (including instruments), geologic field mapping, airplane mapping, subsurface surveying, and geophysical methods.—*W. A.*

6207. Tables of sine, cosine, and exponential integrals, vol. 2, prepared by the Federal Works Agency, Work Projects Administration for the city of New York, 225 pp., 1940.

For volume 1, see Geophysical Abstracts 105, No. 6087. Volume 2 includes an introduction, a bibliography, and the following six tables: (1) Values of Si (x), Ci (x), Ei (x), and $-\mathrm{Ei}\,(-x)$ for x ranging from 0 to 10 at intervals of 0.001; (2) values of Si $(\pi \pm h)$, Si $(2\pi \pm h)$, Si $(3\pi \pm h)$, and Ci $\left(\frac{\pi}{2} \pm h\right)$, Ci $\left(\frac{3\pi}{2} \pm h\right)$, Ci $\left(\frac{5\pi}{2} \pm h\right)$, for $h = 0.0000\ (0.0001)\ 0.0100$ and $h = 0.010\ (0.001)\ 0.050$; (3) values of Si (x) and Ci (x) for $x = 10.0\ (0.1)\ 20.0\ (0.2)\ 40.0$; and Ei (x) and $-\mathrm{Ei}\,(-x)$ for $x = 10.0\ (0.1)\ 15.0$; (4) values of $\frac{1}{6}\,p\,(1-p^2)$ to six decimal places; (5) values of $p\,(1-p)$; and (6) multiples of $\frac{\pi}{2}$ and other constants.—*W. A.*

6208. The Accra earthquake of June 22, 1939: Gold Coast Geol. Survey Bull. 13, 67 pp., illus., 75 Cornwall Gardens, South Kensington, London, S. W. 7, 1941. Price, 3s.

This bulletin contains a description of the earthquake of June 22, 1939, by N. R. Junner, with notes by D. A. Bates, who discusses (1) the geologic effects of the earthquake; (2) seismological observations; (3) the geology of the Accra area; (4) the relation of earthquake effects to geology; and (5) recommendations for the rebuilding of Accra. Ernest Tillotson reports on a seismological study of the earthquake, and C. S. Deakin gives the engineering aspects of the earthquake. The bulletin

concludes with a geologic map of the Accra area and an isoseismal map of the earthquake of June 22, 1939.—*W. A.*

10. PATENTS

6209. Casing for boreholes; John W. Flude, San Antonio, Tex., assignor by mesne assignments to the Hercules Powder Co., Wilmington, Del., a corporation of Delaware: U. S. patent 2,224,565, issued December 10, 1940.

This invention relates to a borehole casing for geophysical prospecting, consisting of a tubular casing of a length suitable for supporting the walls of a borehole for seismic blasting, said casing being formed of a partially waterproofed fibrous composition having a stiffness capable of withstanding the exterior pressure exerted by the walls of a borehole, being capable of suspending its own weight when lowered into a borehole, and being adapted to maintain the borehole open temporarily to permit the explosion of several seismic blasting charges before collapsing, but being capable of slowly absorbing water and becoming water-soaked so that it disintegrates to such an extent that it ceases to be an obstruction and need not be removed from the borehole. Claims allowed, 3.

6210. Method of making weathering corrections; Hugh C. Schaeffer, Tulare, Calif., and Raymond A. Peterson, Altadena, Calif., assignors to Consolidated Engineering Corporation, Pasadena, Calif., a corporation of California: U. S. patent 2,229,191, issued January 21, 1941.

This invention relates to seismic prospecting and in particular to a method for making weathering corrections in an area in which a low-speed surface layer overlies a high-speed layer, comprising drilling two spaced shot holes in the earth to depths adjacent to the bottom of said surface layer; planting a seismic wave-receptor station on or adjacent to the earth's surface at a point intermediate between said shot holes and substantially in line therewith and a second seismic wave-receptor station at the bottom of one of said shot holes; generating seismic waves successively at the bottom of each of said shot holes; measuring the time required for a seismic wave to travel from each shot hole to said intermediate point, along a path including a portion within and adjacent to the top of said high-speed layer, and substantially parallel thereto; and measuring the time required for a seismic wave to travel from the bottom of one shot hole to the bottom of the other shot hole, also over a path including a portion within and adjacent to the top of said high-speed layer and substantially parallel thereto. Claims allowed, 6.

