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BY

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AND

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NOTE.—For a greater differentiation of contents section 8 of previous reports is replaced by section 0 and section 9, and the former section 9 is replaced by section 10 and section 11. An additional section on drill-hole methods, section 8, is introduced.

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By V. L. Skitsky and S. T. Vesselowsky

FOREWORD

Geophysical Abstracts are issued by the Section of Geophysics of the Geological Survey, United States Department of the Interior, as an aid to those engaged in geophysical research and exploration. The publication covers world literature on geophysics contained in periodicals, books, and patents. It deals with exploration by gravitational, magnetic, seismic, electrical, radioactive, geothermal, and geochemical methods and with underlying geophysical theory, research, and related subjects.

Inasmuch as geophysicists in the field may have little opportunity to consult libraries, the policy is to provide abstracts sufficiently informative in themselves to keep readers abreast of developments in the United States and abroad.

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Acknowledgments.—Grateful acknowledgment is made for the advice and assistance given by various sections of the Geological Survey.

O. GENERAL GEOPHYSICAL SUBJECTS

ANNUAL REVIEW, 1947

9962. Lundberg, Hans. Mining geophysics: Mining and Metallurgy, vol. 29, no. 494 (annual review), pp. 88–92, New York, 1948.

Geophysical exploration for metalliferous ores during 1947 was marked by an increasing use of aeromagnetic and electrical methods. Developments are reviewed on the basis of reports from the United States, Canada, Sweden, Africa, India, and Australia, some details of surveys are given, and advances are noted.

United States.—The United States Department of Interior, Geological Survey, conducted geomagnetic exploration over 48,000 miles of traverses covering an area of 36,000 square miles within the United States and also aeromagnetic observations in the Pacific region and Latin America; electric resistivity surveys for ground water in Florida, Tennessee, Pennsylvania, and Wisconsin; resistivity, magnetic, and seismic surveys for lead in Missouri, nickel in California, mercury in Oregon, copper in Arizona, tungsten in North Carolina, iron in Utah, and zircon-bearing pegmatities in Wisconsin; geochemical surveys for copper, zinc, and lead in New York, Arizona, Colorado, Tennessee, and Wisconsin; an underwater gravity survey in the Gulf of Mexico, in connection with an oceanographic study; and accessory research in magnetic, resistivity, and geochemical techniques. Private companies and individual investigators reported extensive areomagnetic surveys in various States; regional gravity and magnetic studies of the eastern seaboard; magnetic, resistitvy, and radioactivity surveys in the Tri-State lead-zinc district; an aeromagnetic and a geochemical survey in Pennsylvania; geothermal surveys in Texas and California, and geothermal research. Canadian companies made spontaneous polarization, resistivity, and magnetic surveys in various States.

Canada.—The National Research Council of Canada carried out tests of aeromagnetic exploration near Ottawa and, acting through its Associate Committee on Geodesy and Geophysics, made grants totaling $25,000 for geophysical research, chiefly to universities. The Dominion Observatory conducted a seismic investigation near Kirkland Lake and gravity investigations in various parts of the country, partly in combination with magnetic observations. Geophysical exploration companies made extensive magnetic, resistivity, spontaneous polarization, and ratiograph surveys in Quebec, Ontario, Manitoba, and British Columbia, increasingly using electrical methods. New models of magnetic and electromagnetic apparatus were under investigation. An increase

in geophysical instruction and research was reported from the University of Toronto. In Newfoundland ratiograph reconnaissance continued.

Other countries.—In Sweden the magnetic and electrical methods were employed primarily, and observations significant in magnetic interpretation were made of magnetite disseminated in till and of long magnetic zones in pure granite. In addition, use was made of gravimetric, seismic, and radioactive methods, and also of an electromagnetic technique and apparatus for reaching great depths. In Africa geophysical work included gravity surveys for gold and magnetic and resistivity surveys for water in the Orange Free State; gravity surveys for iron in Northern Rhodesia; magnetic and resistivity surveys for water in Southwest Africa; and gravity and magnetic surveys for lead in Tanganyika and Nigeria. In India self-potential and resistivity exploration was made in coal fields and for the location of graphite. In Australia large-scale investigations by electrical, magnetic, and gravity methods were commenced in various mineralized areas. In Latin America spontaneous polarization and resistivity surveys were made in the Peruvian Andes for sulfides and in Bolivia for tin, and electrical and magnetic surveys were made in Mexico for various metals.—*V. S.*

9963. Prey, A. Die modernen Methoden und Ergebnisse der Geophysik [Modern methods and findings of geophysics]: Experientia, vol. 4, no. 3, pp. 88–100, Basel, Switzerland, 1948.

Geophysics develops methods for deriving the properties of the interior of the earth from observation of the physical behavior of the earth's surface. The mean density of the earth is determined by measurements of its weight, and its increase in density toward the interior can be calculated by Clairaut's theorem. Seismic observations have shown, however, that the density of the earth does not vary continuously. Since transverse seismic waves through the earth's center are never observed, the earth's core must possess very little rigidity.

Seismic waves can be viewed mathematically as elastic, since the "elastic-viscous" condition of the earth, according to Jeffreys, behaves toward brief impulses as a rigid body. However, the earth behaves toward impulses of longer duration as a plastic body. The plasticity of the earth's interior is a necessary postulate for the theory of isotasy. Prey and Schweydar have assumed rigidity of the earth to be variable with the radius according to the law $\mu=1.6 \times 10^{12}(1-0.83r^2)$. The formation of the continents may be explained by the separation of the moon from the earth, whereby the sial mantle was torn asunder. If the sinking of the continental segments has occurred very slowly, then the earth's viscosity must be of the order of 10^{25}. If this viscosity is of the order 10^{23}, then the sinking followed very rapidly after the separation of the moon.—*Author's abstract, condensed by S. T. V.*

9964. Wilson, J. T. Some aspects of geophysics in Canada with special reference to structural research in the Canadian shield—Part 1, Review of recent geophysical work in Canada: Am. Geophys. Union Trans., vol. 29, no. 1, pp. 1–12, Washington, D. C., 1948.

After mentioning how the National Committee for Canada of the International Union of Geodesy and Geophysics has been reorganized,

this paper reviews recent progress of geophysics in Canada. Both routine and research work are discussed in the fields of geodesy, gravity, meteorology, hydrology, oceanography, seismology, terrestrial magnetism, atmospheric ionization, radioactivity, geothermometry, volcanology, and tectonics. A hundred references are given to Canadian papers, most of which have appeared since the end of the war.—*Author's abstract.*

1. GRAVITATIONAL METHODS

9965. Boulanger [Bulanzhe], Iu. D. Some of the achievements of exploratory gravimetry abroad [in Russian]: Prikladnaia Geofizika, no. 2, pp. 96–109, Moscow, 1945.

Progress in the construction and application of torsion balances and gravimeters is reviewed. The author discusses the studies of Roland von Eötvös on the gravitational field of the earth and the methods of its exploration. About 25 years after its discovery by Eötvös, the torsion balance was applied to practical prospecting for oil in Czechoslovakia. In the United States the first application of the torsion balance was made in 1922. In 1936 some 60 exploration parties were working with torsion balances. Following this there was a sharp decline in the number of torsion balances used because of the use of the gravimeter, which showed higher productivity in field practice. Another drawback of the torsion balance is the disturbing influence registered on it by rugged relief, which necessitates a very accurate survey of the terrain if high precision measurements are desired. In 1932 pendulum apparatus again came into prominence because of improvements in design introduced by the Gulf Co., which resulted in high precision and productivity. This was followed by the appearance of new gravimeters, which are now the preferred tools of the geophysicists. Among the better models the author mentions those of La Costa-Romberg, Gulf Co., Askania, and Mott-Smith.—*S. T. V.*

9966. Canadian Geophyhical Bulletin. Bibliography of gravity in Canada: Vol. 1, no. 3, pp. 33–38, Ottawa, Ontario, 1947.

A. H. Miller and A. A. Brant give a bibliography of the papers published on gravity investigations in Canada, supplemented with notes on unpublished gravitational prospecting results. The bibliographical entries cover the period 1905–46, and the notes list surveys made during 1939–47 of the Waite-Amulet ore deposit, the Moulton Hill ore body, the Walton barite deposit, the Fort Norman area, Steep Rock Lake, and other localities.—*V. S.*

9967. Evans, P., and Crompton, W. Geological factors in gravity interpretation illustrated by evidence from India and Burma—Discussion: Geol. Soc. London Abstracts Proc., 1945–46 Sess., nos. 1416–1425, pp. 31–36, London, 1946.

The communication of Evans and Crompton to the Geological Society of London on gravity work in India and Burma is reported briefly, with a discussion by members. T. Holland regarded the paper as outstanding; E. C. Bullard pointed to the reducing effect of isostatic and geologic corrections on the magnitude of anomalies; A. O. Rankine found the use of broad extrapolation between regions of investigated geology an aca-

demical procedure; T. Dewhurst suggested the possibility of local gravity highs within the belt of low gravity between India and Burma because of the presence of serpentine intrusions; W. F. P. McLintock recognized the difficulty of arriving at correct values for the densities of rock masses; and J. Phemister pointed out that the Airy isostatic hypothesis stood in better agreement with the findings of the investigation than the Pratt-Hayford hypothesis. Questions were answered by P. Evans.—*V. S.* (For the paper of Evans and Crompton *see* Geophys. Abstracts 130, no 9333.)

9968. Gassmann, F., and Prosen, D. Graphische Bestimmung der Wirkung gegebener dreidimensionaler Massen auf die Schwereintensität [Graphic determination of the effect of given three-dimensional masses on the force of gravity]: Inst. Geophys. Mitt., no. 8, 12 pp., 3 diagrs., Zurich, Switzerland, 1947.

A combined graphic-numerical method is offered for determining the effect of a three-dimensional mass of any shape on the intensity of gravity. The mass is assumed to be homogeneous and to have a density greater than that of the surrounding medium, and its configuration is represented by contour lines. The body thus delineated is then replaced by cylinders passing through the contour lines; the altitudes of the bases of the cylinders are calculated; and the horizontal projections of the resulting substitute body, seen from above and below, are plotted on a counting diagram. The gravity anomaly, produced by the substitute body at the point for which the effect of the original mass is to be determined, can then be calculated by a process of summation accomplished by means of a given equation. The calculations of the method are illustrated by an example.—*V. S.*

9969. Heiskanen, W. The geoid study of the International Isostatic Institute: Am. Geophys. Union Trans., vol. 28, no. 3, pp. 361–365, Washington, D. C., 1947.

The author reports on the studies of the geoid made at the International Isostatic Institute during recent years. In order to be able to determine the undulations of the geoid we should know the gravity field over the earth's entire surface, that is, the gravity anomalies. In the Isostatic Institute, Tanni has estimated the gravity field of the earth as accurately as possible, taking into consideration the isostatic reduction according to Hayford (*T*-113.7 km.). These anomalies with the aid of Stokes' formula give the undulations of the geoid.—*Author's abstract.*

9970. Hubbert, M. K. Gravitational terrain effects of two-dimensional topographic features: Geophysics, vol. 13, no. 2, pp. 226–254, Tulsa, Okla., 1948.

This is the full text of the paper. For abstract published in advance, *see* Geophys. Abstracts 131, no. 9524.

9971. Hubert, M. K. Calculations by line integrals of gravity anomalies produced by two-dimensional masses: Geophysics, vol. 13, no. 2, pp. 215–225, Tulsa, Okla., 1948.

Many computing schemes have been devised for determining the gravity anomalies produced by two-dimensional masses. Most of these

are based upon the evaluation of an areal integral and require specially constructed templates or tables. In the present paper it is shown that the gravity anomaly Δg at the origin of coordinates, produced by a two-dimensional mass of constant density contrast $\Delta\rho$, may be obtained quite simply by means of either of the line integrals

$$g=2\kappa\Delta\rho\phi\Theta dz=-2\kappa\Delta\rho\phi z d\Theta,$$

where z is the vertical coordinate, and Θ the polar coordinate expressed in radians of a point on the periphery of the mass in a plane normal to its axis and passing through the origin.

The line integrals are evaluated around the periphery of the mass and are of opposite sign if taken in the same direction of traverse, or are of the same sign if taken in opposite directions. For use of these integrals no special equipment is required other that a simple template consisting of radial lines, Θ=constant, and horizontal lines, z=constant, which can be constructed in a few minutes with protractor and scale. This can be drawn either for 1:1 or for an exaggerated vertical-to-horizontal scale.—*Author's abstract.*

9972. Lagrula, Jean. Nouvelles mesures de l'intensité de la pesanteur en Algérie, mise en évidence d'une corrélation sismo-gravimétrique [New measurements of the intensity of gravity in Algeria, demonstration of seismic-gravimetric correlation]: Acad. Sci. Comptes Rendus, vol. 224, no. 9, pp. 636-638, Paris 1947.

Results of measurements of gravity made with a Holweck-Lejay gravimeter at 55 stations in Algeria during 1946 are presented with brief explanatory notes. It is found that in the Chott Chergui region isoanomaly contours form a loop in the direction of Geryville, inviting further investigations, and in the Chott El Hodna region a zone of very pronounced negative anomalies registers minimum values within a narrow strip between Msila and Barika. Generally, isogravitational contours correspond closely with the isoseismic contours traced by Veselowsky for the earthquake of February 1946. A shifting of the gravity contours 10 kilometers to the north would result in their practically coinciding with the seismic contours.—*V. S.*

9973. Lejay, Pierre. Développements modernes de la gravimétrie [Modern developments in gravimetry], xii, 244 pp., 75 figs., Paris, Gauthier-Villars, 1947.

Modern advances in gravimetry are critically examined in the light of the evidence accumulated by investigations. Principal attention is given to the form of the geoid, problems of corrections, geologic significance of anomalies, and measurements at sea. In the course of the inquiry the formula of Stokes for the form of the geoid is expressed in agreement with de Graaf-Hunter, only the third degree terms of flattening being ignored, and an analysis is made of determinations of the absolute deviation of the vertical. Distinct simplification is introduced into calculations of topographic corrections. The isostatic corrections considered are primarily of the Pratt and Airy types. Isostatic theory is discussed with reference to its physical basis, and Bouguer anomalies in various explored regions are considered in their bearing on deep local geology. The work of Vening Meinesz on measurements at sea and of

Bullard in east Africa is described. A few pages are devoted to gravitational prospecting.—*V. S.* (A review appeared in Annales de Géophys., vol. 3, no. 3, p. 111, Paris, 1947.)

9974. Lukavchenko, P. I. Exploration of the geologic structure of oil-bearing formations in the Kirovobad region by gravimetric method [in Russian]: Azerbaidzhanskoe Neftianoe Khoz., no. 12 (258), pp. 12–14, Baku, 1947.

A gravimetric survey of the Kirovobad-Naftalan region, Caucasus, was begun in 1942. The general survey, finished in 1944, was followed by detailed exploration with a network of stations averaging one per square kilometer. The instruments used were an Ising quarter gravimeter and a Boliden gravimeter with nonastatic spring system. The accuracy of the final results, in the opinion of the author, is ± 0.3 milligal. The final computation of the field readings was made by the method of A. N. Tikhonov and Iu. D. Boulanger. The results of the surveys are presented in a map giving the isoanomalies with a 1 milligal contour interval. Several positive anomalies were disclosed by the survey.—*S. T. V.*

9975. Molodenskii, M. C. The gravimeter and its spring system [in Russian]: Prikladnaia Geofizika, no. 2, pp. 11–28, Moscow, 1945.

The structural elements of different types of gravimeters are analyzed. The study was made by the author as a preliminary step in designing a new gravimeter intended to embody the best features of modern gravimeters. The author concludes that the following features are highly desirable: A small "effective" temperature coefficient should be attained not only by compensation but by small temperature variation, the indication of the instrument should be insensitive to slight deviation of its axis from the vertical, uniform linearity of the scale of the instrument is desirable, displacement of the pointer must be appreciable, stress concentration in the spring system should be avoided, over-all dimensions of the instrument should be small, a nonastatic spring system is preferable, deformations of the housing should not affect the indications of the instrument, and range of the instrument should be from 500 to 1,000 milligals.

An analytical study is made of the dimensions of different parts of the new instrument and of their mutual positions to give the greatest possible accuracy. For the measurement and registration of displacements of the moving system the electric capacity variation, provided with electric amplification, was chosen. The new gravimeter is now under construction.—*S. T. V.*

9976. Morelli, Carlo. La rete geofisica e geodetica in Italia nel suo state attuale e nei suoi rapporti con le struttura geologica superficiale e profonda (Geophysical and geodetic network of Italy in its present state and its relation to surface and subsurface geologic structure): Istit. Geofis. Triste Pub., no. 222, 80 pp., Trieste, 1946.

Gravimetric measurements made by the different investigators who have surveyed various regions in Italy were collected by the author, critically analyzed, recalculated to common base station, and presented in the form of detailed tables and two gravimetric maps. Corrections and reductions of Fayé, Bouguer, isotatic, Bowie, and Burns are discussed and

applied to the measurements. In all, 1,029 measurements were used, of which 82 were made over sea or on small islands off Italy. The maps give the isoanomalies with 20-milligal contour intervals. The first part of the work by the same author contained geomagnetic data on Italy.—*S. T. V.* (*See also* Geophys. abstract 10007.)

9977. Niggli, Ernst. Über den Zusammenhang zwischen der positiven Schwereanomalie am Südfuss der Westalpen und der Gesteinszone von Ivrea [Concerning the relation between the positive gravity anomaly at the southern foot of the western Alps and the rock zone of Ivrea]: Inst. Geophys. Mitt., no. 8, 10 pp., Zurich, Switzerland, 1947.

The method of F. Gassmann and D. Prosen for the calculation of the gravity anomalies produced by three-dimensional masses has been used for determining the cause of the positive anomaly in the area on Lago Maggiore in southern Switzerland. The test has shown the method to be effective even in application to this case, which is not as simple as the theoretical example treated by Gassmann and Prosen. The anomaly in question extends in one direction practically to infinity, and the subterranean mass that must be regarded as its cause consists of several component blocks having different densities.—*Author's abstract, revised by V. S.* (For a description of the method *see* Geophys. abstract 9968.)

9978. Sans Huelin, Guillermo [Huelin, G. S.]. Probas realizadas y ensayos con el gravimetro electro-mecanico Askania no. 25 [Tests of the electromechanical gravimeter Askania no. 25 and experiments made with this instrument]: Inst. Geog. y Catastral Mem., vol. 16, no. 3, pp. 1–18, Madrid, 1944.

The gravimeter tested is an electromechanical type provided with a nonastatic system of springs. Elongation of the springs caused by a variation of the gravity is measured photoelectrically with vacuum tubes. A magnification as high as 50,000 was obtained. As a result, a variation of 1 milligal in the gravity force causes a displacement of 10 millimeters in the pointer of the instrument, thus making it possible to make readings with a precision of 0.1 milligal. Greater accuracy of measurement in practical surveys could be attained only by an extensive and very accurate preliminary survey of the terrain to be investigated in order to effect topographic reductions. The instrument is protected against temperature influence by an insulating casing and by an automatic thermostatic control powered by an auxiliary portable battery. The article contains a detailed description of the tests made of this instrument and a report on measurements of gravity made with it in Berlin, Madrid, Toledo, and Aranjuez. The results of these measurements were comparable in precision with the best pendulum observations previously made in these places. Seven plates illustrate the construction of the gravimeter.—*S. T. V.*

9979. Shwank, O. A. The density of rocks in the regions of the Samarskaia Luka and Buguruslan [in Russian]: Prikladnaia Geofizika, no. 3, pp. 159–172, Moscow, 1947.

To clarify the causes of inaccurate interpretation of gravitational data in the regions of Samarskaia Luka and Buguruslan, U.S.S.R., a study

was made of the density of local rocks. The local geology and the types of borehole cores employed are described, and the results are tabulated. It is found generally that, with increasing depth, the density and the age of rocks increase and their porosity decreases, when hydrochemical influences are insignificant.

These findings pose the question as to whether rock porosity decreases with depth, with age, or with a third factor. Such alternatives are examined, and porosity is found to depend principally on a third factor, which varies with locality and is influenced by age. The forms such a factor can assume are deemed to be pressures either produced in the course of tectogenesis or caused by the load of changing water masses.—*V. S.*

9980. Siñeriz, J. G. Estudio critico del gravimetro Noorgard modelo 1946 [Critical study of the Nørgaard gravimeter model of 1946] : Rev. Geofis., vol. 6, no. 23, pp. 381–408, Madrid, 1947.

This study deals with Nørgaard's gavimeter model of 1946, which is typical of instruments that measure the intensity of gravity by the torsion of a filament of quartz without recourse to the principle of astaticism. The description of the apparatus is accompanied by an original theoretical exposition of its mode of operation, and special attention is given to the correction for temperature with a view to determining the conditions which the gravimeter must satisfy to avoid the effects of thermal variation.

There is also consideration of the displacement of the zero, or drift, which does not exceed 0.05 milligal per hour under normal working conditions. The accuracy of readings and of Δg is found to be of the order of ± 0.035 milligal, provided there is no exceptional variation of temperature. Finally, the springs employed in the apparatus are discussed, and consideration is given to the advantages of such a system.—*Author's abstract, translated by V. S.*

9981. Steenland, N. C. Deflection of the vertical in the Bahamas [abstract] : Geophysics, vol. 12, no. 3, p. 497, Tulsa, Okla., 1947.

Discrepancies between astronomic and geodetic distances between stations in the Bahamas are discussed with reference to the great topographic relief of the area.

9982. Stoyko, Nicolas. Sur la variation jouralière de la marche des pendules et de la deviation de la verticale [On the diurnal variation of pendulum motion and of plumb line deflection] : Acad. Sci. Comptes. Rendus, vol. 224, no. 20, pp. 1440–1441, Paris, 1947.

A study was made during 1940–43 of the diurnal variation of pendulum motion in clocks at the Observatory of Paris. The calculation of the maximum deviation of the vertical, based on the results of this study, gave a value nearly identical with one determined by L. Eblé from direct observation of horizontal pendulums at the observatory in 1919. The close coincidence between the diurnal variation of the motion of the pendulum and that of the deviation of the vertical is interpreted to mean that both variations have the same cause, traceable to the thermal effects of sun rays.—*V. S.*

2. MAGNETIC METHODS

9983. Bărbat, M. T. Recherches magnétiques dans la région de Cârnecea-Calina, dép. de Caras, pendant l'année 1934 [Magnetic investigations in the region of Cârnecea-Calina, district of Caraș, during the year 1934]: Inst. Géol. Roumanie Comptes rendus, vol. 23, pp. 117–123, Bucharest, 1940.

The existence of a mineralized zone of banatites at the contact between Mesozoic limestones and crystalline schists in the district of Caraș, Rumania, prompted the author to make a magnetic survey in the adjacent Cârnecea-Calina area in order to determine whether mineralization extended into the local limestone anticline. The vertical geomagnetic component was measured with an Askania-Schmidt variometer over a network of 230 stations spaced 25 to 100 meters apart and covering about 7 square kilometers. The results showed very small magnetic variations and gave no indication that metasomatic contacts had produced at this place metalliferous mineralization of the type of ferrous oxides and sulfides. It is concluded that the anticline investigated is not near enough to the banatite zone to have undergone the same geologic processes.—*V. S.*

9984. Bozorth, R. M. Magnetism: Rev. Mod. Phys., vol. 19, no. 1, pp. 29–86, Lancaster, Pa., 1947.

Magnetism is discussed in the light of past theories and with reference to the nature of ferromagnetic phenomena and materials, the effects of various factors on magnetic properties, the phenomena of diamagnetism and paramagnetism, and present theory of ferromagnetism. The methods of measurement under consideration include ballistic techniques, alternating-current techniques, the use of magnetometers, and other general and special methods.—*V. S.*

9985. Burch, J. E. Cartographic aspects of the airborne magnetometer: Photogram. Eng., vol. 13, no. 4, pp. 633–639, Menasha, Wis., 1947.

The airborne magnetometer is particularly well suited to reconnaissance surveys over large areas of inaccessible terrain and furnishes data sufficiently precise to determine positions within about 100 feet. On the other hand, such a terrain is rarely mapped topographically on a small scale and with great accuracy, and wide water-covered spaces offer no landmarks. Therefore, the chief cartographic problem in aeromagnetic surveys is usually the accurate position fixing of magnetic readings. The use of shoran and its difficulties in practice are discussed, and the over-land operational technique of the Fairchild Aerial Surveys is described. The acuracy of position fixes by this technique is believed to be within 150 feet.—*V. S.*

9986. Burgaux, S. J., and Lou, Z. T. Carte magnétique de Chine [Magnetic map of China]: Observatoire de Zi-Ka-Wei, Études sur le Magnétisme Terrestre, Étude 40, no. X, 74 pp., Zi-Ka-Wei near Shanghai, China, 1937.

The geomagnetic maps of China prepared at the Zi-Ka-Wei Observatory include 4 charts of secular variation in declination for the years 1909–36 and 2 charts of isogons for epochs 1915 and 1936; 3 charts of

secular variation in horizontal intensity for the years 1908–36 and a chart of isogons for epoch 1936; and 2 charts of secular variation in vertical intensity for the years 1908–36 and a chart of isogons for epoch 1936. The underlying data at 385 field stations and at 63 repeat stations are tabulated for 8 separate areas of China, the methods of their reducation are indicated, and the anomalies appearing on the maps are discussed.—*V. S.* (A review appeared in Terres. Magn. and Atmos. Electr., vol. 52, no. 4, p. 504, Baltimore, Md., 1947.)