6211. Oil- and gas-detector apparatus; Curtis R. Chalkley, Fort Mitchell, Ky.: U. S. patent 2,229,884, issued January 28, 1941.

In an apparatus for detecting and determining the presence of oil, gas, and other distillable products when penetrated by the rotary well-drilling apparatus, the drillings being converted into a sludge by a continuous stream of liquid, a gas collecting and combustion chamber; an endless conveyor providing a movable base for said chamber; means for delivering a small quantity of circulating sludge from a well bore for deposit upon said conveyor; and means for heating the sludge upon the conveyor and while within said chamber to effect a fractional dis-

tillation of the sludge and collect in said chamber the volatile parts thereby liberated from the sludge for a detection thereof. Claims allowed, 11.

6212. Method of calibrating field timing systems; John P. Minton, Dallas, Tex., assignor by mesne assignments to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,230,002, issued January 28, 1941.

This invention relates generally to seismographic surveying methods and more particularly to the method of "frequency-calibrating" a timing mechanism located at a point remote from a master frequency-timing mechanism that comprises generating a signal of a standard frequency controlled by the master timing mechanism and of too low a frequency to be readily transmitted by a conventional audio-frequency telephone system; modulating said standard frequency signal onto a carrier wave of an audio frequency sufficiently high to be readily transmittable by such a conventional audio-frequency telephone system; transmitting said modulated carrier wave over a conventional audio-frequency telephone to the point of location of the timing mechanism to be calibrated; demodulating the carrier wave to obtain the standard frequency signal and calibrating the timing mechanism by use of said standard frequency signal. Claims allowed, 1.

6213. Apparatus for analyzing gaseous mixtures; Gerald L. Hassler, Berkeley, Calif., assignor to Shell Development Co., San Francisco, Calif., a corporation of Delaware: U. S. patent 2,230,593, issued February 4, 1941.

This invention pertains to a method and apparatus for analyzing a gaseous mixture for the presence therein of hydrocarbons, and it finds a particularly useful application in methods of underground exploration. In an apparatus for analyzing a gas mixture, a cell comprising a reaction chamber and an electrode chamber adapted to be filled with an electrolytic liquid capable of reacting with said gas mixture; liquid conduits between said two chambers forming in combination therewith a hydraulic circuit; means to maintain a liquid circulation through said circuit; flow-restricting means adapted to maintain an air gap within said hydraulic circuit at either side of the electrode chamber, thereby electrically insulating said chamber; means to pass the gas mixture through the liquid within the reaction chamber; at least two electrodes within the electrode chamber; means to pass an electrolytic current between said electrodes within the electrode chamber; and means for observing changes in the specific conductivity of the liquid due to its reaction with the gas mixture. Claims allowed, 1.

6214. Modulated steady-state reflection-seismic surveying; Neil R. Sparks, Tulsa, Okla., assignor to Stanolind Oil & Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,235,089, issued March 18, 1941.

This invention relates to a method of seismic surveying comprising generating steady-state seismic vibrations in the earth; continuously varying the frequency of these vibrations substantially as a known function of time; receiving reflected waves and relatively direct waves thus generated; and determining at least one-beat frequency between said relatively direct and said reflected waves. Claims allowed, 5.

6215. Method and apparatus for logging wells; Ludwig W. Blau and Robert Russell Thompson, Houston, Tex., assignors to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,236,668, issued April 1, 1941.

This invention relates to a method for producing a composite well-log, which comprises moving a pair of spaced conductive elements along a borehole filled with an aqueous fluid; feeding to one of said conductive elements a unidirectional current having a wave form varying between a minimum and a maximum value; picking up said current after its passage through the substrata around the borehole by said other conductive element at successive points along said borehole; simultaneously picking up, by said other conductive element, the natural earth potential between each of said successive points and a fixed point; simultaneously applying said picked-up current and potential to a recording instrument having a movable element sensitive to both; and recording the movement of said element. Claims allowed, 15.

6216. Method of subsurface prospecting; Samuel S. West, Houston, Tex., assignor by mesne assignments to E. E. Rosaire, Houston, Tex.: U. S. patent 2,237,643, issued April 8, 1941.

This invention relates to the method of determining underground structure, which comprises causing an alternating current to flow in the earth; continuously measuring the alternating potential difference between two points subject to the influence of the earth current; comparing said measured potential to another alternating potential whose wave form can be varied at will; and altering the wave form of the last-mentioned potential until it corresponds to that of the earth potential. Claims allowed, 13.

6217. Method and means for locating concealed bodies; Dale H. Nelson, Water Mill, N. Y., and William D. Buckingham, Southampton, N. Y., assignors to the Western Union Telegraph Co., New York, N. Y., a corporation of New York: U. S. patent 2,238,072, issued April 15, 1941.

This invention relates to the method of locating a concealed body, capable of distorting the lines of force of a magnetic field, by detecting means affected by said lines of force, which comprises the steps of causing relative movement between said detecting means and the body in the vicinity of said body; producing during such movement successive electrical responses, said responses being dependent upon the degree of distortion of said lines of force by said concealed body in the path of said detecting means; determining the ratio of the respective magnitudes of said successive electrical responses; and determining from said ratio the location of said body. Claims allowed, 48.

6218. Measurement of sound velocities in strata traversed by boreholes; Raymond T. Cloud, Tulsa, Okla., assignor to Stanolind Oil & Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,238,991, issued April 22, 1941.

This invention relates to an apparatus for determining the velocity of sound in the strata traversed by a cased well, comprising means for generating a sound wave; means vertically spaced from said first-mentioned means for receiving said sound wave; electrical means for producing an electrical effect as a function of time; means associated with said generating means and actuated at the time of generation of said sound wave for initiating the production of said electrical effect; a first

electrical circuit associated with said receiving means; a second electrical circuit associated with said receiving means, with said electrical means, and with said first electrical circuit, said first electrical circuit operating upon receipt of the first sound wave arriving at said receiving means via the casing of said well to render said second electrical circuit responsive to the receipt of the second sound wave arriving at said receiving means via the strata traversed by said well; means associated with said receiving means and including said second electrical circuit for discontinuing the production of said electrical effect on receipt of said second sound wave at said receiving means; and means responsive to said electrical means for recording the time required for said wave to travel between said generating means and said receiving means via the strata traversed by said well. Claims allowed, 3.

6219. Gravity meter; Truman S. Morris, Houston, Tex.: U. S. patent 2,239,049, issued April 22, 1941.

This invention relates to a gravity meter comprising a vertically movable weight which is affected by gravity; means for guiding the weight, including an involute spring formed in a substantially horizontal plane, with one end connected to the weight and the other end to a support; a solenoid connected to the weight; a permanent magnet adapted to cooperate with the solenoid to support the weight; and means for indicating the vertical position of the weight. Claims allowed, 7.

6220. Method of, and apparatus for, electrical investigation of drill holes; Jacob Neufeld, Tulsa, Okla., assignor to Well Surveys, Inc., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,239,466, issued April 22, 1941.

This invention relates to apparatus for electrically investigating characteristic differences between geologic strata traversed by a borehole, comprising in combination two electrodes capable of being suspended at different depths in the borehole; a source of transient voltage; insulated conductors connecting said electrodes and adapted to be suspended at different depths in the borehole; a peak voltmeter; a derivator; and insulating conductors connecting said exploring electrodes to the said peak voltmeter and to the said derivator, another peak voltmeter, and electrical connections between the derivator and the said other peak voltmeter. Claims allowed, 14.

6221. Apparatus for surveying wells; Roland Ring, Houston, Tex., assignor to Sperry-Sun Well Surveying Co., Philadelphia, Pa., a corporation of Delaware: U. S. patent 2,240,417, issued April 29, 1941.

An oil-well surveying instrument consisting of a combination of a float chamber; a float in said chamber; a compass chamber above the float chamber; a valve between said chambers to control the flow of liquid therebetween; a compass within the compass chamber; an indicator card on the compass; a bob suspended above the compass, said bob being so constructed that the point thereof is maintained in spaced relation with the indicator card by a liquid within the compass chamber; and means for admitting liquid to the float chamber to open said valve, whereby the liquid in the compass chamber is lowered and the point of the bob engages the indicator card to produce a record thereon. Claims allowed, 18.

6222. Method and apparatus for electrical underground prospecting; Marcel Schlumberger, Paris, France: U. S. patent 2,240,520, issued May 6, 1941.