9987. Chapman, Sydney. Variation of geomagnetic intensity with depth, with reply by S. K. Runcorn: Nature, vol. 161, no. 4080, p. 52, London, 1948.

Recently S. K. Runcorn derived from Blackett's theory a formula for the ratio of the horizontal magnetic intensity at a given depth to the intensity on the surface. A. L. Hales and D. I. Gough compared the results computed by this formula both with those obtained from their empirical measurements of horizontal magnetic intensity at a depth of 4,800 feet and with those computed by the formla corresponding to any conventional theory which places the source of the geomagnetic field wholly in the earth's core (see Geophys. abstract 9993).

The author points out that Runcorn's formula cannot be correct, because it does not agree with the formula of the "core" theories when the mean density of rocks down to the depth of the performed measurements is zero, and gives a formula which he considers accurate. Runcorn answers that his formula cannot satisfy the indicated requirement because it involves an approximation concerning rock densities which is only applicable to spheres with a density distribution departing slightly from uniformity, as is roughly true of the earth.—*V. S.*

9988. Coulomb, J. Prévision de la variation diurne de la déclinaison magnétique [Forecasting the diurnal variation of magnetic declination]: Acad. Sci. Comptes rendus, vol. 224, pp. 1727–1728, Paris, June 16, 1947.

Use is made of an equation in the form $\Delta_r(t)=(r+r_0)D(t)$ for representing the sum total of monthly diurnal variations typical of any selected month of each year, such as January, and a method is indictated for obtaining the 12 values of r_0 and the 12 x 24 values of $D(t)$. Numerical data will be published in the Annuaire du Bureau des Longitudes for 1948.—*Cent. Nat. Rech. Sci., Bull. Anal., vol. 8, no. 10, pt. 1, p. 2306, Paris, 1947, translated by V. S.*

9989. Dolginov, S. Concerning the American areomagnetometer [in Russian]: Razvedka Nedr, vol. 13, no. 3, pp. 45–51, Moscow, 1947.

The principles underlying magnetic instruments are discussed in the light of a critical review of the investigations made in various countries during the last 15 years, which culminated in the design of airborne magnetometers in the United States. Consideration is given to different types of transformer and choking-coil models, such as the magnetometer of Aschenbrenner and Goubau for the registration of abrupt geomagnetic disturbances, the portable magnetometer of Turney and Cousing, and the instrument of I. L. Bershtein based on the principle of superposed magnetic fields, and to the work of W. Krammer on

changes of alternating current in areas of magnetic saturation, the designs developed by G. S. Gorelik and the Institute of Terrestrial Magnetism in the U.S.S.R., and other investigations and inventions. The features of the models considered advantageous are analyzed mathematically.—*V. S.*

9990. Dreyer, R. M. Magnetic survey of southeastern Crawford County, Kansas: Kansas Univ., Geol. Survey Bull 70, pt. 5, pp. 107–115, Lawrence, Kans., 1947.

A magnetic survey of southeastern Crawford County was undertaken in an attempt to develop a technique for mapping geologic structures in detail over large areas, to aid in exploration for a northward extension of the Tri-State zinc and lead mining district in Kansas.

The magnetometer was found suitable for delineating the location and trend of significant structures in this area. It is indicated that local magnetic anomalies probably bear an inverse relationship to structural elevation and that structures exist which might be favorable for the localization of lead and zinc deposits. Therefore, exploratory drilling for the purpose of locating ore bodies would be justified, especially along minor structural highs inferred from the magnetic survey.—*Author's abstract.*

9991. Eckersley, T. L. Differential penetration and magnetic storms: Terres. Magn. and Atmos. Electr., vol. 52, no. 4, pp. 433–440, Baltimore, Md., 1947.

There are two types of magnetic storms, both associated with the approach of a neutral stream of charged particles to the earth. One type is caused by slowly moving particles which are separated out into a ring stream before they reach the ionosphere. The other type is produced by more swiftly moving particles that penetrate the ionosphere and set up, by a process of differential penetration, a vertical electrical field. This field, combined with the earth's magnetic field, generates a westerly drift of the ions in the F-layer, with a consequent reduction in the F-layer density and the production of an abnormal E-layer by the positive ions in the neutral stream. The drift current itself is responsible for the violent change in the earth's magnetic field.—*Author's summary, condensed by V. S.*

9992. Galbraith, F. M. The magnetometer as a geological instrument at Sudbury: Am. Inst. Min. Met. Eng. Trans., vol. 164, pp. 98–103, New York, 1946.

This paper describes the use of the magnetometer, under geologic direction, in the exploration of the Sudbury nickel district. The writer's experience at Falconbridge has led him to the belief that only through detailed work and by careful correlation of both geological and geophysical results can geophysical prospecting methods be applied successfully to mining exploration problems. It is hoped that the basic technique described in the paper will be found to have general application.—*Author's abstract.*

9993. Hales, A. L., and Gough, D. I. Blackett's fundamental theory of the earth's magnetic field: South African Sci., vol. 1, no. 6, pp. 118–120, Johannesburg, 1948.

Explanations of the earth's magnetic field can be divided into two types—conventional theories which attribute the field to some property of the terrestrial core, such as ferromagnetism or convection currents, and the recent fundamental theory of P. M. S. Blackett, according to which the magnetic field of a rotating body is that of a dipole having a strength proportional to the body's angular momentum.

To determine which explanation is correct, S. K. Runcorn made calculations based on the deduction that, if the first theory is true, the magnetic field at a point lying underground but outside the core should be unaffected by the matter above it, whereas, if the second theory is true, the opposite should occur, because the entire matter of the earth contributes to the field in proportion to its angular momentum. His results showed that Blackett's theory demands a decrease of the horizontal geomagnetic component with depth, whereas the other theory requires its increase with depth. For empirical verification the authors made a series of measurements of the horizontal component with Askania magnetometers in a Witwatersrand mine both at a mean depth of 4,800 feet and at the surface and obtained tentative results favoring Blackett's theory. The experiment is described, and the findings are given.—*V. S.* (For Blackett's theory *see* Geophys. Abstracts 132, no. 9745.)

9994. Harang, Leiv. Pulsations in the terrestrial magnetic records at high latitude stations: Norske Vidensk. Akad. Geofys. Pub., vol 13, no. 3, 12 pp., Oslo, 1942.

A study is made of "giant pulsations" of the terrestrial magnetic field, often noticeable on records from magnetic observatories situated near the auroral zone. These pulsations are regularly occurring periodic disturbances. As a main source of information for the study of these phenomena the records of the magnetic observatory in Tromsø during the years 1929–41 were used. The author finds that the annual variation of these pulsations indicates two maxima at the equinoxes and a diurnal maximum between 8 and 10 a. m. The intensity of these pulsations also varies with the latitude of the observatory.—*S. T. V.*

9995. Instituto Geografico y Catastral. Carta nacional de declinaciones magneticas, hoja especial del Archipielago Balear [National map of magnetic declinations, special sheet covering the Balearic Isles], 32 pp., Madrid, 1942.

This is an issue of the work of the Geographic and Cadastral Institute of Spain devoted to the Balearic Isles. An introductory chapter deals with the history of magnetic measurements carried out on these islands, explains the details of the preparation of the map, and also discusses the general geologic structure of the Balearic Isles. The map is drawn on a scale of 1:500,000, and data correspond to July 1, 1942. Nine smaller figures illustrate several points of interest.—*S. T. V.*

9996. Ising, G. Nya metoder för magnetometri [New methods of magnetometry]: Teknisk Tidskr., vol. 76, pp. 1299–1306, 10 figs., Stockholm, Dec. 14, 1946.

An account is given of the various methods and recently introduced instruments for measuring the terrestrial magnetic field, designed particularly for determinations aboard ships and airplanes. The instruments include direct-reading models and electromagnetic induction models.—*Cent. Nat. Rech. Sci., Bull. Anal., vol 8, no. 10, pt. 1, p. 2306, Paris, 1947, translated by V. S.*

9997. James, H. L., Clark, L. D., and Smith, L. E. Magnetic survey and geology of the Ice Lake-Chicagon Creek area, Iron County, Michigan: U. S. Geol. Survey Strategic Min. Investig. Prelim. Rept. 3–213, 11 pp., 6 pls., Washington, D. C., 1947.

As a part of a general re-study of the Iron River-Crystal Falls district in Michigan, a magnetic survey was made during 1944–46 in the Ice Lake-Chicagon Creek area where iron ore was mined in 1909–34. Approximately 11,000 stations were occupied, in part with Hotchkiss Superdips and in part with an Askania vertical magnetometer, having sensitivities of about 40 gammas and 17.5 gammas per scale division, respectively. The determinations were made for the most part at spaced intervals of 100 feet along compass lines 200 to 400 feet apart.

The magnetic results and the inferred geology are presented in 5 maps which show numerous anomalies sometimes exceeding 1,000 gammas. The largest and most persistent anomalies are recorded over magnetic slate, whereas broad areas of weak anomaly are found over hanging-wall beds located stratigraphically below the strong magnetic horizon. Provisional interpretations of the anomalies lying outside the main hanging-wall basin have been to the effect that the crest in most cases is situated over the axis of a syncline rather than over a single bed. Other findings are given.—*V. S.*

9998. Jelstrup, H. S. Observations de radio et de magnétisme terrestre faites pendant l'éclipse 9 juillet 1945 [Observations of radio and geomagnetism during the eclipse of July 9, 1945]: Norske Vidensk. Akad. Avh. 1946, Math.-Natur. Kl., no. 4, 13 pp., Oslo, 1946.

The author made observations at Mo i Rana, Norway, during the solar eclipse of July 9, 1945, in order to determine the intensity of radio signals passing through a zone of total eclipse, to measure the variations of the vertical geomagnetic component, and to compare both results with identical measurements on the day preceding the eclipse. A Philips recording field-strength meter and a zero magnetic balance B. M. Z. were used for the measurements. The findings are presented in tables and graphs. They show that the intensity of radio signals declined and the magnetic intensity rose during the day of the eclipse. Other conclusions are given.—*V. S.*

9999. Jensen, Homer, and Peterson, E. F. Prospecting from the air: Sci. Am., vol. 178, no. 1, pp. 24–26, New York, January 1948.

The use of the airborne magnetometer for exploration of mineral deposits is described and illustrated by the Bahamas survey. The instrument, carried by a plane flying at an altitude of 300 to 1,500 feet

with a speed of about 125 miles per hour, can furnish data on an area of 1,000 to 10,000 square miles per month. It traces a continuous profile of relative magnetic intensity and gives the generalized pattern of the area rather than the discrete information collected by ground surveys. Position fixing can be made by means of Shoran or with a gyro-stabilized continuous-strip camera, which provides an unbroken record of a flight path 700 feet in width and 400 miles in length. More than a quarter of a million square miles have been mapped by the airborne magnetometer since its first preliminary runs in 1941.—*V. S.*

10000. Joesting, H. R., Bacon, L. O., and Getz, J. H. Geophysical investigation of manganiferous iron deposits, Boston Hill, Grant County, New Mexico: U. S. Bur. Mines, Rept. Inv. 4175, 12 pp., 14 figs., Washington, D. C., February 1948.

During 1945 geophysical surveys were made at the Boston Hill mine works, New Mexico, in search for possible extensions of the local manganiferous iron deposits. In this area the exposed Paleozoic formations are cut by several hornblende-diorite porphyry dikes and by an intrusive of quartz monzonite porphyry, both of Laramide age, and mineralization is confined to Ordovician and Silurian dolomites. Magnetic and electrical resistivity survey methods were chosen on the basis of sample tests, which showed the ore to be magnetic and porous and the dolomite nonmagnetic and dense.

The magnetic survey, made with a vertical Askania magnetometer over an area of 1 square mile, with stations spaced at 50-foot and 100-foot intervals on lines 200 feet apart, revealed a considerable number of strong and localized anomalies measuring as much as 1,000 gammas or more, which indicated the presence of magnetic bodies close to the surface. To determine the extent and variation of mineralization, tests were performed on local ore samples for comparing their magnetic susceptibility with their metallic content. The electrical survey, carried out in selected places essentially for experimental purposes, with an electrode spacing calculated to measure earth resistivity to a depth of 80 feet, furnished additional indications on deposits. Resistivity lows generally were found to coincide with magnetic highs.—*V. S.*

Jones, W. A. Experience with some electrical and magnetic methods of prospecting. *See* Geophys. abstract 10083.

10001. Kalashnikov, A. G., and Krasnogorskaia, N. V. Investigation of the "magnetic" tube of Kubetskii used as indicator of the intensity of a magnetic field [in Russian]: Acad. Sci. U. R. S. S. Comptes rendus (Doklady), new ser., vol. 56, no. 7, pp. 703–705, Moscow, 1947.

The deviation of electrons in a cathode ray tube by the action of a transverse magnetic field has often been used for the measurement of the intensity of this field. The present article reports the results of experiments in which the secondary emission of electrons was used in order to increase the sensitivity of the method. Kubetskii's magnetic tube with a Cu-S-Cs cathode and six stages of amplification was employed. Its photoelectric sensitivity is 1.3 microampere per lumen. The sensitivity of the instrument to variations of the intensity of the

magnetic field is 14 microamperes per oersted. The authors state that the instrument can be used to good advantage for precise magnetic measurements and that its sensitivity can be greatly increased. It is useful in geophysical exploration.—*S. T. V.*

10002. Kalinowska, Zofia. Izogony w Polsce na rok 1947 [Isogons in Poland for the year 1947]: Observ. Géophys. à Swider Trav., no. 11, 6 pp., 1 map, Warsaw, 1947.

The magnetic isogonic map of Poland for 1947, presented herewith, is based on observations made before the war at the Geophysical Observatory at Swider, Poland, and, for the western region, partly at the Potsdam Observatory (Magnetische Vermessungen, 1935). Use has been made also of the control observations conducted by the Geophysical Observatory at Swider in the summer of 1946. Appended tables 1 and 2, showing the corrections for each month and for each hour, are taken from Transactions of the Geophysical Observatory at Swider, no. 7, Isogons in Poland for the year 1935.—*Author's abstract, translated by V. S.*

10003. Keller, Fred, Jr., Balsley, J. R., Jr., and Dempsey, W. J. Field operations and compilation procedure incidental to the preparation of isomagnetic maps: Photogram. Eng., vol. 13, no. 4, pp. 644–647, Menasha, Wis., 1947.

Since 1943 the Geological Survey in cooperation with other agencies has surveyed more than 200,000 square miles of territory with the airborne magnetometer. The field operations and compilation procedures developed in the course of this work for the preparation of isomagnetic maps are described.

Field operations consist mainly in planning suitable traverses, determining the location of the airplane, eliminating the effects of magnetic diurnal variation and instrumental drift, and measuring magnetic values. The records obtained include a base map with check-point locations, a record of the magnetic profile with identification marks and numbers for position fixing, a radar altimeter record with edge marks, a continuous-strip film of the terrain with check-point numbers, and a log of direction for each flight line.

For compilation a mechanical device can be used to transform recorded magnetic profiles to rectangular coordinates, to adjust the vertical or magnetic scale to any desired value, to remove discontinuities in recording, and to correct the distance scale to that of the check-points plotted on the maps.—*V. S.*

10004. Koulomzine, T., and Massé, L. Magnetic anomaly of inclined vein of infinite length: Am. Inst. Min. Met. Eng. Tech. Pub. 2260, Min. Technology, vol. 11, no. 6, 17 pp., New York, 1947.

The first part of this paper describes an easy method of computing anomalies caused by infinitely long dikes, which applies equally well to wide dikes and to thin veins. It is more accurate and faster than the graphical methods suggested by Puhoux and Lee and should be of interest to geophysicists engaged in solving geologic and mining problems.

The second part concerns the interpretation of the thick dike anomaly. The proposed method yields accurate results with a minimum of actual

computation, though it requires some care in field measurements.—*Authors' summary, condensed by V. S.*

10005. Malinina, N. E. The magnetic field of western Siberia [in Russian, with English summary]: Acad. Sci. U.R.S.S. Bull. (Izvestiia), Sér. Géog. et Géophys., vol. 11, no. 1, pp. 61–78, Moscow, 1947.

A map of the regional magnetic anomalies of western Siberia has been prepared from data of the general magnetic survey conducted during 1931–43 by the Institute of Terrestrial Magnetism, U.S.S.R. These data comprised determinations at 4,116 absolute stations and 24,457 relative stations. Measurements of the vertical component made by different crews varied in accuracy from ±100 to ±200 gammas. For successive stations occupied with the Schmidt balance by the same crew, the accuracy of the differences ΔZ approximated ±20 gammas. Anomalies were calculated with reference to the normal field of the U.S.S.R. for epoch 1935.

The map shows the magnetic field of western Siberia to be much less disturbed than that of European U.S.S.R. Instead of extended, intensive anomalies there are numerous relatively small anomalies marked by abrupt changes in magnetic values. The map is the first published on the regional magnetic anomalies of western Siberia.—*V. S.*

10006. Mariani, Jean. Théorie des champs macroscopiques [Theory of macroscopic fields], 98 pp., Paris, Centre de Documentation Universitaire, 1947. [Mimeographed.]

According to P. M. S. Blackett the proportionality observed between the magnetic moment and the angular momentum of massive rotating bodies, such as the earth, sun, and stars, probably can be explained only by a unified field theory. (See Geophys. Abstracts 132, no. 9746.) Such a theory is advanced by the author, who has dealt with the problem in several recent papers and now discusses the unified field in more inclusive terms, showing that a gravitational field is necessarily accompanied by an electrical field. The treatment is broadly generalized and philosophical. The equations of the unitary macroscopic field are deduced, the conditions at the limits are examined, and other problems are considered. The theory is applied further to massive rotating bodies and their magnetic fields in a way similar to that of Sutherland, discussed in Blackett's paper.—*V. S.* (For a list of Mariani's earlier papers *see* a note by H. T. H. Piaggio in Nature, vol. 161, no. 4090, p. 450, London, 1948.)

10007. Morelli, Carlo. La rete geofisica e geodetica in Italia, 1, Stato attuale—rete magnetica [The geophysical and geodetic network in Italy, 1, Present state —magnetic network]: Istit. Geofis. Trieste Pub., no. 222, pp. 1–42, Trieste, 1946; also Tecnica Italiana, vol. 1, no. 1, pp. 3–41, Trieste, 1946.

The data on the Italian magnetic network established by the Military Geographic Institute are presented in a form suitable for use in geophysical prospecting. The observations of the geomagnetic field at all stations are tabulated, and the anomalies of the declination and the horizontal component are shown on two maps. The explanatory text deals with the net of absolute stations of the first order, accessory calculations, precision of measurements, plotting of the anomalies, and related questions. A bibliography is appended.—*V. S.*

10008. Newton, H. W. Note on "sudden commencements" and other small characteristic impulses: Terres. Magn. and Atmos. Electr., vol. 52, no. 4, pp. 441–447, Baltimore, Md. 1947.

The comparison of magnetograms from the Royal Observatory, Greenwich, and the Cheltenham Magnetic Observatory, Maryland, is found to contribute additional data to previous observations that the "sudden commencements" recorded around 08^h have a tendency to be inverted and that a close correspondence in time and character exists among other small trace movements. It is concluded that reproductions of magnetograms from various observatories have an immediate value both in the study of the features of sudden commencements recorded at any one observatory and in the investigation of the "similarity phenomenon" as to the time and character of other small impulses which is apparent in the records of widely separated observatories. Besides the unmistakable sudden commencements, there seems to be evidence that certain analogous rapid impulses exist over wide areas of the earth, if not throughout the world. Coordinated data on all these possibly related phenomena may have, it is considered, an important bearing on general theory.—*V. S.* (*See also* Geophys. Abstracts 132, no. 9772.)

10009. Newton, H. W. "Sudden commencements" in the Greenwich magnetic records, 1879–1944, and related sunspot data: Roy. Astron. Soc. Monthly Notices, Geophys. Suppl., vol. 5, no. 6, pp. 159–185, London, 1948.

Statistics of "sudden commencements"—their average amplitude, direction of impulse, hourly and monthly frequencies—are derived from 681 cases identified on the Greenwich magnetograms over six sunspot cycles. It is found that, besides the sudden commencements marking the onset of many geomagnetic storms, there are frequent cases in which no appreciable disturbances follow. About half of all sudden commencements have, in opposition to the main impulse, a small preliminary impulse, the presence of which seems subject to some diurnal effect. Other diurnal and seasonal effects are detected. The occurrence of sudden commencements in relation to the sunspot cycle and to individual sunspots is investigated. An addendum gives the results of a sample comparison of sudden commencement pulses and other minor movements on the Abinger and Lerwick magnetograms.—*Author's abstract, condensed by V. S.*

10010. Roberts, E. B. Magnetic work of the United States Coast and Geodetic Survey from July 1, 1946, to June 30, 1947: Am. Geophys. Union Trans., vol. 29, no. 1, pp. 104–106, Washington, D. C., 1948.

The magnetic work of the United States Coast and Geodetic Survey from July 1, 1946, to June 30, 1947, consisted in magnetic field observations, provision of magnetic data for various organizations, collection of observational material in a central depository, preparation of isogonic charts, publication of reports, operation of observatories, and instrumental activities. Field observations, partly at repeat stations, were made in the United States, central and northern Alaska, Ecuador, Bolivia, Peru, Chile, Argentina, Uruguay, Brazil, Panama, New Zealand, an Arctic area near the north geomagnetic pole, and Little America in the Antarctic.—*V. S.*

10011. Scott, W. E. Mean *K*-indices from thirty magnetic observatories and preliminary international character-figures, *C*, for 1946: Terres. Magn. and Atmos. Electr., vol. 52, no. 4, pp. 497–503, Baltimore, Md., 1947.

Geomagnetic activity—the frequency and intensity of magnetic disturbance—is supposed to indicate the influence of solar corpuscular radiation on the earth. Magnetic disturbance also has associations with other terrestrial phenomena similarly correlated with solar changes, and notably with auroras, earth currents, and disturbances of the ionosphere such as those measured by radio methods. Two schemes for magnetic characterization, adopted by international agreement, are three-hourly range index *K* and daily character-figure *C*, as follows:

K-index.—Three-hourly range indices, *K*, characterize the variation in the degree of irregular magnetic activity throughout each Greenwich day, for the intervals 0–3, 3–6, ... 21–24 hours G. m. t. Each observatory has definite, fixed standards or scales for *K*, measured in units of force (gamma). The indices range from 0, very quiet, to 9, extremely disturbed. Mean indices, K_M, are derived for each three-hourly interval from the individual indices *K* assigned at each observatory.

Character-figure C.—The *C*-figures classify Greenwich days on a scale of 0–1–2 (the character "0" applies to quiet, "1" to moderately disturbed, and "2" to greatly disturbed day). They are thus useful in describing and comparing the degree of magnetic activity day by day. For each day the mean of the figures supplied by all the cooperating observatories is taken, to one decimal place, and the result is called the international magnetic character figure *C.—Author's abstract.* (The present series of preliminary mean values of the geomagnetic indices *C* and *K* are concluded with the publication of the figures for 1946. It is proposed hereafter to issue final values of these indices for current years and also to cover the period 1940–56.—*V. S.*)

10012. Slaucitajs, L. Magnetic elements of Latvia for 1940.5: Baltic Univ. Contr., no. 21, 24 pp., Pinneberg, Germany, 1947.

Tables are given of the magnetic elements for 1940.5 in Latvia, determined by surveys over land and sea in 1932 and 1937–43 and reduced to common epoch. They include tabulations for stations where all magnetic elements were measured and tabulations for stations occupied for partial determinations. The previously published data of the *Z*-net and of special measurements of magnetic elements in anomalous areas are not included (see Geophys. Abstracts 132, no. 9769.)—*V. S.* (Additional information can be found in the following studies by the same author: On the geomagnetic secular variation in the past centuries at Riga: Baltic Univ. Contr. 7, 6 pp., Hamburg, 1946; Isomagnetic maps of Baltic Countries: Baltic Univ. Contr. 18, 1 p., 3 maps, Hamburg, 1946.)

10013. South African Mining and Engineering Journal. Magnetometric surveying: Vol. 58, pt. 2, no. 2849, p. 49, Johannesburg, 1947.

A brief account is given of the successful location of magnetic minerals by the use of the magnetic airborne detector, developed in the United States. Demonstration trials of the airborne magnetic detector were conducted in the Sudbury and Val d'Or areas by the Geological Survey using American Naval equipment. It is felt that this device is a revolu-

tionary method of geophysical exploration and will result in a tremendous saving of time.—*S.T.V.*

10014. Suslennikov, V. V. Principal results of the aeromagnetic survey in the Karelian-Finnish S.S.R. [in Russian]: Razvedka Nedr, vol. 13, no. 5, pp. 67–71, Moscow, 1947.

An account is given of the main results of the aeromagnetic survey of 1945–46 conducted in the Karelian-Finnish S.S.R. in quest of ferro-quartzite ores, generally considered geologically improbable in this region. An area of more than 125,000 square kilometers was investigated, and as many as 40 anomalies were discovered, some of them so intense that the range of the instruments was exceeded even from a flying height of 450 meters. Three anomalies are discussed.