This invention relates to a method of electrically prospecting the

underground, which comprises simultaneously recording the relative magnitudes of the telluric fields at two different stations of the area to be surveyed, the respective curves of said recording each described by a point the coordinates of which are proportional to the respective values of the components of the telluric field at said stations along two rectangular axes of coordinates. Claims allowed, 11.

6223. Well-surveying method and apparatus; Jacob Neufeld, Tulsa, Okla., assignor to Well Surveys, Inc., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,241,154, issued May 6, 1941.

This invention relates to a method of determining the nature of formations penetrated by drill holes and the like that comprises measuring the fluorescence of substances present in the earth penetrated by a drill hole at a measured depth, repeating the measurement on the substance present at other measured depths, and mechanically correlating the measurements of depth with the measurements of fluorescence to give a graphic comparison of the variation in fluorescence over a range of depths. Claims alowed, 9.

6224. Apparatus for underwater seismic surveying; Daniel Silverman, Tulsa, Okla., assignor to Stanolind Oil & Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,241,428, issued May 13, 1941.

This invention relates to apparatus for seismic surveying in areas covered by deep water, comprising means for generating seismic waves at the bottom of a deep body of water and means for receiving said seismic waves at at least five horizontally spaced points near the surface of said body of water. Claims allowed, 11.

6225. Electrical surveying; Daniel Silverman and Paul F. Hawley, Tulsa, Okla., assignors to Stanolind Oil & Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,241,623, issued May 13, 1941.

This invention relates to the method of electrical surveying, which comprises passing an electrical current through the earth between a current electrode adjacent to the surface thereof and a distant grounded electrode and measuring the potential difference between two grounded electrodes on opposite sides of said current electrode and equally spaced therefrom. Claims allowed, 6.

6226. Method of geophysical exploration; Theodor Zuschlag, West Englewood, N. J., assignor by mesne assignments to Lundberg Exploration S. A., Panama City, Panama, a corporation of Panama: U. S. patent 2,241,874, issued May 13, 1941.

This invention relates to the method of geophysical exploration, comprising creating a continuous mechanical wave pattern; intermittently determining the momentarily effective amplitude ratio and phase difference between two points within said wave pattern by a noncontinuous measuring procedure; repeating this procedure with other selected points; plotting the thus-determined values; and interpreting the resultant amplitude and phase patterns as to their geophysical meaning. Claims allowed, 4.

6227. Method of logging drill holes; Lawrence F. Athy and Harold R. Prescott, Ponca City, Okla., assignors to Continental Oil Co., Ponca City, Okla., a corporation of Delaware: U. S. patent 2,242,161, issued May 13, 1941.

This invention relates to a method of logging boreholes, including the steps of introducing into the borehole a chemical reactant adapted

to react with the material forming the borehole in a reaction producing a temperature change, measuring the temperature with respect to depth to obtain the desired borehole log. Claims allowed, 3.

6228. Geophysical apparatus; Ludwig Machts, Marburg, Germany: U. S. patent 2,242,312, issued May 20, 1941.

This invention relates to a portable device for investigating properties of the substructure of the earth's surface through influence of an electric alternating field by said properties, comprising a radio transmitting unit including a frame aerial; a radio receiving unit having associated with it a second frame aerial; a structure for the reception of both said receiving and transmitting units; a pivotal support for at least one of said units received in said structure; means for adjusting the pivotally supported unit so as to vary the linkage between said two units; and a mass of metal displaceably mounted in relation to the received units and arranged to lie within the field of influence of the transmitter so as repeatedly to cause a disturbance in the said field. Claims allowed, 19.

6229. Method for determining the beds traversed by drill holes; Eugene G. Leonardon, Houston, Tex., assignor to Schlumberger Well Surveying Corporation: U. S. patent 2,242,612, issued May 20, 1941.

This invention relates to a process for determining the beds traversed by a drill hole, comprising circulating in this drill hole a liquid whose temperature is different from the natural temperature of the beds traversed by the drill hole, maintaining said circulation for a sufficient length of time to produce an appreciable change in the temperature of the more impervious of such beds, and subsequently obtaining indications of the temperatures of the liquid at different depths in the drill hole. Claims allowed, 15.

6230. Electrical prospecting; Paul W. Klipsch and Solomon Bilinsky, Houston, Tex., assignors to E. E. Rosaire, Houston, Tex.: U. S. patent 2,243,428, issued May 27, 1941.