Two positive anomalies were detected near Lake Gimola, the values of the vertical component for the larger of them reaching 164,000 gammas measured on the ground. Both were interpreted to be due to ferro-quartzite deposits, as was subsequently confirmed by drilling. The minimum depth of the lower boundary of the deposits causing the larger anomaly was calculated by the formula of A. P. Kazanskii and found to be 150 meters. The calculations are presented (for the derivation of the formula *see* Geophys. Abstracts 100, no. 5323).

The third and most extensive anomaly, distinguished by high negative values, was located near Lake Kimas and also was shown by drilling to be due to ferro-quartzites.—*V. S.* (For a preliminary report on the survey *see* Geophys. Abstracts 130, no. 9361.)

10015. Toperczer, M. Erdmagnetische Bodenuntersuchungen in der Südoststeiermark [Geomagnetic surveys in the southeastern portion of Styria]: Berg- und Hüttenmännische Monatsh. Montan. Hochschule Leoben, vol. 92, no. 10–11, pp. 157–165, Vienna, 1947.

Magnetic surveys made in the years 1936–39 in Austria, especially in the region around the city of Graz, are reported. The vertical component of magnetic intensity was measured by means of an Askania magnetic field balance. In these surveys 841 field stations, with an average distance of 1.5 kilometers, were covered. At four points absolute determinations of the magnetic intensity were made. The intensity of the magnetic field at a point of the earth's surface is composed of three parts—the first determined by the magnetism of the whole terrestrial globe, the second by the regional influences of continental scale, and the third by the influence of local magnetic masses. The last is the most interesting from the practical point of view. A map drawn on a scale of 1:150,000 covers an area of 20 by 25 km.^{2} and shows isonanomalies from -80γ to $+180\gamma$ with a 10γ contour interval. The data are reduced to the epoch of 1930.0.—*S.T.V.*

10016. Tuckerman, Bryant. Graphs of the induced magnetic moment and shielding effect of a spherical shell in a uniform magnetic field: Terres. Magn. and Atmos. Electr., vol. 52, no. 3, pp. 369–373, Baltimore, Md., 1947.

Graphs are presented of values computed by conventional formulas for the induced magnetic moment and the shielding effect of a spherical shell of constant permeability placed in a uniform magnetic field. They

show the extent of the magnetic shielding due to a spherical shell, the induced magnetic moment of a spherical shell relative to a solid sphere of infinite permeability, and the induced magnetic moment of a spherical shell relative to a solid sphere of the same permeability. The underlying mathematics, the principles of plotting, and the applications of the graphs are discussed briefly. The problem is considered to be of interest in the theory of the deviations and compensation of the magnetic compasses and in the shielding of electromagnetic instruments from external magnetic fields.—*V. S.*

10017. Tuve, M. A., and Harradon, H. D. Summary of the year's work to June 30, 1947, Department of Terrestrial Magnetism, Carnegie Institution of Washington: Terres. Magn. and Atmos. Electr., vol. 52, no. 4, pp. 523–530, Baltimore, Md., 1947.

A brief review of the past history of the department is given, and a reorientation of activities toward a laboratory and experimental type of research, contemplated with the completion of the war program, is discussed. Among the long-range problems unsolved by past work are listed the origin of the main part of the earth's large magnetic moment, and the maintenance of the terrestrial electric charge in spite of a strong constant current from the air to the earth. For the solution of these and other more immediate and limited questions, the plans for the next few years call for varied investigations of relatively short duration in the fields of magnetism, exploratory geophysics, laboratory physics, and biophysics, to be conducted in cooperation with other agencies who will carry a large share of the work. Thus, further research should become essentially that of a physics department, with special emphasis on geophysical experiments.—*V. S.*

10018. U. S. Coast and Geodetic Survey. Magnetograms, Honolulu, T. H., January-June 1946: Serial MG–H46.1, 106 pp., Washington, D. C., 1947.

This report is the first of a series planned to present the records of the Honolulu Magnetic Observatory in a new form. It shows reduced reproductions of the magnetograms obtained during the period covered. Continuous records of the declination, D, horizontal intensity, H, and vertical intensity, Z, for each day are presented. Full-size copies of the original magnetograms will be furnished at a nominal cost if a definite need can be shown. An explanatory introduction gives the necessary information on details of the observation made and the content of the tables.—*S. T. V.*

10019. Wallis, W. F., and Green, J. W. Land and ocean magnetic observations, 1927–44: Carnegie Inst. Washington Pub. 175, 243 pp., Washington, D. C., 1947.

This volume, the eighth in the series "Researches of the Department of Terrestrial Magnetism," contains results of magnetic investigations conducted the world over during the 18 years from 1927 to 1944. The data are presented in two extensive tables, one for land and one for the oceans, and are accompanied by an explanatory text on methods, instruments and measurements, detailed reports by field observers, and descriptions of the stations occupied. Previous results of the magnetic

observations made on land were given in volumes 1, 2, 4, 6, and 7, and of the magnetic observations made at sea in volumes 3 and 5.—*V. S.*

10020. Wasserfall, H. F. The horizontal component of magnetic intensity at Oslo Observatory 1843–1930: Norske Vidensk. Akad. Geofys. Pub., vol. 13, no. 2, 52 pp., Oslo, 1941.

The present publication contains tables of values of the horizontal component of magnetic intensity at Oslo Observatory taken daily at 9 a. m. and 2 p. m. during the years 1843–1930. The geographic coordinates of the station are: latitude, 59°54.7′ N; longitude 10°43.4′ E. A short introductory chapter gives a description of instruments and methods used during the period of observation.—*S. T. V.*

10021. Wyckoff, R. D. The Gulf airborne magnetometer: Geophysics, vol. 13, no. 2, pp. 182–208, Tulsa, Okla., 1948.

Airborne magnetometer operations involve two basic problems: Measurement of the magnetic field intensity and navigation of the aircraft to provide the desired profile configuration and accurate mapping of the profiles flown. Currently the navigation and mapping presents the most serious problem if the operation is to be made completely airborne. A brief outline of the magnetometer instrumentation is presented, together with a discussion of the mapping problem. Examples of results are given.—*Author's abstract.*

3. SEISMIC METHODS

10022. Berger, L. Quelques observations sur le séisme des 25 et 26 janvier 1946 en Haute-Savoie [Some observations on the earthquake of January 25–26, 1946, in Haute-Savoie); Météorolgie, no. 2, pp. 224–228, 2 maps, Paris, Apr.–June 1946.

The earthquake in question had an epicenter in the Valais. Observations appear to show that seismic vibrations reached their maximum intensity along the axis of the geologic masses oriented in the direction of shock oscillation and their minimum intensities behind the mountain chains disposed perpendicularly to the axis of the propagation of these oscillations.—*Cent. Nat. Rech. Sci., Bull. Anal., vol. 8. no. 9, pt. 1, p. 2002, Paris, 1947, translated by V. S.*

10023. Bernard, Pierre. Sur la cause des "microseismes" à grande période [On the cause of "microseisms" with a long period]: Ann. Géophys., vol. 3, no. 1, pp. 96–100, Paris, 1947.

Seismograms, recorded by the vertical modified Galitzin instrument at the Institute of the Physics of the Globe in Paris, were studied for determining the causes of irregular oscillations occasionally observed in the records of seismographs sensitive to long periods. These oscillations are known to have periods of as much as 30 seconds and can persist for several hours. C. Maurin, L. Eblé, and F. Whipple have explained such oscillations within the horizontal component as caused by the action of the wind.

The present study reveals that oscillations, particularly in the vertical component, occur also in the absence of wind. The results, obtained

under varied conditions of atmospheric turbulence, temperature, location, and instrumental protection, are presented. They tend to show that the investigated pulsations are attributable both to the mechanical action of wind transmitted through the soil and to the movement of the air inside the apparatus caused by thermal, gaseous, and hygrometric variations.—*V. S.*

10024. Berson, I. S. Concerning the choice of the longest possible time curves of reflected waves [in Russian]: Acad. Sci. U.R.S.S. Bull. (Izvestiia), Sér. Géog. et Géophys., vol. 11, no. 3, pp. 271–282, Moscow, 1947.

When carrying out seismic work in regions with numerous reflecting boundaries, it is necessary to take into account the possibility of interference phenomena. The interference of reflected waves increases with an increase in the distance between the seismograph and the shot point. The author considers the problem of finding the longest time curve that can be chosen without increasing the interference of reflected waves. The investigation is carried out for the case of horizontal reflecting layers where the wave velocity is constant or increases monotonically with the depth. The author considers the ratio of the longest possible time curve, t_{max}, to the depth, H, of the reflected boundary and gives graphs of this ratio for different velocities of wave propagation. In the case of a constant velocity this ratio first increases and later becomes constant. If velocity increases monotonically with depth this ratio has a maximum value. The longest possible time curve depends to a considerable extent on the velocity and on the gradient of the velocity, that is, on the law of the increase of velocity with depth. As a general rule the time curve is to be taken shorter if the velocity gradient increases.—*S. T. V.*

10025. Bonchkovskii, V. F. Microseismic disturbances and their causes [in Russian]: Seismol. Inst. Trudy, no. 120, 41 pp., Moscow 1946.

A study is made of microseismic disturbances observed on March 5 and 6, 1938, at Pulkovo Observatory, near Leningrad. Seismograms of this observatory and of six other Russian seismologic stations were used in this study: Sverdlovsk, in the Ural Mountains; Makeevka, in the Ukraine; Irkutsk, in Siberia; Tbilissi and Baku, in the Caucasus; and Tashkent, in central Asia. Analysis of the resulting seismograms shows the cause of the disturbances studied to be strong winds at the western shore of Scandinavia. It is interesting to note that the velocity of propagation of the microseismic waves along the Russian plain was found to be very low. This figure, in the opinion of the author, needs to be confirmed by more accurate measurements.—*S. T. V.*

10026. Bullen, K. E. Some developments of modern seismology: Australian Jour. Sci., vol. 9, no. 6, pp. 204–207, Sidney, 1947.

A review of principal developments in modern seismology is given, introduced by brief remarks on the history and nature of seismic recording. It is found that travel-time data, aided by advances in seismograph construction, wave theory, elasticity theory, and statistical theory, have reached a stage where no further progress can be made in the main tables for the average earthquake.

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With the aid of these tables several features of the earth's structure have been ascertained. Except within about 40 kilometers of the outer surface, the earth is essentially symmetrical about its center. A surface of discontinuity separates the largely liquid, composite core from the rocky mantle. The mantle's uppermost 30 to 40 kilometers are markedly heterogeneous, with the layering in the Pacific region significantly different from that in other regions. Additional details of the structure of the earth are listed, and numerical values of the compressibility, rigidity, and density of materials in the earth's interior are discussed. Advances along certain other lines of seismological investigation are mentioned.—*V. S.*

10027. Byerly, Perry. Periods of seismic waves [abstract]: Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, 1264, Baltimore, Md., 1947.

A final report is given regarding the periods of waves measured on the seismograms of near earthquakes recorded on Wood Anderson instruments at the stations of the University of California network. The investigation was commenced under a grant from the Penrose Bequest. The number of periods read was 18,636. The data do not suggest that certain periods are preferred at any station (that is, that the localities of the stations have free or resonance periods). The Coda periods are longer for the more distant shocks. There is some tendency for *P* and *S* periods to be greater for more distant shocks. The periods increase with the Richter magnitude of the shocks. For the data available the epicentral distance is usually greater for the shocks of greater magnitude. (*See also* Geophys. Abstracts 132, no. 9784.)

10028. Clements, Thomas, and Emery, K. O. Seismic activity and topography of the sea floor off southern California: Seismol. Soc. America Bull., vol. 37, no. 4, pp. 307–313, Berkeley, Calif., 1947.

The positions of submarine epicenters of seismic shocks occurring during a 12¼-year period were plotted on a bathymetric chart of the area off southern California. The data show that the sea floor is active seismically and that the seismic activity and the topography are related. It appears that the major topographic features are of tectonic origin and that the forces, which brought them about, are still active.—*Authors' abstract.*

10029. Coster, H. P., and Gerrard, J. A. F. A seismic investigation of the history of the River Rheidol in Cardiganshire: Geol. Mag., vol. 84, no. 6, pp. 360–368, Hertford, Hertfordshire, England, 1947.

In 1935 Jones and Pugh studied the history of the Rheidol River in Cardigan, England, and attributed its rejuvenation and sharp westerly turn at Devil's Bridge to capture by a westward-flowing stream eroding back its head to the east. Another similar capture was supposed to have occurred 3 miles to the south. To test this hypothesis the authors have applied the seismic refraction method for determining the thickness of the drift overburden in the river's old mature valley and comparing their results with the data of Jones and Pugh on the bedrock floor of this valley.

Measurements were made at five sites at intervals down the valley, and in each case geophones were spread in a line across the valley so that they were near the bedrock outcropping at either end. A small charge was exploded from the bottom of a hole bored at one end of the line, and a graph was plotted of the time of first arrivals at the geophones. The method and calculations are described. The results showed that there is a step in the valley near Devil's Bridge but gave no conclusive evidence on the order in which the captures of the valley took place.—*V. S.*

10030. Datskevich, A. A. On calculating the structural specifications of a seismograph [in Russian]: Prikladnaia Geofizika, no. 3, pp. 106–118, Moscow, 1947.

The advantages of new magnetic materials prompt the author to discuss the construction of an improved seismograph and deduce its operating formulas. For a choice of structural scheme he compares four current seismograph models with respect to sensitivity and magnetic, elastic, and thermal characteristics and concludes that the use of springs is unavoidable in a low-frequency apparatus with high sensitivity.

The comparison provides a basis for theoretical calculations of the improved seismograph's structural specifications, which are presented and are illustrated by a numerical example. It is found possible to construct an apparatus that would either have the same weight as the current models and twenty times the sensitivity, or the same sensitivity and a twentieth the weight. The study was made under the auspices of the Institute of Applied Geophysics (NIIPG), Moscow.—*V. S.*

10031. Dix, C. H. Effect on seismic waves of passing through a focus [abstract]: Geol. Soc. America Bull., vol. 58, no. 12, p. 1265, Baltimore, Md., 1947.

We consider first the effects where, prior to passing through the focus, the wave front is cylindrical. In such a case a delay occurs amounting to a quarter wave length shift of phase in passing through the focal line. For the case of a spherical wave front converging on a point focus the delay is half a wave length. In the case of a generally curved wave front the delay is a quarter of a wave length on crossing each focal line.

The above considerations are developed for the steady state case but can be applied by a Fourier integral analysis to almost any pulse that may occur. Another important consideration is the fact that the curvature of the wave-front surface is a "point property" which usually varies from point to point on the surface, so that the above delaying effects apply to the waves from only a small part of the wave front, whereas the actually observed result must be an integrated result covering the whole wave front.

The above effects are deduced on the assumption that the equation of motion is strictly a linear wave equation. One may perhaps have reservations regarding the validity of this equation at a focus where nonlinear effects may enter. However, even in the case where nonlinear effects do enter, one may perhaps be justified in assuming that the "linear part" will behave as here described. The effects described above have been known for many years in optics.—*Condensed by V. S.*

10032. Dix, C. H. The existence of multiple reflections: Geophysics, vol 13, no. 1, pp. 49–50, Tulsa, Okla., 1948.

Two independent methods are advanced for determining the existence of multiple reflections. The first requires precise timing and consists in comparing the reflection time of the primary reflection with that of the double reflection. If the start of the single reflection is picked within ±0.005 seconds and if this reflection is reduced to the plane giving rise to the double reflection, such as the base of the weathering layer or the top of the ground, then the time of the double reflection should be double the time of the single reflection.

The second method consists in observing abnormally large time moveouts (t_x–t_0) in special spreads for velocity determinations and in ascertaining the presence of the t_x vs. X effect. When both methods give positive indications, the reflection can be considered as a multiple; when, however, either or both give contrary evidence, the existence of multiples becomes increasingly doubtful.—*V. S.*

10033. Dobyns, D. R. A study of seismic character and energy return from shooting high- and low-velocity explosives: Geophysics, vol. 12, no. 4, pp. 618–638, Tulsa, Okla., 1947.

This paper is a report of investigations made to determine the possibilities of changing the character of reflection records by shooting explosives which vary in detonation velocity from 5,000 to 21,000 ft./sec. and also to ascertain what energy return would result from shooting these explosives in refraction work. Magnolia Petroleum Co. crews, working under the author's direction, carried out these investigations in Florida, Mississippi, and Texas. The results are discussed, and the records are presented.—*Author's abstract.*

10034. Ellsworth, T. P. Multiple reflections: Geophysics, vol 13, no. 1, pp. 1–18, Tulsa, Okla., 1948.

This discussion is the lead paper of a symposium on the subject of multiple reflections. Possible types of multiple reflections are considered and compared with unusual reflections observed on records taken in the northern Sacramento Valley of California. Geological and geophysical data are presented to demonstrate that a shallow basalt flow is producing identifiable multiple reflections. Consideration is given to the possible frequency of occurrence of multiple reflections during seismic surveys as well as to the limitations they may place upon seismic interpretations.—*Author's abstract.*

10035. Eremeev, A. N. Seismic station VIRG-24 [in Russian]: Razvedka Nedr, vol. 13, no. 3, pp. 36–39, Moscow, 1947.

A seismic station with 24 channels (VIRG–24) was constructed in 1946 by the All-Union Institute of Exploration Geophysics, U.S.S.R. It consists of seismographs, amplifiers, oscillographs, a mixer, a generator, a recorder of the time of explosion and arrival, a control board, a feeding unit, regulatory instruments, and shot-point equipment. These parts are described. The seismometers in use at present have an electromechanical coupling of 12 x 10^7 CGSμ, an impedance of 2,500 ohms, and a proper frequency of 20 hertz. The amplifiers have a co-

efficient of the order of 50,000. The generator with a frequency of 100 hertz is considered more advantageous than one with the usual frequency of 50 hertz, because the basic frequency recorded in prospecting is also 50 hertz and necessitates special filtering.—*V. S.*

10036. Fage, A.; and Sargent, R. F. Shock-wave and boundary-layer phenomena near a flat surface: Roy. Soc. Proc., ser. A, vol. 190, no. 1020, pp. 1–20, London, 1947.

Shock-wave and turbulent boundary-layer phenomena near the smooth flat metal floor of a specially designed supersonic tunnel are studied from traverses made with pitot, static pressure, and surface tubes, and from direct shadow and Töpler striation photographs. Near-normal and oblique shock-wave systems, with or without a bifurcated foot, are considered.—*Authors' abstract, condensed by V. S.*

10037. Gamburtsev, G. A. The development of experimental seismology in the Soviet Union [in Russian]: Acad. Sci. U.R.S.S. Bull. (Izvestiia), Sér. Géog. et Géophys., vol. 11, no. 5, pp. 409–414, Moscow, 1947.

Experimental seismology is defined as that branch of seismology which operates with artificially created seismic waves. The most important phases of the evolution of experimental seismology in Soviet Russia during the last 30 years are outlined, with attention given both to studies of seismic waves and to development of seismic methods of exploration in geology and in prospecting for minerals. A detailed description of the use of reflected waves in seismic exploration is given. A recent improvement is the "correlation method of refracted waves" introduced by the Institute of Theoretical Geophysics of the Russian Academy of Sciences. This sensitive method makes possible the exploration of stratified or inhomogeneous media as well as the sounding of very deep ground. Mention is made of improvements in the technique of measurements, introduction of multichannel registration of incoming waves, accurate filtering of troublesome phases, and precise time interval measurements (up to 1/1,000 of a second) between individual events.

The author reports that geophysical exploration had not been stopped by the war but became more intensive in eastern regions of the Soviet Union.—*S. T. V.*

10038. Gamburtsev, G. A., Riznichenko, Iu. V., Berson, I. S., and Epinat'eva, A. M. A combined method for seismic prospecting: Acad. Sci. U.R.S.S. Comptes rendus (Doklady), vol. 51, no. 6, pp. 433–435, Moscow, 1946.

During 1938–44 the Institute of Theoretical Geophysics, Moscow, accumulated evidence showing the advisability of a joint application of the reflection method and the correlation-refraction method in seismic prospecting. Such application consists in recording both refracted and reflected waves, tracing them together, and making interpretation in the light of the combined data. The time-distance curves are correlated on the bases of the common and reciprocal points of refraction and reflection records; particular modes of application depend upon local geology and the purpose of prospecting.

The combined method is found to resolve a wider range of problems and to attain a higher precision of results than the separate methods, as

illustrated by the determination of velocity profiles and surfaces of separation, and by the investigation of boundaries at various depths and in various regions. An example of a simple system of time curves sufficient for definite interpretation is discussed for a case where the average velocity in the overlying medium is constant.—*V. S.*

10039. Gorshkov, G. P., and Levitskaia, A. Ia. Some problems of the seismotectonics of Crimea [in Russian]: Acad. Sci. U.R.S.S. Comptes Rendus (Doklady), vol. 54, no. 3, pp. 255–258, Moscow, 1946.

A brief account is given of earthquakes in the Crimea, the epicenters of the shocks recorded during 1928–41 are mapped, and the area of the peninsula is divided into seismic zones ranging in intensity values from class VIII in the southeast to class IV in the northwest, in terms of the International Scale. The Crimean seismic stations at Yalta, Sevastopol', and Feodosiya have registered a total of 615 earthquakes during 1928–38. With the use of hodographs and of the method of Wadati, calculations were made of the coordinates of 116 epicenters and of the depths of 45 foci. The epicenters are found to be concentrated in the Black Sea, within an area of 2,500 square kilometers to the southwest of Yalta.—*V. S.*

10040. Gutenberg, B., and Fu, C. Y. Remarks on multiple reflections: Geophysics, vol. 13, no. 1, pp. 45–48, Tulsa, Okla., 1948.

The acceptance of multiple seismic reflections as an explanation of the regularity in time intervals between successive impulses and of the alternating sequence in changes of phase, observable in certain seismograms, is found to require a clarification of the presupposed energy concentration, the positions of the reflecting surfaces, the sharpness of the source impulse, and the velocity contrast of the adjacent media. These questions are discussed in the light of the data submitted by T. P. Ellsworth and other writers. Various difficulties of the hypothesis are pointed out, and possible supporting considerations are examined.—*V. S.*

10041. Gutenberg, B., and Richter, C. F. Energy release in earthquakes [abstract]: Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, p. 1266, Baltimore, Md., 1947.

Energy values given here may require later multiplication by a correction factor. This will not affect their ratios. The mean annual release of seismic energy radiated in elastic waves is 1.2×10^{26} ergs (85 percent in shallow earthquakes, 12 in intermediate, 3 in deep shocks). Individual years 1904–46 range from 60×10^{26} ergs in 1906 to 2×10^{26} in 1930. The highest seismicity occurs from Japan to the Solomon Islands. In the Marianas Islands, the Hindu Kush, and Rumania, more energy is released in intermediate than in shallow shocks. The annual average for the world includes about 2 great shallow shocks and 17 other major earthquakes, of which about 5 are intermediate and 1 is deep. Four independent series of large shocks (northern and southern, shallow and deep) indicate an annual period with maxima in the second half of the calendar year. Similarly, shallow as well as deep shocks show a maximum at about 6 hours of the local day. Significance tests for the individual series are not favorable.

10042. Inglada, Vincente. Contributión al estudio del batisismo sudamericano de 17 de enero de 1922, Parte 1 [Contribution to the study of the deep-focus South American earthquake of January 17, 1922, Part 1]: Inst. Geog. y Catastral Mem., vol. 16, no. 8, pp. 1–164, Madrid, 1944.

Studies of deep-focus earthquakes clarify many questions connected with the structure of the terrestrial globe. Recently some geologists denied the possibility of earthquakes having foci deeper than 10 kilometers; now there is no doubt that many observed earthquakes have their hypocenters at a depth of 500–700 kilometers. These studies have been made possible by improvements in the construction of modern seismographs. As examples, the author describes several seismographs (Wiechert's type) of the seismic observatory of Toledo, Spain. On the basis of the seismograms of this observatory the coordinates and the initial time of the South American earthquake of January 17, 1922, were computed. Analysis of the seismograms of some 80 other observatories yields similar results.—*S. T. V.*

10043. Jeffreys, Harold. On the Burton-on-Trent explosion of 1944, November 27: Roy. Astron. Soc. Monthly Notices, Geophys. Suppl., vol. 5, no. 5. pp. 99–104, London, 1947.

Seismic waves from the Burton-on-Trent explosion of November 27, 1944, were recorded at four British and six continental stations. The five observations of *Pn* suggest that the times of *Pn* about distance 8° for a surface focus are $3^s.9 \pm 1^s.3$ shorter than those given in the author's 1940 table. The anomaly cannot be explained by any permissible reduction of the thickness of the upper layers. It seems just possible that it might be explained by an increase of the velocity of *Pn* at shorter distances, but further investigation is needed before this explanation can be adopted. *Sg* was satisfactorily recorded, and it is likely that the low velocity of *Sg* found in the Oppau explosion was not due to misidentification but to ordinary errors of observation. The energy of the explosion and that of ground movement were in about the same ratio as in the Oppau explosion.—*Author's abstract.*

10044. Johnson, C. H. Remarks regarding multiple reflections: Geophysics, vol. 13, no. 1, pp. 19–26, Tulsa, Okla., 1948.

Evidence is offered on the existence of multiple seismic reflections in Butte County, California, and criteria for evaluating their probability and recognizing their presence are discussed. In the two examples considered, as many as seven multiples were believed to exist on the basis, in part, of high wave-shape correlation between the initial basalt reflection and subsequent recurrences. The alternate recurrences were reversed in phase to compensate for the negative reflections at the under side of the base of the weathered layer. Illustrations of records are presented.

It is concluded that several seismogram features can be considered indicative of the existence of multiple reflections in a locality: a sharp velocity contrast at the base of the weathered layer; a cored bed of high velocity or density contrast; an abnormally strong reflection; a recurrence of strong energy bursts at apparently uniform time intervals

showing agreement with the initial reflection time of the abnormally strong reflection referred to the weathered layer; and occasionally, a lack of energy between such bursts.—*V. S.*

10045. Kisslinger, Carl. Fourier analysis of a blast record: Am. Geophys. Union Trans., vol. 29, no. 1, pp. 36–37, Washington, D. C., 1948.

This paper reports the Fourier analysis of a seismogram of a dynamite blast recorded by a Taylor-Macelwane seismograph. The first six harmonics were calculated for 26 sections of the record. The errors inherent in such an alaysis are discussed.—*Author's abstract.*

10046. Ladd, H. S., Tracey, J. I., and Lill, G. G. Drilling on Bikini Atoll, Marshall Islands: Science, vol. 107, no. 2768, pp. 51–55, Lancaster, Pa., 1948.

This is the full text of the paper. For abstract published in advance, *see* Geophys. Abstracts 132, no. 9806.

10047. Lynch, W. A. The envelope method of analysis applied to surface waves: Am. Geophys. Union Trans., vol. 28, no. 6, pp. 838–839, Washington, D. C., 1947.

The envelope method of analysis of vibrations is described briefly, and examples are given of its application to the main phase of teleseisms and to microseisms where beating occurs. The importance of its use in the theoretical study of microseisms caused by storms is emphasized, as it readily separates the minor component of the resultant vibration from the major component. In the examples presented the minor component had a period about 14 percent greater than that of the major component and contributed about 45 percent of the total maximum amplitude of the beat cycle. This component has been ignored heretofore. The application of the method to the study of traffic microseisms is mentioned.—*Author's abstract.*

10048. Macelwane, J. B. Seismicity of Mississippi Valley [abstract]: Am. Assoc. Petroleum Geologists Bull., vol. 32, no. 2, p. 304, Tulsa, Okla., 1948.

Seismicity and the factors which govern it are not readily susceptible to quantitative definition and determination even under the best conditions. The seismicity of the Mississippi Valley especially has been under observation too short a time in general, and in particular has been studied by means of seismographs at too few points even in recent years to allow anything but a qualitative and sketchy assessment. The area may be divided, in general, into several provinces such as the upper, middle, and lower Mississippi Valley, the Gulf Coast, and the larger tributary valleys.

10049. Molard, Pierre. Le séismographe amplifié en haute fréquence de la station du Morne des Cadets, Martinique [The seismograph with high frequency amplification at the station of Morne des Cadets, Martinique]: Ann. Géophys., vol. 3, no. 1, pp. 24–62, Paris, 1947.

Electronic amplification of the movements of a seismograph offers interesting possibilities because it permits a high output which renders possible precise mechanical registration. In the first section of the present paper a description is given of an apparatus with amplification

in part effected at high frequency, which was used for several years at the Observatory of Martinique. This seismograph possesses a response analogous to that of apparatus with direct enlargement and employs two recorders, which register various movements of the ground by means of responses of different curvature.

In the second section consideration is given to certain possibilities of this device, particularly those for modifying the pendulum movement by the reaction of the outgoing energy and those for obtaining by properly disposed low-frequency circuits a response curvature chosen at will to begin from a definite pendulum.—*Author's abstract, translated by V. S.*

10050. Munk, W. H. Period increase of seismic surface waves [abstract]: **Geol.** Soc. America Bull., vol. 58, no. 12, pt. 2, p. 1267, Baltimore, Md., 1947.

A theory for the period increase of seismic surface waves is derived from very general assumptions. The derivation follows entirely from the kinematics of wave motion. Good agreement between computed and observed values indicates that the period increase is a phenomenon inherent in the kinematics of wave motion and is not related to the viscous properties of the transmitting medium. These conclusions apply also to the observed period increase of tsunamis and of swell, which obey the general theory. [See Geophys. Abstracts 129, no. 9208.]

The theory leads to two expressions which are especially suitable for comparison with observations. A differential form $dT/dx=(1/V)-(1/C)-\partial T/\partial t$ gives the period increase with distance of an individual wave of group velocity V, wave velocity C, and rate of period decrease at a fixed point $\partial T/\partial t$. An integrated form $T=f(t-x/V)$ requires that from a single disturbance all waves at any time t and distance x obey the same functional relationship. If, in agreement with some observations of Gutenberg and Richter, V is assumed to be a function of T, the first expression leads to a period increase of the order of 1 second per 1,000 kilometers consistent with empirical evidence. The second expression is applied to records of a small Mexican earthquake in 1943 and gives at least the right order of magnitude.

10051. Nature. Earth movement resulting from an atomic bomb explosion: Vol. 159, no. 4029, pp. 85–86, London, 1947.

Seismic phenomena on the occasion of the atomic bomb test of July 16, 1945, in the Jornada del Muerto Valley, New Mexico, are discussed in the light of H. Lamb's theoretical deductions in 1904 and L. D. Leet's preliminary qualitative analysis of actual records. Lamb had predicted from his solutions of elastic wave equations the wave pattern at a distant point from an impulsive force applied vertically at the earth's surface and had suggested that in such case the general to-and-fro movement characteristic of a seismogram might be due either to a succession of primitive shocks or to instrumental imperfections.

There was only a single initial vertical ground impulse in the atomic test sited, no succession of primitive ground shocks, and no self-oscillation in the three-component Leet seismograph. However, the seismograms showed continuous oscillation. The first waves to arrive were

P_2 on the longitudinal and vertical seismograms. These were followed by S_2, P_1, C, H, and other waves. Leet's findings are reported.—*V. S.* (For Leet's paper *see* Geophys. Abstracts 126, no. 8693.)

10052. Navarro de Fuentes, J. R. La forma de las isosistas en relacion con la estructura geologica del terreno en el sismo de 20 de Marzo de 1933 [The shape of the isoseismic lines of the earthquake of March 20, 1933, as related to the geologic structure of the region] : Inst. Geog. y Catastral Mem., vol. 16, no. 4, pp. 1–18, Madrid, 1944.

When an earthquake originates at a point in the earth's crust a seismic wave spreads in all directions through a disturbed zone. The size of this zone is determined by the amount of energy released by the initial shock and by the damping characteristics of the soil. The heterogeneity of the earth's crust causes a deviation from the ideal circular form of a disturbed zone, because every fault or tectonic discontinuity causes an increase of the damping effect and consequently a decrease of the intensity of the quake. Islands of "seismic silence" are found in the region strongly affected by an earthquake. Therefore, every irregularity of the isoseismic lines is a hint to the geologist of some tectonic cause. The author discusses the possible influence of some known geologic features of La Mancha plain, Spain, on the propagation of the seismic disturbance and explains in the light of these data the shape of the isoseismic lines. A detailed geologic map is appended—*S. T. V.*

10053. Neumann, Frank. Measurement of permanent ground displacement by geodetic and seismographic methods [abstract] : Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, p. 1267, Baltimore, Md., 1947.

During the Imperial Valley earthquake of May 18, 1940, in California an accelerograph record was obtained at El Centro, and subsequently a geodetic resurvey of the area revealed a permanent displacement of the marker at El Centro. The paper is primarily a discussion of the accelerogram analysis published in 1941 in the light of geodetic results now available. It is concluded that with adequate instrumentation it will be possible to compute permanent displacements of this character.

10054. Petrashen, G. Lord Rayleigh's problem for surface waves on a sphere: Acad. Sci. U.R.S.S. Comptes Rendus (Doklady), new ser., vol. 52, no. 9, pp. 757–760, Moscow, 1946.

Lord Rayleigh's problem is considered for the case of an isotropic elastic sphere with a free boundary and steady surface waves propagated between points of generation and extinction situated at the poles 0 and π, so that the waves have a regular form over the entire spherical surface. In the analysis the equation of elasticity for the sphere is expressed in a form that takes account of a harmonic function of time, and the problems of boundary for radial functions are resolved by means of a system of generalized spherical vectors ultimately allowing a finite solution for the sphere. Mathematical derivation is presented. It is found that the curvature of the spherical surface has no effect on the character of steady surface waves and that such waves on a sphere have a discrete spectrum of frequencies. Other results are given.—*V. S.*

10055. Rey Pastor, Alfonso. Estudio sismico-geografico de la region sudeste de la peninsula iberica [Seismo-geographic study of the southeastern region of the Iberian Peninsula]: Inst. Geog. y Catastral Mem., vol. 16, no. 5, pp. 1–23, Madrid, 1944.

Greater precision of seismographic recording and improvements in the methods of computation have made possible a more accurate determination of seismic coordinates and a better knowledge of the nature of the seismic focus and the causes of earthquakes. The results of seismologic studies give geologists more reliable and more complete information on the geologic structure of the region and make possible a more accurate localization of faults and other geologic features. The author analyzes the seismologic evidence accumulated in many studies of different earthquakes which occurred in the southeastern portion of the Iberian Peninsula and deduces several conclusions concerning the geology of the region. A seismotectonic map drawn on a scale of 1:100,000 indicates the conclusions of the author.—*S. T. V.*

10056. Robertson, E. I. Seismic refraction methods of prospecting for oil: Petroleum, vol. 10, no. 8, pp. 170–173, London, 1947.

The fundamental principles of the seismic methods of geophysical prospecting are the same as those of the much older science of seismology. As the speed of the elastic waves produced by earthquakes depends upon the elastic properties and densities of the rocks through which they pass, seismologists have been able to deduce the general structure of the earth from a study of observatory records. However, since the distance between the centre of an earthquake and the nearest observatory is usually very large, such records rarely give any information about the structure and nature of the rocks in the outer layers of the earth's crust. To obtain this information the prospector creates an "artificial earthquake" by exploding a buried charge and measures the times taken for the primary elastic waves produced to reach a number of detectors placed nearby. This article deals with the refraction seismic technique. Previous articles in this series dealt with other geophysical methods of prospecting for oil.—*Author's abstract.*

10057. Rothé, J. P. L'enregistrement dans les stations fraçaises des ondes séismiques de l'explosion d'Héligoland [Registration of seismic waves of the explosion of Helgoland by French stations]: Acad. Sci. Comptes Rendus, vol. 224, pp. 1572–1574, Paris, 1947.

The velocity of the P_1 waves (5·5) is the normal velocity of waves through the granitic layer. The velocity of the P_n waves is abnormally high. The surface of the Mohorovicic discontinuity is less steep under northern Europe than under the Alps.—*J. P. R., Dominion Observatory, Ottawa, Bibliog. Seismology, no. 1, p. 15, 1947.*

10058. Rothé, J. P. Quelques aspects de la structure terrestre eclairés par la sismologie [Some aspects of terrestrial structure clarified by seismology]: Rev. Scientifique, vol. 85, no. 7, pp. 401–408, Paris, 1947.

Seismology, the study of earthquakes, although still a young science, is increasingly becoming one of the most effective means of verifying

fundamental geologic hypotheses and augmenting knowledge on the structure of the earth. In a recent study the author endeavored to present some of the results obtained in this field by modern seismologists. [See Geophys. Abstracts 132, no. 9821.] In the present paper he attempts to give more precise information regarding certain points that seem of particular interest to him, namely, the problem of the Pacific, the formation of the Atlantic Ocean, and the nature of quakes at their foci.—*Author's abstract, translated by V. S.*

10059. Rozova, E. A. The earthquakes of central Asia [in Russian]: Seismol. Inst. Trudy, no. 123, 122 pp., Moscow, 1947.

A study was made of 1,245 earthquakes which occurred in the Russian part of central Asia in the years 1929–40 and for which seismograms were available. On the whole, records of 24 Russian stations have been used. Intensity of the strongest earthquakes was as high as grade 7 (Mercalli-Cantini scale). In the first chapter of her study the author analyzes different methods used in the determination of seismic coordinates and states that the most accurate results were obtained by the graphic methods of Wadati or Caloi, as well as by the method of hyperbolas proposed by Mohorovičič. In the second chapter the author explains her own method, which has been used in the present study with good results. Most of the earthquakes had their foci at a depth of less than 10 kilometers, but in 64 cases this depth was greater than 200 kilometers and in 14 cases it was 300 kilometers and more. The most disturbed belt lies on latitude 39°20′ N. between the meridians 69° and 72° E., running along the intersection of the Hercynian disturbances with the Tertiary formations.—*S. T. V.*

10060. Scholte, J. G. The range of existence of Rayleigh and Stoneley waves: Roy. Astron. Soc. Monthly Notices, Geophys. Suppl., vol. 5, no. 5, pp. 120–126, London, 1947.

The author derives equations of the boundary curves of simple Stoneley waves and determines the range of their existence. For generalized Rayleigh and Stoneley wave systems the range of existence is also given. Small values of T/L excepted, a fairly good approximation of this range can be obtained by the calculation of the asymptotes of the boundary curves. These asymptotes are determined by the equation of the simple Stoneley boundary curves and by the frequency equation of the waves in an isolated layer. This approximation is accurate enough for practical purposes.—*S. T. V.* (*See also* Geophys. Abstracts 132, no. 9824.)

10061. Schwinner, Robert. Seismik und tektonische Geologie der Jetzzeit [Seismic activity and tectonic geology of the present time]: Zeitschr. Geophysik, vol. 17, no. 3–4, pp. 103–113, Braunschweig, 1941.

Earthquakes are usually caused by disruptions along shear zones. Faults are to be considered as manifestations of a universal tectonic process going on at the present time. The analysis of the causes of the deep-focus earthquakes typical of the circumpacific zone could serve as an example. These earthquakes represent in their sum total an

endogenetic transformation, probably related also to geologic processes of the other hemisphere. It is evident that a logical mechanical explanation of this tectonic process would be a powerful advance in geological science. Therefore, it is urgent that seismologists, in cooperation with geologists, study the shear fractures following the earthquakes not as a sporadic event but as a phenomenon of a very general nature.—*Author's abstract, translated by S. T. V.*

10062. Shepard, Ward, Jr., and Beyer, G. L., Jr. A recording six-trace cathode ray oscillograph: Geophysics, vol. 12, no. 3, pp. 424–431, Tulsa, Okla., 1947.

This is the full text of the paper. For abstract published in advance, *see* Geophys. Abstracts 126, no. 8677.

10063. Sherman, D. I. The vibration of elastic half-space in the case of known displacements or external forces at the boundary [in Russian]: Seismol. Inst. Trudy, no. 118, 47 pp., Moscow, 1946.

This paper gives a new solution of the three-dimensional problem of propagation of elastic waves in half-space, when the displacements or the external forces at the boundary are known. For simplification the initial displacements and velocities are assumed to be zero. The method makes direct application of Fourier's integrals and gives a number of successive transformations of the expressions of scalar and vectorial potentials in both variants of the problem, furnishing solutions in the form of multiple integrals. With their aid an analysis is made of the propagation of different types of waves.—*Author's abstract, translated by V. S.*

10064. Sloat, John. Identification of echo reflections: Geophysics, vol. 13, no. 1, pp. 27–35, Tulsa, Okla., 1948.

The three factors considered in this paper are the record times, the moveouts, and the character of echo reflections. It is shown that full-path echoes do not repeat at exact multiples of the primary time when dip is present and that certain echoes cannot exist when the primary dip is above a critical value. Consideration of echo moveouts on split spreads proves that they are almost exact multiples of the primary moveout up to the critical angle. The equation for the ratio of normal echo moveout to that of primary moveout is given for the case of single-end spreads, and it is shown that vertical velocities may be computed from echo normal moveouts.

The effect of plotting echo reflections by the $x^2=T^2$ relation is discussed, and the difference in travel times and moveouts caused by neglect of curved path is shown to be small. Under character, the question of phase inversion of echoes is considered with a computation of the reflection amplitude coefficient for echoes in the Sacramento Valley. An abnormal value for this coefficient is suggested as a requirement for the existence of echo reflections. The conclusion is reached that reflection coefficients large enough to give echoes are usually encountered, if at all, at depths such that the resulting echoes do not interfere with normal seismic interpretation.—*Author's abstract.*

10065. Ulrich, F. P. Progress report of seismological work by the United States Coast and Geodetic Survey in the western United States during 1946: Seismol. Soc. America Bull., vol. 38, no. 1, pp. 55–67, Berkeley, Calif., 1948.

The United States Coast and Geodetic Survey continued its regular seismological work in the western United States during 1946. The year's progress report outlines activities connected with the earthquake questionnaire program, strong-motion research, tiltmeter observations, general seismology, instrumental work, and related problems. Advances in cooperative investigations in the American Republics are noted, principal earthquakes in 1946 are listed and indicated on maps, and strong-motion and tiltmeter records are presented.—*V. S.*

10066. Van Melle, F. A. Wave-front circles for a linear increase of velocity with depth: Geophysics, vol. 13, no. 2, pp. 158–162, Tulsa, Okla., 1948.

Formulas are derived which express the depth of the center of the wave-front circle and its radius as simple algebraic functions of known geometric quantities. By virtue of their simplicity these formulas are readily applicable to the migration of reflections. While not intended to replace wave-front charts in areas of steep dip, they have proved their usefulness in areas of moderate dip.—*Author's abstract.*

10067. Vesanen, Eijo. On seismogram types and focal depth of earthquakes in the north Japan and Manchuria region: Isostat. Inst. Internat. Assoc. Geod. Pub., no. 15, 25 pp., Helsinki, 1946.

The author uses his classification of seismogram types as a basis for a study of correlation between the depth of focus and the type of seismogram produced by earthquakes in northern Japan and Manchuria, a distinct type region according to this classification (Geophys. Abstracts 121, no. 7985). The analysis shows that conditions in a focus change with the shift in its location from one layer to another. The results shed light on the structure of the earth in the region of northern Japan, on the general depth classification of earthquakes, and on the origin of *P* and *S* waves.

It is found that a certain *P* and *S* type of wave is characteristic of the earthquakes in each layer of a type belt. The *P* and *S* waves do not always have their source in the same place and originate independently of each other. The depth of the boundary between the shallow-shock layers and the intermediate-shock layers appears to be variable. Other conclusions are given.—*V. S.*

10068. Vishniakov, N. V. Recording of the volumetric deformations produced in an element of the earth's surface by an earthquake [in Russian]: Acad. Sci. U.R.S.S. Comptes rendus (Doklady), new ser., vol. 58, no. 3, pp. 397–400, Moscow, 1947.

Instruments used for the measurement and registration of seismic waves are built on the pendulum principle and record the displacements of the point of observation as a function of time. The author describes a new instrument, a seismic extensiometer, measuring and recording volume variations at a certain point caused by an earthquake. The instrument consists of three pairs of steel pipes embedded in the ground

in three mutually perpendicular planes. In each pair one pipe carries a connecting beam, the other an electromagnetic transducer. A displacement of the beam generates an electromagnetic force in the coils of the transducer, proportional to the velocity of the relative displacement of the pipes. It can be proved that the deflection of the galvanometer to which the coil is connected measures the relative displacement of the pipes of one pair. If the coils of the three pairs of pipes are connected to the same galvanometer its deflection measures the variation of the volume enclosed by the pipes. One such seismic extensiometer was installed in 1946 in the seismologic observatory of Obi-Garma, Western Siberia, and has already registered the volume changes occurring during several earthquakes.—*S. T. V.*

10069. Walling, Dean. Notes on multiple reflections: Geophysics, vol. 13, no. 1, pp. 55–56, Tulsa, Okla., 1948.

There is apparently conclusive evidence that multiple seismic reflections exist, that they take place only under special geologic and topographic conditions, and that they fall within the reach of present amplifying systems. The question remaining unanswered is how frequently these reflections occur in different localities. When they actually happen, a failure to identify them as multiples may sometimes introduce serious errors in the results of seismic surveys because reflecting horizons may be computed and utilized at more than twice their actual depths. Such errors must be guarded against particularly in areas where the primary reflections are few and poor while the multiples are fair. Generally, prospecting practice seems to show that the interpretations of the vast majority of seismic records is not affected by multiple reflections because they are rare and can be easily identified.—*V. S.*

10070. Weibull, Waloddi. The thickness of ocean sediments measured by a reflexion method: Oceanograf. Inst. i Göteborg Medd. 12, 17 pp., Göteborg, Norway, 1947.

The author describes an acoustic method for determining the thickness of oceanic sedimentary layers. Explosive charges placed in water are detonated, and the waves generated by the explosions and reflected from the bottom layers are recorded by means of an apparatus of the type constructed by Bofors and tested aboard the survey ship "*Skagerak.*" The method and apparatus are described, and some results obtained during an expedition in the eastern Mediterranean are presented. Sedimentary layers, located at depths ranging from 2,000 to 3,600 meters, were measured between Algiers and Naples and were found to have a thickness of 200 to 2,700 meters.—*Author's French summary, translated by V. S.*

10071. Weiss-Ksenofontova, Z. T., and Popov, V. V. Concerning the seismic characteristics of the Ural Mountains [in Russia]: Seismol. Inst. Trudy, no. 104, 12 pp., Moscow, 1942.

A study is made of some 40 earthquakes observed in different localities in the Ural Mountains since 1778. The study covered an area of some 200,000 square kilometers. Of these earthquakes, only that of August

17, 1914, was recorded by the Russian and west European seismological stations. Its intensity was of sixth grade, according to the Mercalli-Cantini scale, and its epicenter was located near the city of Sverdlovsk. The disturbed area included 75,000 square kilometers. All the remaining earthquakes were of local character, being caused either by rock bursts or in several cases by ground settlement in regions of former mining. A general map of the region and a special map of the area disturbed by the earthquake of August 17, are appended.—*S. T. V.*

10072. Willmore, P. L. Seismic aspects of the Heligoland explosion: Nature, vol. 160, no. 4063, pp. 350–351, London, 1947.

On April 18, 1947, the British Royal Navy carried out the demolition of German fortifications on the Island of Helgoland by the simultaneous detonation of 3,997 tons of explosives. Extensive arrangements were made in advance by geophysical institutions in various countries for simultaneous seismic observations on a continental scale. Permanent seismological observatories within 1,000 kilometers stood alerted; the stations at Copenhagen, De Bilt, and Prague organized field parties; 23 stations were operated by the Göttingen Geophysical Institute and other German organizations; the German Admiralty sent ships with hydrophones to the North Sea; and the U. S. Navy supplied 10 two-component horizontal seismographs, distributed along a line from Bremerhaven to northern Italy.

As a result, readable seismograms were obtained from most field stations as far as Trieste and from permanent observatories as far as Puy de Dôme, 998 kilometers away. The times for the first arrivals indicate a slightly higher velocity than that given by the Burton-on-Trent explosion, possibly because of the thick alluvial and glacial deposits underlying the near stations.—*V. S.*

10073. Wood, H. O. A possible layer for the transmission of fast *P* waves from surface disturbances: Seismol. Soc. America Bull., vol. 38, no. 1, pp. 33–39, Berkeley, Calif., 1948.

Theoretical considerations and empirical evidence are offered to show that there may be a high-speed layer at relatively shallow depth below the surface of the earth but much above the base of the granitic layer, which transmits fast *P* waves from surface seismic disturbances. It is pointed out that both pressure and temperature increase from the surface downward under the augmenting load of the overburden. Accordingly, there is a possibility that the rise in pressure may bring about changes in the elastic constants and densities of rocks sufficient to effect an increase in wave speed at a depth less than that where the rise in temperature will become high enough to offset and even reduce this speed.

Thus, a variation in wave velocity would be produced by purely physical causes of pressure and temperature, rather than by specific changes in the mineralogical or lithological characteristics of the rocks. The shallow layer of higher wave velocity thus created could be irregular as to thickness, depth, and geographic distribution. It would affect the seismographic phases registered at different places in investigations of *major* blasts at or near the surface but would not materially change the seismograms of natural earthquakes registered at the same places.—*V. S.*

10074. Zvolinskii, N. V. Plane surface waves in an elastic semispace and in a liquid layer covering it [in Russian] : Acad. Sci. U.R.S.S. Comptes rendus (Doklady), vol. 56, no. 4, pp. 363–366, Moscow, 1947.

The author continues his analysis (*see* Geophys. Abstracts 131, no. 9596) of the problem of possible vibrations of a system consisting of an elastic semispace covered with a layer of compressible liquid. He derives three differential equations (of the elliptic type) controlling the problem, one for the liquid medium and two for the elastic semispace, where both longitudinal and transverse waves are possible. He gives the general solutions of these equations and discusses their physical meaning with different values of the constants characterizing the elastic system. He especially discusses imaginary solutions, their physical equivalent being surface waves over the boundary layer. The author points out that it is possible to solve the problem also by the Fourier method, but prefers the former as it is more general.—*S. T. V.*

4. ELECTRICAL METHODS

10075. Ananian, A. A. Electric conductivity of frozen soils [abstract, in Russian] : Akad. Nauk. S.S.S.R., Otd. Geol.-Geog. Nauk, Referaty za 1944 god, p. 124, Moscow, 1945.