This invention relates to the method of electrical exploration, which comprises connecting electrodes embedded in the earth so that the impedance between them forms an arm of a bridge network; applying a time-varying potential to appropriate diagonal points in the bridge; detecting the magnitude and wave shape of the potential across another diagonal pair of points in the bridge; and balancing the bridge with resistance and impedance until the detected wave form has negligible amplitude over at least an appreciable period of time, whereby the values of resistance and impedance used to produce the balance may be utilized for geological interpretation. Claims allowed, 6.

6231. Apparatus for analysis of seismographic records; Lacoste G. Ellis, Beaumont, Tex., assignor to Sun Oil Co., Philadelphia, Pa., a corporation of New Jersey: U. S. patent 2,243,730, issued May 27, 1941.

This invention relates to apparatus for the analysis of seismographic time records of the vibrations resulting at different points from a source of disturbance in the earth, comprising scanning means for each record responsive to its variations; means for providing relative movement between said scanning means and records to effect simultaneous scanning thereof; means for algebraically summing during the scanning the responses of the scanning means for the various records; means for varying

during the scanning the relationships of the scanning means to the records to effect simultaneous scanning of values of said records which were produced not simultaneously but in predetermined time relationships varying with respect to the time of their production after the occurrence of the disturbance at the source; and means for recording the results of the summing means. Claims allowed, 5.

6232. Gravity meter; Dayton H. Clewell, Dallas, Tex., assignor by mesne assignments to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,243,746, issued May 27, 1941.

In a gravity meter in which a mass is resiliently suspended from a support during the measuring process and clamped into position between measurements, the improvement that comprises means to stop any oscillation of the mass caused by its release from the clamps or by other disturbances, including a plurality of parallel electroconductive plates fixed to the mass; a plurality of stationary electroconductive plates positioned in parallel relationship to and intermeshing with said first series of plates when the mass is in its normal or base position; means to impress an electrical potential difference upon said members; and means to connect and disconnect said potential difference, whereby the conductive members will attract one toward the other during the application of the potential difference and tend to fix the position of the mass. Claims allowed, 1.

6233. Gravity meter; Dayton H. Clewell, Dallas Tex., assignor by mesne assignments to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,243,747, issued May 27, 1941.

In a gravity meter in which a mass is resiliently suspended from a support during the measuring process, the improvement that comprises means to stop any oscillation of the mass, including a nonmagnetic electroconductive element fixed to the mass and means to create an alternating magnetic field of such a pattern around said element so that the force of reaction between the alternating magnetic field and the eddy currents in the conductive element produced by the alternating magnetic field will cause the conductive element and therefore the mass to assume a predetermined stable position relative to the pattern of said magnetic field. Claims allowed, 4.

6234. Gravity meter; Dayton H. Clewell, Dallas, Tex., assignor by mesne assignments to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,243,748, issued May 27, 1941.

This invention relates to a device for geophysical prospecting that comprises a support; a mass resiliently suspended from said support; means for noting the relative positions of the mass and support; a nonmagnetic electroconductive member fixed to said mass; means to generate an alternating magnetic field including said conducting member; and means to measure the strength of said field. Claims allowed, 1.

6235. Gravity meter; Dayton H. Clewell, Dallas, Tex., assignor by mesne assignments to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,243,749, issued May 27, 1941.

This invention relates to an apparatus for geophysical prospecting that comprises a support; a mass resiliently suspended from said support; means to note the relative positions of said mass and support; a conductive member fixed to said mass; stationary conductive members on

opposite sides of said first-mentioned conductive member; means for applying a potential between said stationary conductive members; and means for varying the potential between said first-mentioned conductive member and the two stationary conductive members, whereby an electrostatic force is exerted on said first-mentioned conductive member and through it upon said mass. Claims allowed, 3.

6236. Gravity meter; Dayton H. Clewell, Dallas, Tex., assignor by mesne assignments to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,243,750, issued May 27, 1941.

This invention relates to a gravity meter that comprises a mass supported jointly by a leaf spring directed upwardly at an acute angle to the horizontal and a coil spring at an obtuse angle to the leaf spring, said springs exerting thrust toward the mass supported therebetween, the leaf spring forming a fulcrum about which the mass moves, and the coil spring being positioned so as to oppose obliquely any downward movement of the mass and thus relieve the leaf spring of at least a part of the bending stress the mass would otherwise impart to it. Claims allowed, 5.

6237. Method and means for analyzing and determining the geological strata below the surface of the earth; Roland F. Beers, Dallas, Tex.: U. S. patent 2,244,484, issued June 3, 1941.

This invention relates to a system for making acoustic impedance measurements in a borehole, which comprises an acoustic oscillator located in said borehole for transmitting sound waves corresponding in frequency to that of the impressed alternating current, a source of alternating current of variable frequency, an alternating-current impedance-measuring bridge, having a plurality of variable impedance arms, and one arm being said acoustic oscillator, whereby a group of acoustic impedance measurements may be made over a frequency range to determine the physical lithological properties of the formation around the borehole. Claims allowed, 2.

6238. Apparatus for making geophysical or other measurements; Ludwig Machts, Marburg, Germany: U. S. patent 2,246,259, issued June 17, 1941.

In an instrument for exploring magnetic fields, a cathode-ray tube adapted for operation on low voltage and having an annular anode positioned transverse of the electron stream from the cathode and positioned relatively near the cathode and further having an auxiliary annular electrode mounted substantially coaxial with said anode and positioned in said tube transverse of the electron stream and relatively remote from the cathode; means for supplying to said anode a potential positive with respect to said cathode; means for supplying to said auxiliary electrode a potential positive with respect to the cathode of value smaller than is supplied to said anode; and means for measuring the current delivered from said auxiliary electrode, said apparatus with particular reference to the interior diameters of said annular anode and auxiliary electrode and the respective positions of said anode and electrode being so constructed and arranged that when there is no nonaxial magnetic field component acting on the tube substantially all of the electron stream will pass through the aperture in said auxiliary electrode, but under an applied nonaxial component of magnetic field a portion of said electron stream will impinge on said auxiliary electrode whereby a current will flow through said measuring instrument. Claims allowed, 3.

6239. Well-surveying instrument; Roland Ring, Houston, Tex., assignor to Sperry-Sun Well Surveying Co., Philadelphia, Pa., a corporation of Delaware: U. S. patent 2,246,319, issued June 17, 1941.

This invention relates to a well-surveying instrument, comprising a casing adapted to enter a borehole; means for supporting therein a record member capable of being marked electrolytically by the passage of an electric current; a pendulum having variable location relative to and adjacent to said record member depending upon inclination of the casing, said pendulum having a portion constantly in contact with said record member when the instrument is upright; means providing a closed electrical circuit including the pendulum and record member; and means providing a substantially continuous flow of current in said circuit while the instrument is being lowered in a hole and during a subsequent rest period, said current being sufficient to produce substantial marking of said record member at the contact of said pendulum portion and record member only when the pendulum is at rest for a prolonged period but insufficient to produce markings of record-obliterating character while the pendulum is in motion during movements of the instrument along a hole. Claims allowed, 9.

6240. Electrical-prospecting apparatus; Charles B. Bazzoni, Wallingford, Pa., and John M. Pearson, Swarthmore, Pa., assignors to Sperry-Sun Well Surveying Co., Philadelphia, Pa., a corporation of Delaware: U. S. patent 2,246,460, issued June 17, 1941.

In combination with a metallic protective casing adapted to be lowered into a borehole and having an opening therein, means for closing said opening against high pressures and for permitting the passage of electrical current comprising concentrically arranged conducting members insulated from each other and from the casing. Claims allowed, 9.

6241. Electrical well-logging apparatus; William Monroe Rust, Jr., and Whitman Denny Mounce, co-inventors, both of Houston, Tex., United States of America: Canadian patent 395,524, issued March 25, 1941.

This invention relates to apparatus for logging a well, which comprises a pair of electrodes, one disposed in the well and one grounded at the surface of the earth; means for passing an alternating current through the earth between the electrodes; a filter for separating the natural direct-current potential difference between the electrodes in the earth from the generated alternating-current potential; means for measuring the alternating-current impedance between the electrodes due to the earth's strata; and means for simultaneously and independently measuring the natural direct-current potential difference existing between the electrodes. Claims allowed, 6.

6242. Gas-mapping method; Stanolind Oil & Gas Co., assignee of George S. Bays, both of Tulsa, Okla., United States of America: Canadian patent 395,763, issued April 8, 1941.