The author reports on the experiments performed at the Yakutsk Permafrost Laboratory, eastern Siberia, during the years 1943 and 1944, aimed at the determination of the electric conductivity of frozen grounds at temperatures near and below the freezing point. The results of these tests can be summarized as follows: At positive temperatures (Centigrade scale) the increase of moisture in the ground increases its conductivity. At temperatures below freezing the increase of moisture, that is, the increase of the ice content in the frozen ground, decreases its conductivity, whereas the decrease of the ice content increases the conductivity, and some samples of frozen ground remain sufficiently conductive for purposes of electric prospecting. Thus fragmental ground with an average moisture content of 21 percent had an electrical resistivity of 6.8×10^{-4} ohm-cm. at —18.5° C. and 5.9×10^{-5} ohm-cm. at —30° C. A sample of clay had a resistivity of 3.33×10^{-4} ohm-cm. at 20° C. and of 1.0×10^{-7} ohm-cm. at —30° C.—*Translated by S. T. V.*

10076. Belluigi, Arnoldo. Campi elettromagnetici dei suoli galvanicamente elettrizzati [Electromagnetic fields generated in the ground under the action of galvanic currents] : Pub. facolta ingegneria Cagliari, Italy, no. 11, 20 pp., 1946.

The author discusses the solutions, given by different authors, of the problem of determining the electromagnetic field generated in the ground by direct current introduced at a point and also presents his solution of the problem. This solution makes possible the establishing of three "principles of equivalence" between tubular conductors and conductors spatially distributed. This is followed by a discussion of practical applications of the established relations and especially by an analysis of the case where the current is introduced into the ground through a long tubular vertical conductor, as through a borehole. Later an extension of the solution is given for the case of alternating current, and a chart

is appended giving the absolute value and the phase angle of the vertical component of the induced magnetic vector for different points of the earth's surface, using a frequency of 500 hertz.—*S. T. V.*

10077. Botset, H. G. The electrolytic model and its application to the study of recovery problems: Am. Inst. Min. Met. Eng. Trans., vol. 165, 1946, pp. 15–25, New York, 1947.

The principle of the electrolytic model is based on the fact that electrical flow through a conducting medium may be used to simulate homogeneous fluid flow through a permeable medium such as an oil-producing zone. The imput fluid carries copper-ammonium ions, deep blue in color, which render its flow through the medium readily observable. The sand is reproduced by an agar gelatin solution which contains colorless zinc-ammonium ions representing the fluid to be produced from this sand. The zinc-ammonium ions and the copper-ammonium ions have the same mobility, so that the two kinds of ions indicate a flow of fluids of equal viscosity. When the model is in operation, photographs are taken of the "flood" at suitable time intervals.—*W. A. Ver Wiebe, Am. Assoc. Petroleum Geologists Bull., vol. 31, no. 4, p. 780, Tulsa, Okla., 1947.*

10078. Carreño, Alfonso de la O. The two non-parallel layers problem according to the new development of the potential drop ratio method of electrical prospecting: Am. Geophys. Union Trans., vol. 29, no. 1, pp. 51–58, Washington, D. C., 1948.

The new alternate of the potential drop-ratio method of electrical prospecting, previously developed by the author in application to two parallel layers, is now employed for the theoretical solution of the problem of two non-parallel layers. In the analysis use is made of mathematical expressions for potential drop ratios measured, beginning from a point-electrode on the ground, between three other electrodes, with a fixed ratio for their successive positions, and equations of apparent resistivity and of potential drops are deduced for three representative types of electrode arrangement. Mathematical derivation is presented.—*V. S.*
(For previous paper *see* Geophys. Abstracts 123, no. 8244.)

10079. Coster, H. P. The electrical conductivity of rocks at high temperatures: Roy. Astron. Soc. Monthly Notices, Geophys. Suppl., vol. 5, no. 6, pp. 193–199, London, 1948.

Measurements of the electrical conductivity of rocks at high temperatures are described. It is shown that the conductivity increases with the temperature T, approximately as $\exp(-\epsilon/kT)$. The theoretical implications of this relationship and their bearing on the conductivity within the earth are discussed.—*Author's abstract.*

10080. Enenstein, B. S. The results of electrometric investigations carried out by means of direct current on permanently frozen soils [in Russian]: Inst. Merzlotovedeniia Trudy, vol. 5, pp. 38–86, Moscow, 1947.

In the first part of his study the author discusses the factors determining the conductivity of permanently frozen ground and gives as the most important the porosity of the geologic formation; the degree of its saturation with water and the chemical composition of the water; the

temperature of the electrolytes filling the pores; the mineralogic properties of the formation as, for instance, its anisotropy; the state of the water in the pores—frozen, liquid, or vapor. He emphasizes the fact that down to the temperature of —12° C. only a part of the water in the pores becomes frozen, the rest remains liquid and contributes to the conductivity of the ground making possible the use of electrical methods of prospecting.

In the second part of his study the author reviews nine surveys made in different regions of Siberia over permanently frozen ground. He describes the extent of the work in each of these surveys and criticizes the results obtained. Few of the surveys can be considered successful. In the southern parts of the region the temperature of the permanently frozen ground varies between 0° and —3° C. Here the layer of the permafrost is not too thick for electrical prospecting by direct current. The author emphasizes the necessity of further experimental work, especially in the field.—*S. T. V.*

10081. Fisch, W. Geoelektrische Untersuchungsmethoden im Dienste der Wasserversorgung [Geoelectrical methods of exploration suitable for water search]: Schweiz. Ver. Gas u. Wasserfachm. Monats-Bull., vol. 26, pp. 125–137, Zurich, May 1946.

An account is given of the exploratory methods of Wenner and Schlumberger, which are based on measurements of the potential difference between two electrodes set in the ground. This difference is a function of the current source, of the distance between the electrodes, and of the specific resistivity of the subsoil.—*Cent. Nat. Rech. Sci., Bull. Anal., vol. 8, no. 9, pt. 1, pp. 2002–2003, Paris, 1947, translated by V. S.*

Joesting, H. R., Bacon, L. O., and Getz, J. H. Geophysical investigation of manganiferous iron deposits, Boston Hill, Grant County, New Mexico. *See* Geophys. abstract 10000.

10082. Johnson, V. A., and Lark-Horovitz, K. The shape of semiconductor resistivity curves [abstract]: Indiana Acad. Sci. Proc., vol. 56, pp. 236–237, Indianapolis, 1946.

If resistivity is measured as a function of temperature for a group of semiconducting samples, the curves obtained differ in shape with the nature of the sample. As temperature rises, the resistivity continually drops for one type of sample; for another type, the resistivity rises to a maximum and then drops to a minimum, rises to a maximum, and then falls. The authors point out that the existence or nonexistence of a maximum may be correlated with the Hall effect curve of the sample. It is shown that the position of the maximum, when it occurs, may also be predicted from Hall effect data.

10083. Jones, W. A. Experience with some electrical and magnetic methods of prospecting: Canadian Min. Met. Bull. 426, Trans. sec., pp. 537–557, Montreal, Quebec, 1947.

To aid mining engineers and geologists in understanding the principles of geophysical exploration for metalliferous ores, the essentials of self-potential, electrical resistivity, and magnetic methods are outlined.

Self-potential methods depend on natural electrical currents generated by spontaneous electrochemical reactions. Typical of these reactions

is the oxidation of ore bodies containing metallic sulfides by the action of weathering agencies creating a negative potential of 100 to 500 millivolts over the top of the ore body. Such spontaneous polarization can take place in deposits of pyrite, pyrrhotite, chalcopyrite, and magnetite, but other subsurface conditions may likewise generate polarization. The equipment and field procedures employed are outlined.

Electrical resistivity methods, on the other hand, consist of applying a known current from an outside source to the ground and measuring voltages at regular intervals on the surface to detect conducting subsurface ore bodies, such as most metalliferous sulfides. Of the various electrode systems used, the straight-line three-point arrangement and the center line pattern, both devised by L. Gilchrist, are described as affording better current distribution in the ground and more freedom from spurious potential effects caused by current electrodes than other electrode configurations.

Magnetic methods of exploration usually are limited to the measurement of differences in the vertical geomagnetic component. The instruments commonly employed are described briefly.—*V. S.*

10084. Kraev, A. P., Semenov, A. S., and Tarkhov, A. G. Electrical sounding at great depths [in Russian]: Razvedka Nedr., vol. 13, no. 3, pp. 40–41, Moscow, 1947.

The four-electrode system of electrical sounding has disadvantages in exploration at great depths because of the need for long feeding cable lines. Apparently the lines of 12 to 15 kilometers now employed cannot be extended much farther. The use of telegraph lines or railway tracks also has its difficulties. As a solution the authors offer electrical dipole sounding for deep prospecting. This method consists in using two dipoles, one for feeding and one for reception. Each dipole has two groundings at a relatively short distance from each other, and the difference of potential is measured at points on the receiving dipole while the distance between the centers of the dipoles is gradually increased. The use of dipoles of 1 to 2 kilometers makes it possible to reach depths that would require cable lines of 100 kilometers with the symmetrical four-electrode system.

Two tests of dipole sounding were made in 1946. In both cases the feeding dipole was located in the sea and had an interval of 1.5 kilometers between its groundings, with a current of 1,000 amperes. In the first test differences of potential were measured in the sea by means of a receiving dipole 300 meters long towed by boat, and the distance between the centers of the dipoles reached 64 kilometers. In the second test measurements were made on land, and greater distances were used. The apparent resistivity results are shown by graphs, and it is believed that the distance between the dipoles could be increased 5 to 10 times, rendering possible electrical exploration of the pre-Cambrian.—*V. S.*

10085. Krasnow, Shelley. An improved apparatus for the Gish-Rooney resistivity measurement technique [abstract]: Geophysics, vol. 12, no. 3, p. 499, Tulsa, Okla., 1947.

In the more than 20 years that have elapsed since the development of the prospecting technique of Gish and Rooney utilizing commutated

direct currents, there has been a substantial evolution in instruments used for the purpose.

A newly improved instrument is described indicative of this evolution, characterized largely by its light weight and compactness. This is achieved by mounting the commutator integrally with the measuring unit, contrary to the older practice of separating the two. A motor drive for the commutator is included. Emphasis is placed on the combined use of the guard ring principle and on electro-magnetic shielding. Potentiometer slide wire current settings are made by means of an "artificial earth" avoiding the usual standard cell and tending to cancel the error in the current measuring meter. Instrumental improvements, including apparatus with measuring instruments, commutator and batteries, all in one unit, an electrode rotation switch for profiling due to Shepard, a commutator capable of carrying as much as 6 amperes for short periods and an integrally mounted mirror and pointer null galvanometer are described.

10086. Ramachandra Rao, M. B. On the electrical prospecting for graphite near Ganacharpur, Kolar district: Mysore Geol. Dept. Records, vol. 42, pp. 56–67, Bangalore, India, 1945.

This is a report on exploratory work carried out in 1943 by the author in the Kolar district, India, with a view to prospecting for graphitic veins. The conditions here are favorable for the application of electrical methods of prospecting because the schist covering the area under investigation are of a moist clayey kind and possess a much higher electrical conductivity than the quartzites in which they are enclosed. Since it is known that graphitic schists often give rise to natural electrical currents, it was decided to test the ground first by the spontaneous polarization method. This was followed by electrical resistivity measurements. On the whole, 940 stations were covered. As a result of the survey a concealed graphitic ore body of a very promising character was located; the following trenching confirmed the findings of the measurements. The report contains the map of the region surveyed and graphs of the profiles obtained.—*S. T. V.*

10087. Ramachandra Rao, M. B. Geophysical investigations for selection of site for Ramapadasagar Dam across the Godavari River in Madras, south India: Am. Inst. Min. Met. Eng. Tech. Pub. 2287, Min. Technology, vol. 11, no. 6, 28 pp., New York, 1947.

This paper presents the results of the earth-resistivity surveys made in the Godavari River in connection with the Ramapadasagar project. After a description of the topographic and geologic features of the area, the findings of the investigation at the several sites explored are outlined, and a detailed account is given of the resistivity methods adopted, the apparatus used, and the interpretation of the curves. Special consideration is devoted to the resistivity measurements carried out over the water course, and the drilling tests made in a number of cases for the verification of electrical indications are reviewed.—*Author's abstract.*

10088. Semenov, A. S. The method of the charged body [in Russian] : Razvedka Nedr, vol. 13, no. 4, pp. 35–42, Moscow, 1947.

The electrical method of the charged body is used for the exploration of strongly conductive ore deposits. It consists in charging them to a certain potential from an outside source and delineating their contours by measurements of the potential differences created between them and the surrounding rocks. Arrangements of feeding and receiving electrodes are outlined for direct current and alternating current determinations of isolines, profiles, and gradients of the potential, with suggestions as to optimum field procedures. Three examples of interpretation in the Monche tundras of the Murman region, U.S.S.R., subsequently confirmed by drilling, are discussed and illustrated by graphs. The method is found useful for the exploration of sulfide ores and certain oxidized ores, graphite, shungite, and anthracite. It can serve to delineate known deposits, to trace relationships between known conducting bodies, and to detect new veins in the vicinity of known deposits.—*V. S.*

10089. Sumgin, M. I., and Petrovsky, A. A. The importance of electrical methods for the study of permanently frozen ground [in Russian]: Inst. Merzlotovedeniia Trudy, vol. 5, pp. 15–17, Moscow, 1947.

The authors emphasize the importance of electrical methods in geophysical exploration and discuss their applicability to the study of permanently frozen ground. They recommend the use of radio methods in regions where the temperature of the ground is below —5° C. and its conductivity is very low. For an area with a temperature near the freezing point, the electrometric methods—electrical resistivity and spontaneous polarization—are preferable. The article contains a map showing the distribution of the frozen ground areas in the U. S. S. R.—*S. T. V.*

10090. Tikhonov, A. N., and Zaborovskii, A. I. The evolution of geoelectric prospecting in Soviet Russia during the last thirty years [in Russian]: Acad. Sci. U. R. S. S. Bull. (Izvestiia), Sér Géog. et Géophys., vol. 11, no. 5, pp. 415–418, Moscow, 1947.

Physicists of the nineteenth century studied telluric currents as the potential source of terrestrial magnetism. Later this hypothesis was relinquished. However, the study of the phenomena connected with the spreading of electric currents through the ground has become important as one of the most efficient methods of prospecting for minerals. Geoelectric exploration in Russia was started in 1919 in connection with the important magnetic anomaly discovered near the city of Kursk. This was followed by a successful survey of iron ores in the Altai Mountains in western Siberia. A great impetus was given to the development of electrical prospecting during the years 1929–31 by the exploration for oil carried out by the Schlumberger Corp. in the northern Caucasus.

In all these surveys direct current methods were used, but since 1932 methods in which the alternating current was used have been successfully developed. Other activities included studies of electrical well logging, investigations of electromagnetic fields in isotropic and anisotropic media, deep vertical sounding, and other methods having

industrial applications. In some of the surveys the areas investigated were very large, and the distances between electrodes were as great as 50 kilometers. Important theoretical studies were made by Soviet geophysicists of many problems of great practical importance in the oil industry. In 1940 A. G. Ivanov made the interesting discovery of seismoelectric phenomena.—*S. T. V.*

10091. West, T. S. Deep electrical prospecting, a reply: Geophysics, vol. 13, no. 1, pp. 97–98, Tulsa, Okla., 1948.

Replying to S. Yüngül's discussion of the "resistolog" procedure, which is an adaption of the single-electrode probe method, the author welcomes his mathematical analysis but points out that the important question of the existence of sharp resistolog features with large electrode separation remains unanswered. The sharp maxima and minima, found to occur consistently at an electrode spacing of 2,000 to 6,000 feet have resulted in conclusive correlations of resistolog curves and have yielded depth indications confirmed by other data, thus appearing to reflect deep geological features. Cases are known in which a maximum is present in all resistologs in an oil-bearing locality and absent from all resistologs in the surrounding area. Empirical evidence thus tends to confirm the value of resistolog data and invites their theoretical explanation.—*V. S.* (For Yüngül's paper *see* Geophys. abstract 10092.)

10092. Yüngül, Sulhi. Deep electrical prospecting, a discussion: Geophysics, vol. 13, no. 1, pp. 92–98, Tulsa, Okla., 1948.

In two papers published in Geophysics, one in October 1944 and the other in October 1946, a method of calculation, called the "resistolog" method, was presented. The object of this method is to eliminate the effects of superficial inhomogeneities, the most troublesome obstacles in interpreting electrical sounding data obtained in the exploration of deep, horizontal discontinuities.

A discussion is given of these papers, principally with respect to the apparent-resistivity formula derived for use with the resistolog configuration, the determination of inflection points on apparent resistivity curves, the effective depth of penetration, and the distortion caused by the "far electrode." A new method for determining inflection points is also described. Presentation includes a comprehensive review of the forementioned papers.—*Author's abstract, adapted by V. S.*

5. RADIOACTIVE METHODS

10093. Comba Sigüenza, Antonio. Genesis de los yacimentos de uranio y torrio e influencia de estos elementos en la formación de manantiales de aguas radiactivas [The genesis of deposits of uranium and thorium and their influence upon the radioactivity of ground waters]: Rev. Geofis., vol. 6, no. 24, pp. 617–632, Madrid, 1947.

On the basis of the chemical analysis of some 10,000 samples of rocks taken from different portions of the globe the author states it can be assumed that the elements uranium and thorium together represent 0.0008 of 1 percent of the upper layer of the earth's crust and that the the proportion of these elements at greater depths must be much greater.

This statement is followed by a discussion of metallogenic conditions determining the formation of ore deposits containing these two metals and by an enumeration of the known mineral combinations containing them. An important geophysical indicator of the presence of these elements is the radioactivity of the subterranean waters penetrating the deposits. The author cites two such cases of radioactivity in Czechoslovakia and one in Spain.—*S. T. V.*

10094. Curran, S. C., and Rae, E. R. Analysis of the impulses from Geiger-Müller tubes: Rev. Sci. Instruments, vol. 18, no. 12, pp. 871–876, Lancaster, Pa., 1947.

A method is described for analyzing the output from a Geiger-Müller tube, suitable for finding the effective dead time of counters of high resolving power. The series of pulses from the tube is used to form a second series of pulses, each member of which is delayed by a variable time interval relative to the corresponding member of the first series. The two series are mixed electrically, and the coincidences are counted. The analysis readily reveals the presence of spurious pulses such, for example, as those produced by the incidence of positive ions on the cathode, and the drift time of the ions can be measured. Results for oxygen, nitrogen, hydrogen, and methane in conjunction with alcohol are given. Correction for the spurious part of the counting rate establishes the fact that there is an appreciable inefficiency in tubes containing such mixtures when detecting beta rays.—*Authors' summary, adapted by V. S.*

10095. Healea, Monica. Bibliography—Geiger and proportional counters, radiation measurements, counting circuits and secondary emission: Nucleonics, vol. 1, no. 4, pp. 68–75, 1947, vol. 2, no. 2, pp. 63–65, and no. 3, pp. 66–74, 1948; York, Pa.

This bibliography was prepared largely during the summer of 1947 for the use of the Electronics Division, Brookhaven National Laboratory, Upton, New York. The references in the first part are selected on the basis of their value to workers newly engaged in nucleonic instrumentation. The second part covers the subjects of ionization chambers, electrometers, other counting instruments, and related statistics. The third part includes references on counter circuits, secondary emission, and general subjects in the field of radiation measurements.—*Author's abstracts, condensed by V. S.*

10096. Hushley, W. J., and Dixon, W. R. The gamma-ray measurement of radium ore concentrates: Canadian Jour. Research, vol. 25, no. 4, pp. 210-222, Ottawa, Ontario, 1947.

A method is described for measuring the radium content of substances in which the radium concentration is of the order of micrograms per gram of material. The gamma-ray activities of the unknown material and of a standard radium capsule are compared by means of Geiger-Müller counters. Corrections for self-absorption and distance are given for rectangular and cylindrical sources. The effect of radiation scattered by source into the detector is discussed. Synthetic bulk sources made up with known quantities of radium were used for the experimental work.—*Authors' abstract.*

10097. Petrovsky, A. A., and Dostovalov, B. N. The first experiments with the transmission of radio waves through permanently frozen rocks [in Russian]: Inst. Merzlotovedeniia Trudy, vol. 5, pp. 121–160, Moscow, 1947.

Experiments made in 1940 near the town of Igarka, eastern Siberia, on the propagation of radio waves through the frozen ground are described. The main experiments consisted in sending out radio signals from a transmitter erected on the surface and noting their reception by a receiver placed in a mine some 10 meters below the ground and in the sending of radio signals from a transmitter placed in the mine and noting their reception by a receiver on the surface.

Wave length was varied from 43 to 76 meters; better results were obtained with shorter waves. Current in the transmitter was 200–300 milliamperes. The receiver had a crystal detector coupled with a galvanometer having a sensitivity of 3×10^{-6} amperes per degree. Both experiments showed that, with the equipment used, the reception of radio waves through the frozen rock was possible up to a distance of 100 meters. The mean temperature of the ground was about —2° C. The bulk of the frozen ground was covered with a layer of thawed soil 1 to 2 meters deep. The article also contains a description of preliminary investigations undertaken to determine the behavior of radio waves under the conditions stated and detailed calculations, graphs, and tables.—*S. T. V.*

10098 Ridland, G. C. Use of the Geiger-Müller counter in the search for pitchblende-bearing veins at Great Bear Lake, Canada: Am. Inst. Min. Met. Eng. Trans., vol. 164, 1945, pp. 117–124, New York, 1946.

In conjunction with a geologic investigation of silver-bearing veins at Contact Lake, Northwest Territories, Canada, a survey was made with a Geiger-Müller counter of the gamma-ray emissions from rocks in the vicinity of the mine workings. The purpose was to determine the extent of the pitchblende lenses occasionally encountered in the silver-bearing fissures. Adjustments made in the counter to equip it for field use are indicated, the field technique is outlined, and suggestions are offered on the general precautions to be observed in exploration.

The results of the survey show that the instrument is capable of detecting not only a pitchblende ore shoot in a shear zone but also the mildly radioactive host rock at a considerable distance from the ore body. Accordingly, the use of the Geiger-Müller counter is recommended for detailed ore exploration in a shear zone and for the detection of radioactive host rocks in large-scale reconnaissance surveys.—*Author's abstract, condensed by V. S.*

10099. Schepot'eva, E. S. Contribution to the methods of radioactivity measurements—A new type of compensation apparatus for measuring ionization currents: Acad. Sci. U.R.S.S. Comptes Rendus (Doklady), vol. 42, no. 4, pp. 185–187, Moscow, 1944.

A simplified type of apparatus is described, which is adapted to measure samples of low or moderate radioactivity with reasonable accuracy and at good speed. It has a compensation chamber of small size as compared to the main ionization chamber, which reduces the background but does

not completely remove its fluctuations.—*J. P. Marble, Rept. Comm. Measur. Geol. Time, 1943–46, p. 51, Washington, D. C., Nat. Research Council, 1947.*

10100. Wu, C. S., Meaker, C. L., and Glassford, H. A. Thin window counter with special mica-to-glass seal: Rev. Sci. Instruments, vol. 18, no. 10, pp. 693–695, Lancaster, Pa., 1947.

A thin window counter with special mica-to-glass seal has been developed especially for the detection of low energy electrons from radioactive isotopes such as C^{14}. It is simple to construct and has proved to be vacuum tight. It can be operated without external quenching and exhibits flat plateaus of 100 to 300 volts. The average useful life of these counters is around a year or more. The efficiency of the counters is very satisfactory.—*Authors' abstract.*

6. GEOTHERMAL METHODS

10101. Bullard, E. C. The time necessary for a borehole to attain temperature equilibrium: Royal Astron. Soc. Monthly Notices, Geophys. Suppl., vol. 5, no. 5, pp. 127–130, London, 1947.

During the drilling of a borehole the temperature is disturbed by the heat generated by the tool and by the circulation of the drilling fluid. If temperatures in the hole are to be used for determining the geothermal gradient it is necessary that the well be left long enough for these disturbances to have subsided. This subject is discussed by the author, and the calculation of the necessary time is presented.—*S. T. V.*

10102. Ippolito, S. Energia geotermica per usi industriali: Criteri di ricerca e orientamenti in Italia [Industrial utilization of geothermal energy: Its criteria in research work and its aims in Italy]: Riv. Geominer, vol. 8, no. 1, pp. 31–38, Milan, 1947.

The author examines the problem of searching for gases and magmatic vapors as potential sources of energy, with particular reference to conditions in Italy. On the basis of certain premises which must govern such utilization, he points out how the most recent geologic concepts about the structure of magma make possible a basic differentiation between the phenomena of plutonic and volcanic nature. The former generally take place in orogenic zones and are due to acid magmas rich in volatile substances; the latter usually occur in fractured zones of the earth's crust and are due to basic magmas containing less volatiles. The magmatic chambers are, in the first case, deep plutonic complexes of large dimensions; in the second case they are subvolcanoes of smaller dimensions and not so deeply seated. Comparing the two types of phenomena especially with regard to the possibility of an accumulation of gases, the author concludes that those of plutonic character are more favorable for industrial utilization because they would produce gases of higher temperature and under higher pressure. As examples of the first and the second type, the author cites the region of Larderello in Tuscany and the Phlegraean Fields near Naples.—*Author's English abstract.*

7. GEOCHEMICAL METHODS

10103. Bronston, Allen. Geochemical survey data forecast major field: World Oil, vol. 127, no. 7, pp. 112–116, Houston, Tex., 1947.

A study is made of the results of the geochemical surveys of 1942 that foretold the discovery of the West Edmond oil pool in central Oklahoma. The quantitative data on liquid, gaseous, and solid hydrocarbons, gathered at that time from soil samples taken at varying depths in the area of this pool, are plotted and are discussed with reference to hydrocarbon adsorption, diffusion, migration, and capillarity of rocks.

The evidence points to several conclusions: Gaseous and liquid hydrocarbons are concentrated over petroliferous accumulations and drop to a negligible amount over dry areas; solid hydrocarbons or waxes increase immediately below the surface but decrease at greater depths; waxes are highly concentrated along faults in both the shallow and deeper samples; and the deeper samples generally are relatively constant in their chemical content. Other features are noted.—*V. S.* (*See also* Geophys. Abstract 126, no. 8733.)

10104. Mogilevskiĭ, G. A. Ten years of geomicrobiological exploration [in Russian]: Razvedka Nedr, vol. 13, no. 5, pp. 48–59, Moscow, 1947.

Applications of the geomicrobiological method of oil and gas prospecting during the 10 years that have elapsed since the author first introduced this approach in 1937 are discussed with special emphasis on geologic interpretation. Attention is given to basic underlying principles, various field techniques, practical field tests, and surveys of oil and gas deposits conducted in the Stavropol', Crimea, Tataria, and Ukhta regions of the U.S.S.R., partly by a combined bacterial and chemical analysis.

Observations in the northern Ukhta region showed no methane-forming anaerobes at a depth of 2 to 3 meters, apparently because of low temperature in the ground. In Tataria propane-oxidizing bacteria predominated, with samples showing a bacterial count of as much as 200. In the Stavropol' region two surveys made at a year's interval gave the same microbiological results. Other findings, confirmed by drilling, are given, and commercial discoveries are indicated. A combined method is proposed for future surveys, consisting of the bacterial analysis of soil and ground-water samples and the study of assorted bacterial cultures kept in shallow ground holes for 12 to 14 days.—*V. S.*

10105. Ore.-Bin, The. Geochemical prospecting: Vol. 8, no. 12, pp. 87–88, Portland, Oreg., State Dept. Geol. Min. Ind., 1946.

The United States Geological Survey has established a special research unit to conduct investigations connected with geochemical prospecting. Several problems are under field study, including one in western New York. Peat bogs in the latter area, when drained for muck farming, developed a toxicity to plants and were revealed by analyses to contain a high concentration of zinc. Geochemical reconnaissance of the area has consisted in analyzing samples of soil, water, and plants for a determination of the origin and the mode of occurrence of zinc.—*V. S.* (See also Geophys. abstract 10108.)

10106. Robinson, W. O., Lakin, H. W., and Reichen, L. E. The zinc content of plants on the Friedensville zinc slime ponds in relation to biogeochemical prospecting: Econ. Geology, vol. 42, no. 6, pp. 572–582, Lancaster, Pa., 1947.

The zinc content of 30 different kinds of plants growing on slime ponds containing on the average 12.5 percent of zinc was determined by the dithizone method. The zinc content ranged from 39 parts per million in the fruit of the false Solomon's seal (*Smilacina racemosa*) to 5,400 in the horsetail (*Equisetcum arvense*). This latter plant varied considerably in zinc at different places on the slime ponds. The zinc contents of the aspen (*Populus grandidentata*), ragweed (*Ambrosia artemisiifolia*), and horsetail grown on normal soils are compared to those on the slime ponds, and it is recommended that the poplar and ragweed be studied further as indicators of zinc ore bodies.—*Authors' abstract.*

10107. Sokoloff, V. P. Geochemical prospecting for ore: Mines Mag., vol. 38, no. 4, pp. 21–24, Denver, Colo., 1948.

Chemical studies of natural water, soils, and vegetation show promise of practical usefulness as a method of prospecting for ore deposits hidden beneath residual or glacial soil. Analyses of surface water for unusually high concentrations of ore metals may, under favorable conditions, indicate the general location of buried metalliferous deposits undergoing oxidation. Dispersion halos, or abnormally high concentrations of some particular element in the soil, may indicate proximity to mineralized bedrock. The character of the dispersion halo depends on the properties of the element in question, on topography, on effect of vegetation, and on nature of the soil. Comparative data for copper, lead, and zinc in soils from Kokomo, Colorado, and Gold Hill, North Carolina, are presented diagrammatically.

Biochemical methods of promise in prospecting work are the location of species of plants which grow only on soil containing an abnormal concentration of a particular element, the analysis of plant tissue for the elements in question, or the identification of specific abnormalities that can be correlated with abnormal concentrations of certain elements in the soil or nutrient solution.—*H. E. Hawkes.*

10108. Staker, E. V., and Cummings, R. W. The influence of zinc on the productivity of certain New York peat soils: Soil Sci. Soc. Am. Proc. 1941, vol. 6, no. 4, pp. 207–214, Morgantown, W. Va., 1942(?)

A chemical study was made in western New York of peat soil areas unproductive of vegetable crops. Preliminary work on a qualitative basis indicated that these soils contain large amounts of zinc. Subsequent quantitative determinations with the polarograph confirmed the presence of much zinc. Additional supporting evidence was also obtained by means of greenhouse studies. A subsequent detailed field survey showed that the amounts of zinc in the local surface soils ranged from 0 to 6.7 percent on the basis of the dry weight of the soil and that low vegetable productivity was invariably associated with high concentrations of zinc.—*V. S.*

10109. Technical News Bulletin. The mass spectrometer in gas analysis: Vol. 31, no. 8, p. 87, Washington, D. C., Nat. Bur. Standards, 1947; World Oil, vol. 127, no. 4, pp. 43, 54, Houston, Tex., 1947; Petroleum Engineer, vol. 18, no. 13, p. 248, Dallas, Tex., 1947.

The mass spectrometer provides the best known approximation to a qualitative and quantitative system of analysis for the determination of the composition of gases and gas mixtures. Qualitative separation of various gases is made on the basis of the weight of the ions produced by electron bombardment of each molecular species. Quantitative analysis usually may be made by a mathematical treatment of the data, sometimes requiring considerable time. In some cases the qualitative and quantitative processes can be conducted simultaneously, as in the older chemical methods.

A combined application of the mass spectrometer and of conventional volumetric methods to the analysis of standard samples of natural gas is being tested in a study conducted by the National Bureau of Standards in cooperation with a subcommittee of the American Society for Testing Materials.—*V. S.*

10110. Vogt. T. "Kjemisk" og "botanisk" malmleting ved Røros ["Chemical" and "botanical" ore prospecting in the Røros area]: Kon. Norske Vidensk. Selsk. Forh. 1939, vol. 12, no. 23, pp. 81–84, Trondheim, Norway, 1940.

Previous cursory investigations of the possibility of chemical and botanical ore prospecting in the Røros area, Norway, are indicated, and investigations of some local waters are described. Brook waters from sulfide deposits in this area were found to contain SO_3 in easily traceable quantities. In an analyzed water sample from the Røros area almost all SO_3 was combined with CaO. A water sample from a brook near a pyrite deposit in the neighborhood of Trondheim also contained H_2SO_4. In the Røros area, where practically all sulfides occur in amphibolites, the SO_4—$BaCl_2$ reaction on waters may be of use as a part of a chemical ore prospecting method, with HCL added to the water before the test to eliminate possible CO_2. Brook waters as well as aqueous extracts of soil samples may be tested. Some especially sensitive reagents for copper (ferric thiocyanate+sodium thiosulfate and others), for zinc (ammonium mercuric thiocyanate, in the absence of ferric compounds), and for nickel (diphenyl+glyoxime) are mentioned as adequate for testing in the field.—*Author's abstract, revised by V. S.*

10111. Vogt, T. Geokjemisk og geobotanisk malmleting—2. *Viscaria alpina* (L.) G. Don som "kisplante" [Geochemical and geobotanical ore prospecting—2, *Viscaria alpina* (L.) G. Don as a pyrite plant]: Kon. Norske Vidensk. Selsk. Forh. 1942, vol. 15, no. 2, pp. 5–8, Trondheim, Norway, 1943.

The occurrence of *Viscaria alpina* (L.) G. Don on different rocks, particularly on serpentine, dunite, and outcrops of cupriferous pyrite deposits, in Norway is discussed. It is presumed at present that the

thriving of the plant at these ore deposits is principally due to the large permanent content of copper and other mineral elements in the local soil, the plant being thus left without competitors.—*Author's abstract.*

10112. Vogt, T. Geokjemisk og geobotanisk malmleting—3. Litt om planteveksten ved Rørosmalmene [Geochemical and geobotanical ore prospecting—3, Some notes on the vegetation at the ore deposits of Røros]: Kon. Norske Vidensk. Selsk. Forh. 1942, vol. 15, no 6, pp. 21–24, Trondheim, Norway, 1943.

As stated in communication 2 of this series, *Viscaria alpina* (L.) G. Don in the Røros area, Norway, is reported particularly from serpentine and cupriferous sulfide deposits. *Melandrium dioicum* (L.) Schinz and Thell., occurring profusely at some ore deposits, also endures the ore-poisoned soil very well. Moreover, the following plants grow very well on more or less ore-poisoned soil: *Equisetum arvense* L., *Equisetum palustre* L., *Equisetum limosum* L., *Juncus trifidus* L., *Agrostis canina* L., *Agrostis borealis* Hn., *Deschampsia flexuosa* (L.) Trin., *Eriophorum vaginatum* L., *Eriophorum polystachium* L., *Carex rostrata* Stokes, *Salix reticulata* L., *Salix herbacea* L., *Salix glauca* L., *Salix arbuscula* L., *Betula odorata* Bechst. coll., *Betula nana* L., and the moss *Oligotrichum hercynicum* (Hedw.) Lam.—*Author's abstract.*

8. DRILL-HOLE METHODS

10113. Dale, C. R. Temperature surveys in producing wells: Petroleum Engineer, vol. 18, no. 13, pp. 146–148, Dallas, Tex., 1947.

Various applications of geothermal surveys in oil wells are discussed, and recommendations are made on optimum procedures. One application is for the location of the lowest point at which a well is producing. In the survey described, the static geothermal gradient of a 6,700-foot well was determined after the well had been shut in for several days, and then the temperature was measured in the producing well at a steady rate of flow. The logs obtained showed that the flowing well's curve deviated from the static curve only to a depth of 6,400 feet and thereafter coincided with it, indicating that there was no production below 6,400 feet.

Other examples are given to show that temperature measurements can also reveal the conditions outside of one or more strings of pipe, the migration of water behind casing, the absorption of oil and gas by sands depleted by production, the escape of oil and gas into low-pressure sands, holes in casing, and other irregularities in wells.—*V. S.*

10114. Ford, R. D. Examples of electrical logs in fractured rocks [abstract]: Am. Assoc. Petroleum Geologists Bull., vol. 31, no. 12, p. 2240, Tulsa, Okla., 1947.

A discussion of electrical logs in fractured rocks is of interest in connection with the occurrence and production of oil from such rocks in California because a fractured-rock reservoir requires a special interpretative technique not only in geologic and engineering work but

also in electrical logging. According to the present terminology, fractured rocks include basement rocks, fractured shales, and cherts, all of which may have similar electric characteristics. Illustrations are given of Santa Maria cherts, Edison schist, Maricopa shales, Elk Hills chert and shales, Newport Beach fractured shales, and Wilmington schist, which show that there is apparently very little correlation between resistivity and production. This may be attributed to the fact that the physical characteristics controlling resistivity are not necessarily the same as those which control production.—*Revised by V. S.*

10115. Gorshkov, G. B., and Liatkovskaia, N. M. Radioactive well logging by neutrons [in Russian]: Vestnik Leningrad. Univ., no. 2, pp. 51–69, Leningrad, 1946.

The authors study two possible ways of using the radioactive properties of geologic formations for well logging. In either method the secondary radiation of the rock strata is used as the parameter determining the profile. This secondary radiation is generated by a radioactive substance lowered into the borehole. The secondary radiation contains slow neutrons and gamma rays. Either of these forms of radiation can be measured and used as the characteristic of the corresponding geologic stratum. The authors have studied both forms of the possible secondary radiation by mathematical analysis and by experiments on a model. They have found the use of gamma rays more advantageous. These conclusions were checked by experiments on a small model of a borehole.—*S. T. V.*

10116. Guyod, Hubert. Interpretation of electric logs in limestone: World Oil, vol. 127, no. 12, pp. 90–94, Houston, Tex., 1948.

This paper summarizes the methods of interpretation of electric logs in limestone reservoirs, in order to show how productive limestones can be distinguished from nonproductive limestones. Electrical logs of wells in limestone are quite different from those in sandstone formations. In limestone they are much more difficult to interpret and must be analyzed much more carefully. Furthermore, the resistivity graph is distorted by tight zones, thus frequently making it difficult to determine true resistivity—the measure of petroleum saturation. In intergranular reservoirs associated with very hard formations the pay thickness may be overestimated. The interpretation difficulties of the resistivity data can be reduced by adequate electrode spacing. In fractured or cavernous reservoirs the potential graph is also extremely misleading; for its interpretation the equivalent circuit analogy is to be used.—*S. T. V.*

10117. Komarov, S. G., and Snytkin, V. V. Pneumatic sounding apparatus with mechanical recording [in Russian]: Prikladnaia Geofizika, no. 2, pp. 91–96, Moscow, 1944.

The apparatus described consists of a pneumatic gun, a thermophone, an amplifier, and a recording system. A sound impulse is produced at the head of the well by the bursting of a paper membrane through the action of compressed air. Reflection of the sound waves from the level

of the drilling liquid or from the suction box of the pumping system is registered by a thermophone consisting of an incandescent tungsten wire through which an electrical current is circulated. Variation of the temperature of the wire produced by the reflected air waves causes variation in the circulating current. This variation is amplified and registered on a recorder placed at the head of the well. The sounding apparatus described has been applied in many cases and found precise and reliable. It was designed by V. V. Snytkin.—*S. T. V.*

10118. Pirson, S. J. Electric logging—Factors which affect true formation resistivity: Oil and Gas Jour., vol. 46, no. 26, pp. 76–81, Tulsa, Okla., 1947.

The factors affecting the true electrical resistivity of formations in a well are the specific resistivity of the saturating waters, the percentage of pore volume, and the shape of the pores. The saturating waters according to Meinzer's classification are of five types having the following resistivity ranges in ohm-meters: Surface waters, $(0.10–3)\times10^2$; soil waters, 10^2; intermediate vadose water, 1–10; surficial ground water, 0.10–10; and deep ground (connate) water, 0.01–0.10. The pore volume and the shape of pores, on the other hand, exercise effects which can be calculated for a material composed of particles assumed to have a simple geometric form and arrangement.

Such calculations are made for three porous media which consist alike of spherical nonconducting particles of equal size but which are packed in a cubic, a rhombic, and a hexagonal arrangement and are characterized, respectively, by a porosity of 47.6, 39.5, and 25.9 percent. The analysis yields formulas for the theoretical resistivity of these media in terms of their porosity and the specific resistivity of the saturating liquid. The theoretical results are discussed in the light of cementation, fluid distribution, and other factors affecting actual conditions in wells.—*V. S.*

10119. Pirson, S. J. Electrical logging—Factors affecting measured apparent formation resistivities: Oil and Gas Jour., vol. 46, no. 29, pp. 63–67, 87, Tulsa, Okla., 1947.

In the electrical logging of wells the deviation of the apparent resistivity from the true resistivity is influenced by the resistivity of the well fluid, the resistivity of the fluid-invaded zone, the electrode configuration employed, and the thickness of the formation. The effects of these factors on measured resistivity are examined on the assumption of isotropic geologic formations and in the light of theoretical considerations of potential distribution in stratified media as related to well logging. A basis is established thereby to deduce formulas of potential for the prediction of the shape of an apparent resistivity curve from knowledge of electrode configuration and formation thickness in the case of systems of two electrodes, three electrodes, and four electrodes. In the analysis various possible positions of the electrode probes with respect to a plane of stratification are taken into consideration, and the standard resistivity curves obtained are plotted for resistivity contrasts varying from 1 to 10.—*V. S.*

10120. Vladimirov, O. K., and Novozhilova, M. E. Resistivimeter with a controllable coefficient [in Russian]: Razvedka Nedr, vol. 13, no. 6, pp. 50–51, Moscow, 1947.

A logging instrument is in production by the experimental geophysical shops of the Ministry of Geology, U.S.S.R., for measurements of the electrical resistivity of formations in drill holes filled with fresh-water muds of high specific resistivity. Since very weak currents, yet compatible with measureable potential difference, must be used in such logging, a special design provides an instrument with a scale coefficient controllable within a range of 0.005 to 0.5 for specific resistivity measurements in ohm-meters. Control is achieved by having two sliding, adjustable electrodes on a graduated ebony rod centered within a brass cylinder closed on both ends and lowered on an electrical cable into the drill hole. For a logging operation the electrodes can be set at any distance from each other within a range of 24 centimeters. The dependence of the coefficient on the spacing of electrodes was determined experimentally and was found to be linear.—*V. S.*

10121. Weber, Reinhold. Ermittlung charakteristischer Eigenschaften der von Bohrungen durchteuften Schichten durch Messung des Gasgehaltes der Dickspulen [Determination of the characteristic features of the layers met with in shaft-sinking by measurement of gas content of the water current]: Oel u. Kohle, no. 47, Berlin, 1941.

The author has worked out a method to determine the gas content of liquids with an accuracy of $1:10^5$ and applied it to investigations of horizontal distribution of carbohydrates over a certain region. Recently the method was used to determine the gas content in the water current of a borehole. It was established that the gas content of the water, taken at the mouth of the hole, corresponds to that at the bottom and that the intermediate formations do not contribute to the gas absorption by the water. A close agreement was established between the graphs of the gas content on one hand and the diagrams made by electrical well logging and the profiles of samples from the boreholes on the other. The method makes possible an observation of the formations during the drilling without interruptions in the operation.—*Abstract by Horwath in Berg-u. Hüttenm. Monatsh., Heft 3, p. 40, Vienna, 1942, translated by S. T. V.*

10122. World Petroleum. Leduc discovery encourages Canada: Vol. 18, no. 9, pp. 70–71, New York, 1947.

The urgent need for oil arising from the war led to an intensification of exploratory activity in Canada. Beginning with 1939 geophysical crews surveyed large areas of Alberta and Saskatchewan. The search proved long and tedious, and many dry holes were drilled. A well hole at Leduc, 20 miles southwest of the city of Edmonton, Alberta, was carefully followed down every foot of the way, frequent cores being examined to observe formations. At 5,029 feet saturated cores were recovered from a porous horizon in the Devonian lime. At 5,176 feet drill-stem tests started a flow of natural gas running to two and a half million cubic feet per day. At a slightly greater depth oil appeared, and all the Leduc wells are now producing steadily. Seismic prospecting at Leduc led to drilling some 20 miles east of the Leduc producers.—*S. T. V.*

10123. Zaks, S. L. The water in oil accumulations [in Russian]: Acad. Sci. U.R.S.S. Bull. (Izvestiia), Classe sci. tech., vol. 7, pp. 787–793, Moscow, 1947.

Quite often oil-bearing strata contain much water which has not been completely removed during the slow process of oil accumulation because the surface tension between minerals and water is greater than that between minerals and oil. Yet the samples of crude oil taken from the well do not contain water, even if the water content of the formation is as much as 50 percent. This fact is of importance in geophysical exploration of oil deposits and in the evaluation of their future yield. Tests were made by the Russian Institute of Fuels on core samples taken from different oil-bearing regions in order to determine their porosity, mineralogical composition, and oil and water saturation. The core samples were carefully protected against water contamination during the cutting and removal from the formation. The tests showed that the oil-bearing strata can have a water content as high as 28.8 percent with no water present in the crude oil. The article gives much information as to reliable characterization of an oil-bearing formation.—*S. T. V.*

9. UNCLASSIFIED GEOPHYSICAL SUBJECTS

10124. Belluigi, Arnoldo. La geofisica mineraria e la Sardinia [Sardinia and geophysical exploration for minerals]: R. Univ. Studi Cagliari Pub., 14 pp., Cagliari, Sardinia, 1945.

The author outlines a program of geophysical exploration of the island of Sardinia, embracing a geodetic survey and a detailed study of the gravimetric, electric, magnetic, and radioactive properties of its soils. The abundance there of metalliferous ores, mostly sulfides and therefore electrically conductive, makes the electrical methods of prospecting particularly appropriate. As an aid in the interpretation of results of geophysical surveys, the author suggests experimenting on models and presents several examples of pertinent computations. As a peculiar difficulty in electrical prospecting he mentions the presence of overlying highly conductive soil strata producing a shielding effect in electrical measurements. He calls attention to the importance of exploration for underground water resources to make full use of the 17 billion cubic meters of yearly rainfall. Finally he mentions the importance of developing radioactive methods of exploration in view of the presence of uranium ores on the island.—*S. T. V.*

10125. De Ment, Jack. Ultraviolet light in uranium prospecting: Mineralight News Bull., no. 9, 5 pp., Los Angeles, Calif., Ultraviolet Products, Inc., 1945 (?).

The use of ultraviolet light in uranium prospecting is based on the property of fluorescence possessed by some secondary uranium minerals, such as uranium phosphates, arsenates, and sulfates. Fluorescence is characteristic of these minerals both in the solid state and in certain solutions. It is best produced by ultraviolet radiations, such as those supplied by certain lamps serviceable for field work and laboratory tests. The commercially valuable primary uraninites, including pitchblende and the columbian-titanium tantalates, are usually non-

fluorescent but often occur in association with the secondary uranium minerals and can be detected through the fluorescence of the latter.

To aid prospectors, information is given on the United States Bureau of Mines' classification of uranium minerals, the average amount of uranium in some of these minerals, the color values of the fluorescent uranium minerals under ultraviolet lamps, and various fluorochemical field tests for uranium used as additional checks in prospecting for pitchblende and carnotite, such as the bead tests, the zinc test, and the Sill and Paterson test.—*V. S.*

10126. Fagin, K. M. Exploration in Alaska: Petroleum Engineer, vol. 18, no. 13, pp. 150–164, Dallas, Tex., 1947.

United States Naval Petroleum Reserve No. 4 in Alaska was explored by various methods during 1944–47. Geological surveys of rivers and outcrops revealed prominent local structures; aeromagnetic surveys furnished a magnetic map of the entire reserve and of promising adjacent territory; and gravimetric surveys with instruments transported by land and by air supplied further data on a large part of the reserve. Seismic reflection surveys served mainly for detailed exploration of a limited number of structures, including those in the Umiat, Omalik, and Cape Simpson areas. The difficult conditions of work and the equipment employed to overcome them are described.

The results indicate structures of low relief and heavy tarry oil seeps in the northern part of the reserve, which is a flat coastal plain with few outcrops. In the southern part they indicate long anticlinal folds and light oil and gas seeps. Wells have been drilled in the Umiat and the Cape Simpson areas.—*V. S.*

10127. Foote, P. D. The discovery of an oil field: Am. Philos. Soc. Proc., vol. 92, no. 1, pp. 15–25, Philadelphia, Pa., 1948.

Petroleum exploration is now a highly organized group activity in which geophysicists play an important part. Recently this concerted effort has rendered possible the quick discovery of the Burghan oil field in Kuwait, on the northwestern shore of the Persian Gulf, which promises to give at least half as much production as the known reserves in all of the 3,180 oil fields in the United States. During a single winter Kuwait's entire area was covered by a network of magnetic and gravity stations, and later the Burghan structure, selected for drilling, was tested by the seismic reflection method. The use of the instruments developed since that time for magnetic and gravity surveys from the air depends even more closely on organized group activity.

The principles underlying various gravitational, magnetic, and seismic methods of oil search are outlined in the light of related geology, the construction of the instruments is indicated briefly, and the interpretation of the results is discussed and illustrated by examples of records.—*V. S.*

10128. Gulatee, B. L. Future of geophysics in India: Jour. Sci. Ind. Research, vol. 6, no. 2, Delhi, India, February 1947.

The author outlines some of the geodetic and geophysical methods used for the determination of the broad features of continents and oceans, for the commercial exploration of small pockets of ores and minerals,

and for the development of fruitful lines of further research on some of these problems.—*India, Cent. Board Irr. Abstracts, no. 88, Simla, S. W., August 1947.*

10129. Macelwane, J. B. An arts and science curriculum in geophysics: Am. Inst. Min. Met. Eng. Trans., vol. 164, 1945, pp. 356–359, New York, 1946.

The Department of Geophysics of St. Louis University, St. Louis, Missouri, has a curriculum in exploration geophysics, with lower division prerequisites and an upper division concentration in geophysics, which meets the requirements of the College of Arts and Sciences for graduation. The complete program of courses is presented, and the considerations that determined its composition are discussed.

The basic viewpoint is that a geophysicist is neither wholly a physicist nor wholly a geologist but a specialist with a field of his own. He differs from the physicist in that he must apply physical instruments and physicomathematical reasoning to physical quantities in their undisturbed natural environment, and he differs from the geologist in the phenomena he observes, the methods and instruments he uses, and the concepts he applies for the solution of his problems. Accordingly, a geophysical curriculum must include not only courses offered in departments of physics or geology but also purely geophysical subjects, such as the figure of the earth, the plumb line, the earth's gravitational field, the theory of isostasy, terrestrial magnetism, electrical theory applied to the earth, refraction and reflection of elastic waves, and other terrestrial phenomena.—*V. S.*

10130. National Research Council of Canada, Associate Committee on Geophysics. First annual report [1945–46], 16 pp., Ottawa, 1947(?).