This invention relates to a method of soil-gas surveying, comprising determining hydrocarbon contents of soil-gas samples from various soils and determining the relative sorptive abilities of said soils to provide a basis for more accurate correlation of data obtained by the determination of the hydrocarbon contents of said various soils. Claims allowed, 11.

6243. Gravity-measuring instrument; Shell Development Co., San Francisco, Calif., assignee of Haakon Muus Evjen and David Saville Muzzey, Jr., co-inventors, both of Houston, Tex.: Canadian patent 396,995, issued June 3, 1941.

In a gravity meter, a knife-edge fulcrum; a casing supported thereon, said casing comprising two airtight chambers maintained at different pressures; a body of liquid in each chamber; and a conduit between the two chambers adapted to permit a liquid flow therebetween upon a change in the value of gravitational acceleration, the centers of gravity of the liquid in the two chambers being offset with regard to a vertical plane passing through the knife edge. Claims allowed, 8.

6244. Well-surveying instrument; Sperry-Sun Well Surveying Co., Philadelphia, Pa., assignee of Roland Ring, Houston, Tex., both in the United States of America: Canadian patent 397,000, issued June 3, 1941.

This invention relates to a well-surveying instrument, comprising a casing adapted to enter a borehole; means for supporting therein a record member capable of being marked by the passage of an electric current; a pendulum having variable location relative to and adjacent to said record member depending upon inclination of the casing, said pendulum having a portion constantly in contact with said record member when the instrument is upright; means providing a closed electrical circuit including the pendulum and record member; and means providing a constant flow of current in said circuit while the instrument is being lowered in a hole, said current being sufficient to produce substantial marking of the said record member only when the pendulum is at rest for a prolonged period but insufficient to produce markings of record-obliterating character while the pendulum is in motion during the lowering of the instrument. Claims allowed, 8.

6245. Vorrichtung zum Messen der Schwerkraft nach dem barometrischen Prinzip (Arrangement for measuring gravity according to the barometric principle); Askania-Werke Aktiengesellschaft in Berlin-Friedenau: German patent 697,037, issued October 4, 1940.

This invention relates to an arrangement for measuring gravity according to the barometric principle applying to a vessel filled with ice water inside of which the measuring device is placed for the purpose of the temperature compensation. The invention is characterized in that between the measuring device and the outer wall of the vessel one or two partitions having heat-insulating walls are provided for. Claims allowed, 3.

6246. Gerät zur Messung der Schwerkraft (Apparatus for measuring gravity); Askania-Werke Aktiengesellschaft in Berlin-Friedenau: German patent 699,271, issued November 26, 1940.

This invention relates to apparatus for measuring gravity having an elastically supported pendulum the center of gravity of which lies above the (fictitious) center of rotation. The invention is characterized in that the position of the center of gravity of the mass on the arm of the pendulum and/or the magnitude of the mass with regard to the force of the spring is selected in such a way that the pendulum when in vertical position remains in an unstable equilibrium. Claims allowed, 2.

6247. Gravimeter; Askania-Werke Aktiengesellschaft in Berlin-Friedenau, Dr. Anton Graf, of Berlin-Steglitz, inventor: German patent 699,272, issued November 26, 1940.

This invention relates to an additional arrangement provided below the elastically suspended mass of a gravimeter. The said arrangement serves for producing a magnetic or an electric field by which the vertical movement of the mass caused by change in gravity may be increased. Claims allowed, 1.

6248. Verfahren zur Bestimmung der Ausbreitungsgeschwindigkeit und Dampfung von Wellen im Erdboden und anderen festen Körpern (Method for determining the velocity of propagation and damping of waves in the ground and in other solid bodies); Dr. Martin Grützmacher in Berlin-Wilmersdorf: German patent 701,341, issued January 14, 1941.

This invention relates to a method of determining the velocity of propagation of mechanical waves in a solid body, for example, along the surface of the ground produced by a sine-shaped excitation of this body by means of an oscillating machine, and recording the said oscillations at the place of the reception by means of an electrical seismograph. The method is characterized in that the oscillation received by the electrical seismograph is transformed into electrical-voltage fluctuation, amplified by means of an amplifier and recorded by a measuring instrument. Claims allowed, 6.

INDEX

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