The Associate Committee on Geophysics, established within the National Research Council of Canada in the second half of 1945, functioned until the end of 1946. It then recommended its own reorganization into an expanded Associate Committee on Geodesy and Geophysics and issued a report for 1945–46 summarizing its activities until the time of reorganization. The report outlines the progress accomplished in projects undertaken in the fields of magnetism, gravitation, electricity, seismology, and tectonophysics.—*V. S.* (*See also* Geophys. Abstracts 131, no. 9641.)

10131. Nature. Water movements and earth currents—Electrical and magnetic effects: Vol. 161, no. 4084, pp. 192–193, London, 1948.

The paper by N. Barber and M. S. Longuet-Higgins, "The electrical and magnetic effects of marine currents," is summarized. Theoretically Faraday's law of electromagnetic induction requires that when a large body of water moves in the earth's magnetic field an electromotive force is set up perpendicular to the direction of motion. This deduction has been confirmed by observations on tidal streams in the English Channel made at various times in the course of work on submarine cables by studies of coastal earth currents, and by experiments with electrodes in the sea.

The evidence gathered on the relationship between the channel's tidal potential gradients and associated electric currents is outlined, and the

resulting electromotive force is estimated to be 3 volts at the time of maximum tide. The flow of electric current is solenoidal and can be expected to have little or no effect at the earth's surface. On the sea bed this flow may produce at a 100-meter depth a tidal variation amounting to ±10 gammas in the east-west component of the magnetic field, but on the land near the coast at a depth of 1,000 meters the variations of the magnetic field is likely to be less than 1 gamma.—*V. S.*

10132. Orlov, A. J. The mean annual motion of the earth's principal axes of inertia: Acad. Sci. U.R.S.S. Comptes Rendus (Doklady), vol. 51, no. 7, p. 509, Moscow, 1946.

The movement of the instantaneous terrestrial pole is caused by the transport of masses (mainly air masses) and is composed of an annual movement and a movement with Chandler's period. The theoretical expression of the equations of this movement is given, and the coefficients are determined numerically on the basis of averages of observed values. The mean motion of the pole of inertia consists of oscillations in the plane of the meridian perpendicular to that of Greenwich with an amplitude of 0.03''.—*Cent. Nat. Rech. Sci., Bull. Anal, vol. 8, no. 9, pt. 1, p. 2001, Paris, 1947, translated by V. S.*

10133. Rinehart Oil News Co. Rinehart's Yearbook 1948, Tulsa, Okla., 1948.

Data on new oil-field discoveries and exploration during 1947 are presented for 22 oil-producing States: Alabama, Arkansas, Colorado, Florida, Georgia, Kansas, Louisiana, Mississippi, Montana, New Mexico, Oklahoma, Tennessee, Texas, Utah, Wyoming, Arizona-Idaho, and Dakotas-Nebraska-Missouri-Iowa. The information is arranged in sections covering one or more States. Geophysical data on crew-weeks and locations are given in the sections on Colorado and Wyoming. In Colorado geophysical exploration continued at a rapid pace, with 426 crew-weeks of gravimeter surveys and 379 crew-weeks of seismograph surveys completed, and in Wyoming extensive work was performed, totaling 553 crew-weeks of gravimeter surveys and 1,093 crew-weeks of seismograph surveys.—V. S.

10134. Sagui, C. L. La terre et l'univers qui l'environne [The earth and the universe which surrounds it]: Inst. de Fisiograf. y Geol. Pub., no. 31, 69 pp., Rosario, Argentina, 1947.

The thesis, developed by the author in a previous paper, that great earthquakes arise from terrestrial and solar causes, is now expanded on the basis of electromagnetic quantum theories into a view of the universe as a system of closely interdependent phenomena forming in the ultimate analysis a network of electromagnetic waves (*see also* Geophys. Abstracts 131, no. 9533). In the analysis consideration is given to the age of the earth as determined by radioactive methods; to cyclones, found dependent on the effects of the solar radiations upon the electromagnetic concomitants of the terrestrial gravitational field; to terrestrial seismic waves and the solar constant, viewed in the light of electromagnetic quantum theories; to the law of Moseley and the forces of repulsion; and to related phenomena in the universe.—*V. S.*

10135. Siñeriz, J. C. La interpretacion geologica de las mediciones geofisicas aplicadas a la prospeccion [The geologic interpretation of geophysical measurements applied to prospecting], vol. 3, 573 pp., Madrid, Inst. Geol. Min. España, 1944.

The present volume contains examples of analysis and geologic interpretation of the following geophysical surveys carried out in different regions of Spain: Magnetic and electrical exploration of La Enebrosilla (Cebreros, Avila); Magnetic prospecting in Cazalla de la Sierra (Sevilla iron deposits); Radioactive investigation of San Rafael (Segovia); Electric exploration of copper deposits in Sierra de Cordoba; Hydrologic exploration by the seismic method in Castellón de la Plana; Seismic explorations of Linares-La Carolina and adjoining regions (Seville province); and Magnetic prospecting in Coruña province. The descriptions of the investigations contain a general statement, geographic and geologic information, and description of the geophysical work and analysis of its results. Numerous maps accompany the text.—S. T. V. (For vols. 1 and 2 *see* Geophys Abstract 116, no. 7339.)

10136. Terrestrial Magnetism and Atmospheric Electricity. National Research Council Advisory Committee on Geophysics to the Office of Naval Research: Vol. 53, no. 1, pp. 97–98, Baltimore, Md., 1948.

The United States National Research Council has appointed a committee of investigators to advise the Geophysics Branch of the Office of Naval Research regarding their research program. The Geophysics Branch is charged with sponsoring basic investigations in various fields of earth science by giving financial aid and other support to projects. With the committee's concurrence, this agency plans to foster geological, geographical, and geophysical exploration of little-known areas, to conduct laboratory and field studies of the properties and processes in the earth's outer crust, and to develop instruments and techniques necessary for these investigations.—V. S.

10137. Tiratsoo, E. N. Exploration spurred by showings in southern France: World Oil, vol. 127, no. 13, pp. 215–217, Houston, Tex., 1948.

The recent discovery of oil at Audignon in southwestern France has encouraged further exploration in the Pyrenees foothills. For the most part the area is covered by Tertiary deposits under which the structures must be found by geophysical methods or subsurface geology. A program of electrical resistivity surveys was started in 1941 and continued through 1943, resulting in the discovery of a large basin in Upper Cretaceous beds. Northward from it resistivity measurements disclosed several anomalies, which were confirmed by other geophysical methods during subsequent years. In 1945 resistivity and gravity work was also conducted in an unexplored section farther north. However, seismic exploration in the Saubrigues area on the western edge of the basin and at points on its northeastern and southwestern edges showed, in conjunction with drilling results, that Upper Cretaceous beds can be productive only when overlain by Flysch rocks, which caused a radical reorientation of the program. The local geology is discussed with brief references to geophysical work.—V. S.

10138. Vening Meinesz, F. A. Convection currents in the earth: Kon. Nederland. Akad. Wetensch. Proc., vol. 50, no. 3, pp. 237–245, Amsterdam, 1947.

The hypothesis of convection currents in the subcrustal layer, used by the author to explain deepfocus and intermediate earthquakes in the eastern half of the Indian Archipelago, is now discussed in its wider bearing on the processes of crustal folding, the sinking of great basins with the rising of the adjacent tectonic belt, the great time lag between these changes, orogenic cycles, and related phenomena.

During the folding period the earth's crust is assumed to have downbuckled along the tectonic belt. It pushed into the interior the subcrustal material poorer in radioactive constituents and caused a slow local heating, establishing a horizontal temperature gradient. As this gradient gradually increased, the developing stresses eventually overcame the elasticity of the local substratum and generated a current, which became a convection current because of the vertical temperature gradient created by the general cooling of the earth.

A convection current of such nature must form within the subcrustal layer a rising column in the area of heating and a sinking column in the area loaded by the resulting flow. The effects on the surface of the earth should be simultaneous rising and sinking movements and a local cooling. In support of this hypothesis calculations are made for the Banda-arc area in the Indian Archipelago.—*V. S.*

10139. Warren, J. The velocity of electromagnetic waves: Australian Jour. Sci., vol. 10, no. 3, pp. 73–76, Sydney, Australia, 1947.

The article deals with one of the fundamental physical constants, the velocity of light, or of electromagnetic waves in general. This has been the subject of many investigations. However, measurements made to date are not now sufficiently accurate, because the development of radar and its application to geodetic and geophysical surveying necessitate much greater precision. The author refers to a review of the literature on this subject by R. T. Ridge in Reports on Progress in Physics (for 1941) and, after an analysis of the recent determinations, concludes that the probable velocity of electromagnetic waves is 299,776 kilometers per second with a probable error of only 4 kilometers per second. An important fact to be considered in the use of radar methods for precise measurement of distance, as, for example, in geophysical surveying, is that the velocity of electromagnetic waves varies with meteorological conditions. Hence in making a precise determination it is necessary to know accurately the atmospheric conditions along the path. It is also possible that the velocity of electromagnetic waves in the earth's atmosphere is not an absolute constant, but that it varies periodically with the time.—*S. T. V.*

10140. Weelden, A. van. Enige beschouwingen over de practijk der geophysische opsporingsmethoden [Some speculations about different methods of geophysical exploration]: Geol. Mijnb., vol. 10, no. 3, pp. 57–59, The Hague, 1948.

This article is an address delivered by the author before the Society of Mining Engineers of Heerlen, Netherlands. The author critically

analyzes different methods of exploration for oil and minerals and emphasizes the difficulties encountered by the exploration geophysicist. As an example, he discusses the problem of determination of depth of the carbon layer, which in the Netherlands can vary from a few meters to about 500 meters. Here the geophysicist would be inclined to use the seismic method. In the densely populated parts of the Netherlands, however, this method would not be successful because it would be impossible to use a large enough charge of explosives. Therefore in those cases where the depth is greater than 100 meters, the electrical method has been applied.

This method was also tried in oil prospecting, but in both cases where tried brought disappointment, because the geophysicist had no criterion adequate for his diagnosis, when, for example, an oil-saturated sand can have the same low electrical conductivity as a deep hard formation. Therefore the electrical method is suitable also for only shallow depths. For the location of faults gravimetric methods are the most suitable, the gravimeter being more convenient to use than the torsion balance. The author emphasizes the advantage of applying several methods for the solution of any important problem. In the process of exploration every newly discovered fact must be critically analyzed and if necessary the adopted procedure modified.—*S. T. V.*

10141. Wrather, W. E. [Annual report of the] Geological Survey: [U. S. Dept.] Interior, Ann. Rept. of Secretary, 1947, pp. 213–258, Washington, D. C., [1948].

The annual report of the Director of the United States Geological Survey to the Secretary of the Interior for the fiscal year ending June 30, 1947, includes accounts of geophysical and geochemical work. During the period geophysical surveys were made on the ground or from the air in 20 States, in Alaska, in Antarctica, and in northern Canada to obtain information useful in investigations of geologic structure, stratigraphy, ground water, permafrost, volcanology, and occurrence of oil and ore. This work included 44,539 miles of aeromagnetic traverse covering more than 42,000 square miles; electrical resistivity surveys, partly in permanently frozen ground; and gravimetric exploration on land and on the Continental Shelf, the latter combined with a cooperative program of oceanographic research. To aid the aeromagnetic and resistivity surveys, theoretical studies were conducted, particularly on the determination of the depth of deposits. Other geophysical work is listed. The geochemical research was aimed at developing techniques by means of which the contents of metallic elements in the vegetation, soil, and natural waters could be used as a guide in the search for ore deposits.—*V. S.*

10. RELATED GEOLOGICAL SUBJECTS

10142. Andrianov, P. I. The bound water of the soil [in Russian]: Inst. Merzlotovedeniia Trudy, vol. 3, 139 pp., Moscow, 1946.

This paper is a review of our present knowledge of bound water, especially that contained in the soil. Free water coming in contact with solid surfaces of soil particles is transformed into bound water under the action of surface tension of the solid particles on the dipole water mole-

cules. Bound water shows properties very different from those of free water. Its specific gravity can be as high as 1.71 and its specific heat as low as 0.6. The dielectric constant of bound water is less than that of free water, and its viscosity is double that of free water. Certain properties of elasticity make bound water in many respects similar to solids. Its modulus of shear is no longer negligible as in the case of free water. Important changes in the freezing temperature of bound water are taking place in the ground. The author mentions experiments where the freezing temperature was lowered to —18.6° C. in capillaries 0.1 millimeter in diameter. The study contains a discussion of different methods employed in studying bound water and descriptions of many experiments made by the author and his students.—*S. T. V.*

10143. Brod, I. A. Concerning a basic geologic condition for the accumulation of oil and natural gas [in Russian]: Acad. Sci. U. R. S. S. Comptes Rendus (Doklady), new ser., vol. 57, no. 6, pp. 595–598, Moscow, 1947.

On the basis of a study of oil production and oil reserves of the world the author concludes that by far the greatest accumulations of oil are concentrated at two points on the globe. One area is the territory around the Mexican Gulf, where 7 out of 10 billion tons of the known resources of the Western Hemisphere are to be found. The greatest amount is concentrated in the Texas-Louisiana-Oklahoma basin. Substantially smaller accumulations are distributed in the folded strata of Mexico, Venezuela, and Colombia. The other area is on the continent of Eurasia, where the pole of oil accumulation is the depression around the Caspian Sea, which spreads south toward the Persian Gulf. Here are to be found such centers of oil production as the Apsheron Peninsula, the Emba region, Iran, Iraq, and Saudi Arabia. They contain 6 out of 7 billion tons of established oil resources of the Eastern Hemisphere.

The geologic history of both of these centers of oil accumulation is characterized by processes of subsidence, which were not only biologically favorable to oil formation but also to the preservation of the oil fluids formed. Orogenic processes may reveal accumulated oil resources, but as a rule orogeny destroys such accumulations and breaks down the process of oil formation. The fact should have bearing on geologic exploration for oil. The author states that up to the present time his views have been shared only by a minority of geologists.—*S. T. V.*

10144. Davey, J. C. Radioactive minerals of the Venezuelan Andes: Royal Geol. Soc. Cornwall Trans., vol. 17, pt. 6, pp. 313–316, Penzance, England, 1947.

The search for deposits of strategic materials sponsored by the Venezuelan Government during the war led to the discovery in 1943 of the radioactive minerals calciocarnotite and pitchblende near the town of Timote in the State of Mérida.

Calciocarnotite, a hydrated vanadate of uranium and calcium, is a yellow earthy powder with a uranium content of more than 2 percent. The uranium oxide content of pitchblende may be as much as 80 percent. One sample of pitchblende contained 124 milligrams of uranium and radium per ton of ore.—*S. T. V.*

10145. Fairbridge, R. W. Coarse sediments on the edge of the continental shelf: Am. Jour. Sci., vol. 245, no. 3, pp. 146–153, New Haven, Conn., 1947.

It is paradoxical that the coarsest sediments of the continetal shelf are found on the outermost edge, apparently too far from the present shore for normal transportation. They have been explained as relics of a Pleistocene shore line, when the sea level was considerably lower than it is today. Their continued exposure and the absence of masking by recent sediments is sometimes ignored, sometimes attributed to current action, and at other times explained by high-amplitude wave action. While admitting much activity by currents and by waves at limited depths, it is here postulated that the soft postglacial sediments on the outer edge of the continental shelf periodically slip off and slide down the continental slope by a process of submarine slumping.—*Author's abstract.* (For relation to oil reservoirs *see* Geophys. Abstracts 124, no. 8429.)

10146. Grave, N. A. Fossil ice masses of the Lena-Aldan watershed [in Russian]: Inst. Merzlotovedeniia Trudy, vol. 4, pp. 10–32, Moscow, 1944.

The author defines fossil ice mass as an agglomeration of isolated blocks of ice or of frozen ground at a certain depth in nonpermanently frozen ground. Such ice formations are usually covered with 5 to 10 feet of active soil. Their dimensions can reach 3 to 4 square kilometers. A study of such fossil ice fields is a new problem to geophysicists, a problem of great practical importance because quite often catastrophic settling of industrial structures can be expected if they happen to be erected on such soils. The cause of the settling is the change in the thermal equilibrium of the ground caused by the cutting down of forests, which opens the ground to more intense insolation, by penetration of sea water in the course of harbor works, by a change in the direction of underground streams by deep excavation, or other factors. The article gives a description of several fossil ice fields discovered in the region between the Lena and Aldan Rivers in eastern Siberia and of the methods used to discover them.—*S. T. V.*

10147. Krejci-Graf, K. Zusammenhang zwischen Tektonik und Ölführung in Süd-Rumänien [The relationship between tectonics and oil accumulation in southern Rumania]: Reichsamt für Bodenforsch. Jahrb., vol. 63, pp. 590–598, Berlin, 1942.

The author shows that there is a definite relationship between the extent of folding and the productivity of oil deposits. He establishes several such relationships with the aid of comprehensive statistical tables of Rumanian deposits. A map of the deposits accompanies the text.—*Inst. Franç. Pétrole Rev., vol. 1, no. 4, pp. 215–216, Paris, 1947, condensed by V. S.*

10148. Kuenen, H. Volcanic fissures, with examples from the East Indies: Geol. Mijnb., new ser., vol. 7, no. 3–4, pp. 17–23, The Hague, 1945.

Volcanic fissures may be classified as basement fissures and flank fissures, with the latter further subdivided into radial, tangential, concentric, and erratic fissures. All forms of transition are found to exist between fissure eruptions and rows of separate volcanoes. When cones are scattered along belts they may be independent of fissures; or irregu-

lar fissures and transverse cracks or hading fissures may have aided the magma to erupt. Straight or slightly curved rows of cones may be attributed to fissures. Examples are given from the neighborhood of Halmahera and from eastern Java, and a remarkable coincidence is noted between several of the East Indian fissures and the stress pattern calculated by Vening Meinesz as a result of a displacement of the poles. Other features of volcanic fissures are indicated.—*Author's summary, condensed by V. S.*

10149. Malkin, D. S., and Echols, D. J. Marine sedimentation and oil accumulation—[Part] 2, Regressive marine offlap and overlapp-offlap: Am. Assoc. Petroleum Geologists Bull., vol. 32, no. 2, pp. 252–261, Tulsa, Okla., 1948.

Marine regression, its resultant stratigraphic marine "offlap," and the compound features "overlap-offlap" and "offlap-overlap" that result from the alternation of transgression and regression, are discussed. Although sands deposited in a regressive sea theoretically are not considered as favorable as the overlying transgressive sands for the trapping of petroleum, the local structural and environmental conditions may effect excellent reservoirs.—*Author's abstract.* (For Part 1 *see* Geophys. Abstracts 108, no. 6414.)

10150. Roberts, A. Geological structures and maps, VII, 66 pp., 30 figs., 39 maps, London, Pitman and Sons, 1947.

This textbook is a practical course in the interpretation of geologic maps, designed for civil and mining engineers. A short explanatory text is supplemented with a series of 39 exercises presented in the form of problem maps dealing with basic aspects of geologic interpretation.—*V. S.*

10151. Rubinstein, L. I. On the solution of Stefan's problem [in Russian]: Acad. Sci. U. R. S. S. Bull. (Izvestiia), Sér. Géog. et Géophys., vol. 11, no. 1, pp. 37–54, Moscow, 1947.

Stephan's problem, as formulated by the author, consists in the determination of the final state of a heterogeneous medium undergoing a change of its initial and boundary conditions. This problem is met with in the geophysical exploration of permanently frozen ground. Only the one-dimensional case is treated and the point of phase separation is determined. This is done by the process of iteration, applied to a system of integro-differential equations derived by the author. Convergence of the process and uniqueness of the solution are also proved. An application of the method to a spherical region with radial symmetry is also presented.—*S. T. V.*

10152. Rühl, W. Petroleum geology [in Germany]: Nature, vol. 160, no. 4073, pp. 724–725, London, 1947.

On September 9–11, 1947, a convention was held in Hanover, Germany, by geologists and geophysicists on the subject of petroleum geology in Germany. The reports presented dealt with the theoretical and practical information collected in northwestern Germany during the past 15 years. Several thousand wells drilled there during that period, mainly in 26 oil fields, have been explored by the latest drill-hole methods.

The total available evidence appears to indicate that 20 fields are associated with salt domes, 15 of them being of the flank type and 5 of the crestal type. The other 6 fields are located on anticlines. The source rocks are mainly dolomite and porous shale of the middle Zechstein, coral oolite of the Malm, shell banks of the Wealden, breccia layers of the Neocomian, and some other rocks. The geophysical investigation of particular interest was the seismic recording of the demolition explosions on Helgoland Island in April 1947 (*see* Geophys. abstract 10072).—*V. S.*

10153. Savarenskii, F. P. Engineering geology [in Russian], 422 pp., Moscow, 1937.

This book deals with the geologic questions connected with structural engineering. Engineering geology is a science of recent origin, owing its development to the growth in size of modern structures. In designing such structures it is imperative to take into account the geologic factors, which often can influence the stability of the structure. The author discusses the settling of ground, landslides, and phenomena of freezing and thawing with the resulting effects upon the structures. This is followed by a discussion of the seismic phenomena in their relation to structures. The last chapter is devoted to geologic investigation of the suitability of sites to structures and to a description of geoelectric and seismic methods of exploration of the soil from the point of view of the structural engineer.—*S. T. V.*

10154. Schneegans, Daniel. Gas-bearing structures of southern France: Am. Assoc. Petroleum Geologists Bull., vol. 32, no. 2, pp. 198–214, Tulsa, Okla., 1948.

The first drilling in southern France took place in 1919 and centered on seepages in connection with complex salt domes. These attempts were unsuccessful, and interest lagged until 1937, when the French Government undertook the investigation of some anticlines in the Petites Pyrénées. The discovery well here penetrated a large natural-gas reservoir on July 14, 1939, and since that time the geological and geophysical exploration of the Aquitaine Basin has progressed vigorously. The report deals chiefly with the geology and production data of the Saint Marcet field. In addition the other exploration activities of the Government are briefly described.—*Author's abstract.*

10155. Schneerson, B. L. Concerning the process of formation of salt domes [in Russian]: Acad. Sci. U.R.S.S. Bull. (Izvestiia), Sér. Géog. et Géophys., vol. 11, no. 6, pp. 497–502, Moscow, 1947.

Upper layers of the earth's crust often contain thick layers of salt. In Russia these layers are found in the Emba oil region and in the United States in the Gulf States. Quite often penetrations of salt are found in the formations covering the salt layers in the form of rudely cylindrical intrusive masses. The author discusses the formation of such salt intrusions in past geologic history through the action of different mechanical forces on initially flat salt layers. He concludes that in the Emba region of Russia, where the thickness of the salt domes is about 3 to 4 kilometers, the process was not a continuous

one but had been disrupted by tectonic disturbances, bringing horizontal forces into play, whereas in the Gulf region of the United States, where the thickness of the domes is greater than 8 kilometers, this process could be a continuous one, going on even at the present time.—*S. T. V.*

10156. Tsytovich, N. A., and Sumgin, M. I. The elements of the mechanics of frozen ground [in Russian], 432 pp., Moscow, Acad. Sci. U.S.S.R., 1937.

The book deals with the properties of frozen ground that are to be taken into account by structural engineers. The most important subjects treated are the following: physical properties of frozen ground, frozen ground as a four-phase system, processes of freezing and thawing, the strength of frozen ground when acted upon by external forces and the deformations caused by them, characteristics of permanently frozen ground as related to structure, interaction between permanently frozen ground and the structure erected thereon, technical investigations of permanently frozen ground preceding construction work, basic calculations in designing foundations for structures to be erected on permanently frozen ground, general consideration, selection of the site and of the type of foundation, stability of structures, thermal balance of the foundation, possibility of thawing of the ground, and heaving of the foundation. Examples of completed foundations are given.—*S. T. V.*

10157. Vogt, T. Fjellkjekens flytestrukturer og malmforekomstene—1, Nord-Rana grubefelt [Plastic flow structures and ore deposits—1, Nord-Rana mining district]: K. Norske Vidnesk. Selsk. Forh. 1944, vol. 17, no. 30, pp. 118–121, Trondheim, Norway, 1945.

Recently the author has studied various pyrite deposits in Norway and discovered a close agreement between the orientation of the plastic flow structures of the rock and the direction of axes of the ore bodies. This agreement is found to be a general feature of epigenetic ore bodies produced before or during the formation of the flow structures. Two extreme types of such structures are distinguished, being connected by transition. They are (1) the common coarse stretching in restricted areas, accompanied by a special type of minor folds having axes coincident with the stretching, the Nord-Rana area being largely of this type, and (2) insignificant mineral structures, such as those on level foliation planes, with the axes of the contingent folds generally diverging from those of the flow structures and of the ore bodies. These types are discussed and are illustrated by maps of known flow structures.—*Author's abstract; condensed by V. S.*

11. TECHNICAL AIDS TO EXPLORATION

10158. Brizzhev, L. On the construction of a better pendulum clock [in Russian]: Astron. Jour. Soviet Union, vol. 24, no. 3, pp. 183–190, Moscow, 1947.

The author discusses the following imperfections of the existing pendulum clocks: large temperature coefficient, complexity of adjustment, extreme sensibility of the pendulum suspension, and insufficient constancy of the period influenced by the phase of the winding impulse. He suggests a new design consisting of a pendulum of fused quartz 1 meter long with a special temperature compensation. The pendulum receives impulses every half period. It is set in a hydrogen-filled barometric

chamber with automatic pressure regulation. An experimental model is under construction in the Institute of Measures and Measuring Instruments at Kharkov. In the opinion of the author quartz is a better material for pendulum construction than invar; it has a smaller temperature coefficient and better molecular stability.—*S. T. V.*

10159. Cameron, H. L. Air photograph interpretation: Canadian Min. Met. Bull. 430, pp. 62–68, Montreal, Quebec, 1948.

The value of aerial photographs as an aid to structural geology was conclusively demonstrated in the area of Chimney Corner-Cheticamp, Cape Breton Island, Nova Scotia, mapped geologically by the author in 1946. In addition to such use, attention is also given in the paper to the helpfulness of these photographs as field maps and aids to traverse planning. Although complete geologic surveys are not possible on the basis of aerial photographs alone, a great deal of structural and other information may be obtained from an intensive study of them. In Nova Scotia a photographic check of the maps, available for a large part of the province, would appear very profitable.—*Author's summary, condensed by V. S.*

10160. Engleman, C. L. Underwater television: Electronics, vol. 21, no. 2, pp. 78–80, New York, 1948.

At Bikini during the summer of 1947 a television camera was successfully used for underwater observation. Underwater television opens many new channels of investigation. Geologists look upon the equipment as a potentially useful tool in conducting underwater studies of bottom formations and submerged reef areas. Application also may be found for it in borehole investigations. The equipment used was a standard television system using 350 lines per frame, having no interlacing, and producing 40 frames per second. The camera is focused by remote control from the panel on the surface. The maximum depth reach during the experiments was 180 feet.—*S. T. V.*

10161. Fleming, Lawrence, and Erath, L. W. Multi-channel amplifier for oscillographic recording: Electronic Ind., vol. 2, no. 4, pp. 8–10, New York, 1948.

An eight-channel direct current amplifier is described which uses a number of special circuits to keep its size within bounds. A simple positioning control circuit varies the bias on the first tube without affecting the gain. The output tubes are single 6V6 tetrodes, in which the plates are fed from a common nonregulated rectifier and the screens from a small series-tube regulator. The "zero" plate current on the power tubes is bucked out of the load circuits by a small common battery. Crosstalk between channels is less than one-half percent under the worst overload conditions.—*Authors' abstract.*

10162. Kapterev, P. N. Asymmetric volume increase of water on freezing [in Russian]: Acad. Sci. U.R.S.S. Comptes Rendus (Doklady), new ser., vol. 58, no. 2, pp. 225–228, Moscow, 1947.

This is a report on experiments made at the Skovorodino station, western Siberia, for the study of frozen ground in the years 1934–36

and in Moscow in 1946. The experiments covered the phenomena connected with the freezing of water when cooled to —38° C., as it occurs in many minerals exposed to this temperature during the winter months. Experimenting with glass and rubber containers filled with water and cooled to this temperature, the author established that in freezing the increase in the volume of the water occurred unequally in different directions, and often the longer dimensions of the containers even shrunk, whereas the shorter ones increased as much as 30 to 40 percent.

Frequently glass containers burst, owing to this expansion, whereas elastic containers invariably changed their shapes, approaching the spherical form. This asymmetric increase of volume can be very harmful to structures and also can produce, under natural conditions, displacement of the water in certain directions. As an additional cause of destructive forces, the author points to "restraint crystallization" of the ice crystals at the walls and in the corners where they are forced to change their usual shape and in doing so develop reaction forces of great intensity.—*S. T. V.*

10163. Kroemmelbein, W. F. Shoran for surveying: Electronics, vol. 21, no. 3, pp. 113-117, New York, 1948.

The article contains a short description of shoran as applied to aerial navigation, surveying, and geophysical prospecting. Shoran appears to be one of the few military developments to have practical postwar uses. It consists of two ground radio beacons and a specially equipped aircraft. The aircraft has a transmitter that radiates pulses at two different carrier frequencies. One of the two ground stations is tuned to one frequency and the other to the other frequency. Each ground station sends its "echo" to the airplane thus enabling it to determine the distance to either of the stations and to find its position with great accuracy. Separation of the ground stations can be as much as 350 miles for an airplane flying at an altitude of 5,000 feet. The accuracy of the determination of the airplane's position is of the order of ± 50 feet.

Shoran can be used to make maps on a scale as large as 1:25,000. The most general commercial use of shoran is its combination with photogrammetry for aerial surveys and mapping. If a magnetic airborne detector and a radio altimeter are installed on the airplane, shoran makes possible accurate contour mapping and thus reduces the cost of general reconnaissance. This technique has application in the oil industry. Shoran is also extensively used in magnetic surveys. As the author states, it is not yet completely adapted to all possible uses, but it has been definitely shown to be practicable as a new tool in exploration.—*S. T. V.*

10164. Leggett, Julian. Effects of underwater surveys on marine life: World Petroleum, vol. 18, no. 13, pp. 56-57, New York, 1947.

An account is given of detonation tests conducted during 1947 in the Gulf of Mexico off the Louisiana coast, under the supervision of the Louisiana Department of Wild Life and Fisheries, to determine the effects of seismic underwater surveys on marine life. Charges of as much as 800 pounds of dynamite were exploded at distances of 50 to 400 feet from specimens of fish, shrimp, and crabs placed in cages either

suspended in water or set on the sea bottom, and the effects of detonations on these specimens were examined after each blast. It was found that even the strongest explosions do little harm to shrimp and crabs but are injurious to fish, especially of the delicate types. Earlier tests had given evidence that oysters are not affected by explosions set off at 50 to 75 feet from their beds (*see* Geophys. Abstracts 128, no. 9099).—*V. S.*

10165. Pavlov, N. P. The influence of retardation of radio receiver on the moment of registration of radio time signals [in Russian]: Astron. Jour. Soviet Union, vol. 22, no. 5, pp. 293–302, Moscow, 1947.

Several modern methods of seismic prospecting require a very accurate registration of time signals corresponding to arrival of different seismic waves. Here an accuracy of 0.001 second is necessary. When the highest attainable accuracy is needed, the author suggests registering the beginning as well as the end of the rhythmic time signal, which according to his experience will materially diminish the influence of many systematic errors. It is also desirable to measure the moments of locking and relocking of contacts if such refinement is available. Finally the shape of the signal can be improved by the use of a normal rectangular wave shape.—*S. T. V.*

10166. Putnam, W. C. Aerial photographs in geology: Photogram. Eng., vol. 13, no. 4, pp. 557–565, Menasha, Wis., 1947.

Geologic interpretation of aerial photographs is discussed in the light of recent advances, as an aid to field mapping and as a substitute for it. The primary application is considered to be the use of photographs as base maps in the detailed field delineation of dips, strikes, faults, contacts, and other features involved in the preparation of geologic maps. Such work is found effective, particularly when performed with the aid of magnifying pocket stereoscopes. On the other hand, the use of aerial photographs as sole sources of information, in place of ground reconnaissance, is believed to be more uncertain and susceptible to error but invaluable for the mapping of inaccessible regions. Criteria for the identification of rock types, geologic structures, soils, and land relief from photographic evidence are discussed briefly, and a few remarks are made on military geology.—*V. S.*

10167. Rich, J. L. Geological applications of oblique photography: Photogram. Eng., vol. 13, no. 4, pp. 565–570, Menasha, Wis., 1947.

From the geologic viewpoint oblique photographs have certain advantages over vertical photographs, particularly because they give a greater aerial coverage and a more natural appearance to the terrain. In areas of rugged relief, where sedimentary rocks are conspicuously exposed, the author considers it possible to make accurate dip and strike measurements directly from oblique photographs tied together by adequate control. The method offered consists in selecting three points on a dipping bed, locating them by intersection, determining their relative elevations by any one of the standard procedures, and deriving dip and strike by the customary three-point technique.

It is also possible to plot on a map the aerial traverse traced in a flight in order to show the approximate locations of geologically sig-

nificant points or the position of the plane when the photographs were taken. The procedure is described and illustrated by an example.—*V. S.*

10168. Wengerd, S. A. Geologic interpretation of trimetrogon photographs—Northern Alaska: Photogram. Eng., vol 13, no. 4, pp. 586–600, Menasha, Wis., 1947.

Geological and geophysical exploration of United States Naval Petroleum Reserve No. 4 in Alaska was preceded by photogeologic and photogrammetric mapping in 1944 and 1945. This preparatory work consisted of trimetrogon and vertical photography, compilation of photogrammetric base maps, and geologic interpretation. It resulted in a photogeologic map of the eastern part of the plateau province of northern Alaska. The geologic interpretation was based on 2,565 aerial photographs, two-thirds of them oblique, and was aimed at utilizing primarily the photographic data on dip and strike indicative of surface structures in upper Cretaceous strata. The use made of photographic analysis for identifying direct shows of outcrops, topographic manifestations of strata, drainage patterns, soil and solifluction patterns, and vegetational patterns is described.—*V. S.*

10169. World Petroleum. Geophotometric mapping is new surveying method: Vol. 18, no. 12, p. 95, New York, 1947.

This is a brief description of a new method of surveying, known as geophotometric mapping, particularly adaptable to gravity meter work. The method consists of recording on photographic film all data usually recorded in the instrument man's notebook. Both speed and accuracy are reported to be improved by the new method. The photographic instrument is mounted in a manner similar to the surveyor's transit and uses 35-millimeter film with 36 exposures to the roll.—*S. T. V.*

12. PATENTS

[The figure in parentheses indicates the classification of the entry; see table of contents]

10170. (1) Apparat för uppmatning tyngdkraften [Apparatus for measuring the force of gravity]. Aktiebolaget Elektrisk Malmletning, Stockholm: Swedish patent 106,215, issued Dec. 29, 1942.

One or more thin elastic antennae of quartz or other suitable material, rigidly attached at one end to a base and left hanging free at the other end are immersed in a liquid serving to dampen their movement, so that, when the apparatus is set for use, they assume an essentially horizontal position and register, by the amount of their flexure observable against an indicator or otherwise, the effect of the force of gravity. Claims allowed, 2.

10171. (2) Verfahren und Vorrichtung zur Messung von Inhomogeneitäten des magnetischen Erdfeldes [Method and apparatus for measuring inhomogeneities of the geomagnetic field]. W. Hensel, Mölkau, and H. Janert, Königsberg, Germany: German patent 738,609, issued Aug. 23, 1943.

A method for measuring variations of the geomagnetic field, consisting in using two equal coils set rigidly on the same axis, so arranged

that both coils revolve about diameters parallel to the common axis, and so electrically connected that the electromotive forces generated in these coils by rotation in a homogeneous magnetic field fully balance and cancel one another, whereas rotation in an inhomogeneous magnetic field produces a residual electromotive force which depends solely on the difference between the magnetic intensities at the positions of the two coils. Claims allowed, 5.

10172. (2) Gyro flux valve compass system. C. F. Fragola, East Hempstead, N. Y., assignor to Sperry Gyroscope Co., Inc., a corporation of New York.: U. S. patent 2,424,562, issued July 29, 1947.

A gyro flux valve compass system comprising a first flux valve adapted to be mounted to rotate in azimuth with the vessel on which the system is employed, a directional gyro, precessing means for changing the azimuthal position of the gyro, a second flux valve responsive to the magnetic field in which it is located, means for creating at said second flux valve an artificial field much stronger than the earth's field at said second flux valve, said second flux valve being rotatably positioned in said artificial field by said directional gyro, said field-creating means being fixed against azimuthal rotation relative to said first flux valve, and circuit means for controlling said gyro precessing means in accordance with the difference between the outputs of the two flux valves to maintain the azimuthal position of the gyro substantially constant in relation to the earth's field. Claims allowed, 15.

10173. (2) Remote reading flux valve compass system. L. F. Beach, Port Washington, N. Y., assignor to Purves Corp., Springfield, Mass., a corporation of Massachusetts: U. S. patent 2,427,654, issued Sept. 23, 1947.

An electrical inductive device for producing through interaction with a unidirectional magnetic field a three-circuit, variable alternating potential output and in which the alternating E.M.F. in each circuit varies with the orientation of the device in the magnetic field, said device comprising an inductor having three core legs of permeable magnetic material angularly disposed with respect to one another, coil means associated with said inductor and adapted to be connected with a source of single phase alternating current for producing periodically varying fluxes in said core legs, and a pickup coil associated with each core leg for generating varying potentials under the influence of said external field upon said core legs, said pickup coils being Y-connected in a three-circuit alternating output similar to that of a Selsyn transmitter, and a receiver having a polycircuit winding connected in polycircuit fashion to the output of said inductive device. Claims allowed, 17.

10174. (2) Concentric core flux valve. R. S. Curry, Jr., Baldwin, and C. F. Fragola, Brooklyn, N. Y., assignors to Sperry Gyroscope Co., Inc., Brooklyn, N. Y., a corporation of New York: U. S. patent 2,428,014, issued Sept. 30, 1947.

A flux valve sensitive to an external unidirectional magnetic field for supplying signal voltage outputs dependent in magnitude on the direction of said field relative thereto, said flux valve comprising concentrically arranged, inner and outer core members of permeable mag-

netic material, an exciting coil encircling said inner core and within the outer core and adapted to be connected to a source of pulsating electrical energy to produce a pulsating flux in said core members, and a pick-up coil encircling said outer core member and lying wholly exterior thereto. Claims allowed, 18.

10175. (2) Magnetic testing device. J. A. Sams, Schenectady, N. Y., assignor to General Electric Co., a corporation of New York: U. S. patent 2,432,811, issued Dec. 16, 1947.

In apparatus for measuring the strength of magnetic fields in magnetic bodies, a gauge head adapted to be moved about upon the surface of such body comprising a spool-shaped magnetic core having an alternating current excitation coil thereon, a U-shaped magnetic shunt of high permeability material extending between the ends of the core outside the coil and pivoted to the center ends of the core so that it may be rotated about the core to different positions, a handle for said gauge head enclosing leads to said coil, the portion of said shunt which lies outside the coil between the ends of the core having an inwardly arched shape to facilitate placing it in magnetic shunting relation in contact with a surface under test. Claims allowed, 5.

10176. (2) Magnetic field indicating means. E. L. Holmes, Barkingside, Ilford, England, assignor of one-half to Henry Hughes & Son, Ltd., London, England, a British limited liability company: U. S. patent 2,435,276, issued Feb. 3, 1948.

A magnetic field indicating means comprising two symmetrical elements of magnetic material disposed in parallel planes and forming closed magnetic circuits therein, a pair of oppositely projecting poles on each element, the axes of each of said pairs of poles lying in the plane of symmetry of the corresponding element and being substantially perpendicular to one another, series connected windings disposed on each pole of said pairs of poles, windings disposed on said elements, means for energizing said element windings by alternating currents of given frequency that are displaced in phase by one-eighth of a cycle, respectively, thereby producing in said series connected pole windings a resultant voltage of double frequency whose magnitude is representative of the magnitude of an external field and whose phase is representative of the angle made by said field with one of said pole axes, means for amplifying said induced voltage, and means for determining the phase of the amplified voltage with respect to a voltage of said double frequency and of reference phase. Claims allowed, 6.

10177. (2) Magnetic field gradient measurement. C. H. Fay, Houston, Tex., assignor to Shell Development Co., San Francisco, Calif., a corporation of Delaware: U. S. patent 2,436,039, issued Feb. 17, 1948.

In a system for measuring the gradient of a magnetic field, a unit comprising two spaced coils and means for rigidly pivoting said coils in fixed relationship to each other for oscillation about a common axis, means electrically connecting said coils in series opposition, a light source, photo-electric means, optical means carried by said rigid unit for varying the illumination of the photo-electric element by the light

source proportionally to the oscillation of said unit, a circuit comprising variable gain ratio amplifier means energized by the output of said photoelectric element, means for passing the output current of said circuit through said coils, means for adjusting the relative intensity of the current passing through each coil, and indicator means in said circuit for indicating the amplification gain of said amplifier means necessary for maintaining said coil unit barely in oscillation by the torque developed by the reaction of the current passing through said coils with the magnetic field in which said rigid unit is oscillating, when said field has a gradient along the oscillation axis of said coils. Claims allowed, 2.

10178. (2) Magnetic detector. W. R. Maltby, Washington, D. C., and R. H. Park, Pluckemin, N. J.: U. S. patent 2,436,394, issued Feb. 24, 1948.

In a device of the character disclosed for remotely detecting the approach of a ship containing magnetic material, a search coil arranged within a magnetic field within which the ship moves and extended substantially throughout the length of the device, a linear bar of magnetic material disposed within said coil and adapted to engage lines of force which are substantially straight and parallel to said bar in the vicinity thereof, and flux gathering flanges in magnetic engagement with the ends respectively of the bar, said flanges extending laterally from the bar a distance substantially half the length of the bar, whereby the flux within the bar is substantially uniform throughout and engages the search coil substantially uniformly throughout the length thereof. Claims allowed, 9.

10179. (2) Magnetic field measuring device. R. R. Burroughs, Washington, D. C., assignor to Eastman Kodak Co., Rochester, N. Y., a corporation of New Jersey: U. S. patent 2,437,374, issued March 9, 1948.

A device for detecting and measuring a shifting magnetic field comprising an electronic tube having at least one cathode and at least two anodes defining a plane orthogonal to at least a component of the magnetic field whereby the ratio of the anode currents is proportional to the field strength effective on the electronic stream from the cathode, a suppressor electrode between the two anodes, at substantially the same electrical potential as said cathode for increasing the sensitivity of change-over of the electron stream from one anode to the other, to change in effective magnetic field, compressor electrodes, also at substantially the same electrical potential as said cathode and located on opposite sides of the electron beam passing from the cathode to the two anodes for compressing said beam, and means connected to the anodes for measuring the relative direct currents therethrough. Claims allowed, 1.

10180. (3) Clip for holding detonators in blasting cartridges. F. H. Rolfes, Johannesburg, Transvaal, Union of South Africa: U. S. patent 2,423,255, issued July 1, 1947.

A detonator clip including a single length of wire bent substantially centrally of that length to form an eye to embrace the fuse immediately beyond the detonator, then reduced in diameter to provide a restricted neck, then projected laterally in the plane of the eye, and downwardly to overlie the detonator, the lateral portions being formed in spaced

strands, the terminals of the strands remote from the eye being bent laterally and terminally arranged to provide a piercing point to enter a cartridge, the spaced strands of the part overlying the detonator providing a means whereby the diameter of the neck may be reduced by moving the strands toward one another to insure more secure fixing of the clip in position on the fuse. Claims allowed, 1.

10181. (3) Method of and apparatus for modulating the frequency of sound waves. C. B. Horseley, Stamford, Conn., assignor to Ultrasonic Corp., Boston, Mass., a corporation of Massachusetts: U. S. patent 2,424,357, issued July 22, 1947.

A method of modulating the frequency of vibrations, which consists in impinging vibrations on one end of a column of gaseous fluid, moving said fluid alternately in opposite directions longitudinally of the column by alternately forcing fluid into and extracting it from longitudinally spaced portions of the column while transmitting said vibrations longitudinally therethrough and receiving the same at the other end of the column, and varying the modulating range by varying the amount of fluid forced into and extracted from the column. Claims allowed, 21.

10182. (3) Modulator for sound waves. W. A. Van Allen, Cambridge, Mass., assignor to Ultrasonic Corp., Boston, Mass., a corporation of Massachusetts: U. S. patent 2,424,375, issued July 22, 1947.

A modulator for sound waves, which comprises a compression wave generator, a first conduit connected to the output of said generator, walls forming a treating chamber, a conduit connected to said chamber and connected at a predetermined angle to said first conduit; a housing secured to both conduits at the intersection thereof, a piston mounted in said housing at an angle to reflect waves from said first conduit through the second conduit, and means for reciprocating said piston in said housing. Claims allowed, 5.

10183. (3) Timing device for recorders. C. D. McClure, Dallas, Tex., assignor, by mesne assignments, to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,424,622, issued July 29, 1947.

The combination with an electric seismograph for producing seismograms, of a vibrating reed for producing timing lines on said seismogram, and means operable by vibration of said reed for producing distinctive symbols on certain of said timing lines. Claims allowed, 10.

10184. (3) Explosive cartridge unit. L. B. Counterman, Kenvil, N. J., assignor to Hercules Powder Co., Wilmington, Del., a corporation of Delaware; U. S. patent 2,425,176, issued Aug. 5, 1947.

In an explosive device comprising a plurality of explosive units, each unit including a cartridge and a sleeve of substantially a common length, the cartridges being held in propagating relationship to each other by means of said sleeves extending across adjacent cartridge ends and forming a substantially continuous tubular reinforcing and joining member for said cartridges, the improvement comprising a chipboard thread carried on the exterior of each of said cartridges, and a chipboard thread receiving recess formed in the interior of each of said sleeves,

said cartridge threads being receivable in free-threadable relationship with said recesses, lockforming serrations carried by said threads and said recesses, said threads being slidable into serrated engagement with said recesses in response to a force tending to longitudinally pull the cartridge from the sleeve, whereby said cartridges are held in locked engagement with each other in said sleeves. Claims allowed, 3.

10185. (3) Safety primer for blasting. H. B. Humphrey, Washington, D. C.: U. S. patent 2,425,741, issued Aug. 19, 1947.

A safety primer for blasting which includes two sections of molded explosive in abutment with each other, the end of one section which is in abutment with the other having a centrally positioned chamber to receive a detonator, the other abutting section having a portion thereof reduced in diameter, a protective shell of readily frangible incombustible material mounted on the reduced portion of the last-mentioned section and against the shoulder thereon and adapted to be passed over the abutting end portion of the other section of molded explosive so as to encompass its said detonator chamber and detonator therein, the said protective shell of readily frangible material being provided with longitudinal slots to receive wires leading to the detonator, the whole arranged whereby the said protective shell of readily frangible material is sufficiently stable to hold the two abutting sections of molded explosive in proper assembled position during handling and insertion of the primer in a borehole but upon application of firm tamping pressure exerted on the primer will split and be expanded against the wall of the borehole to close the borehole and retain the primer explosive and its detonator in proper position thereon. Claims allowed, 1.

10186. (3) Wave sensitive and wave front detecting apparatus. A. M. Nicolson, New York, N. Y.: U. S. patent 2,427,569, issued Sept. 16, 1947.

A method for determining the direction of a source of wave energy comprising, disposing a plurality of groups of wave energy detectors in the path of a wave front generated by said source, said groups being arranged in such relation that an advancing wave front passes said groups in succession, providing a sensible indication when said wave front reaches the first detector in each of said groups, and rendering all the detectors in each group, except the one first to receive said wave front, inoperative to respond to the arrival of a wave front. Claims allowed, 7.

10187. (3) Protective device for blasting circuit. B. L. Lubelsky, Elkton, Md., and R. E. Hartline, Tulsa, Okla., assignors to Mine Safety Appliances Co., Pittsburgh, Pa., a corporation of Pennsylvania: U. S. patent 2,428,334, issued Sept. 30, 1947.

A protective arrangement comprising a device to be actuated by the flow of electric current and a main circuit to connect the device to a source of energy, circuit interrupting means in the main circuit comprising a normally open switch means in the circuit, a manual means to close the switch, an electrically energizable switching operating means in the circuit to open the switch in a time delay manner after closure of the switch means, and a higher impedance energizable switch

operating means arranged operatively with respect to the switch means and connected into the circuit in parallel relation to the device. Claims allowed, 12.

10188. (3) Device for production of underwater sound fields. C. T. Zahn, Dallas, Tex.: U. S. patent 2,434,682, issued Jan. 20, 1948.

A source of liquid wave motion comprising a rotor, a housing within which said rotor is rotatable, said rotor and said housing having concentric aligned inlets located in the axis of rotation of said rotor, said rotor including radially extending liquid conducting means, said housing having a substantially circumferential peripheral outlet, the diameter and internal thickness of said housing being substantially greater than the diameter and external thickness of said radial liquid conducting means of said rotor thereby providing a substantial space between said radial means and said housing, said radial liquid conducting means of said rotor comprising a plurality of converging nozzles L-shaped in cross-section extending toward said housing outlet. Claims allowed, 1.

10189. (3) Self-modulated oscillator. A. V. Wurmser, Bogota, N. J., assignor to Bell Telephone Laboratories, Inc., New York, N. Y., a corporation of New York: U. S. patent 2,435,262, issued Feb. 3, 1948.

A self-modulated electric discharge tube oscillator comprising, an electric discharge tube having input and output electrodes and associated circuits all so interrelated as to cause the organization to generate a steady, substantially pure wave of relatively high frequency, a relatively low frequency modulating wave source comprising a resistance-capacitance combination specific to said input electrodes for determining the modulating frequency, and an injection frequency means connected to said associated circuits adapted to coerce said low frequency combination and lock its frequency into a commensurable relation with its own frequency, said tube having a modulating as well as an amplifying characteristic whereby the organization as a whole is adapted to generate steady, pure waves of both said relatively high and relatively low frequencies together with intermodulation products of the same. Claims allowed, 7.

10190. (3) Method and apparatus for exhibiting seismograph signals. O. F. Ritzmann, Takoma Park, Md., assignor to Gulf Research & Development Co., Pittsburgh, Pa., a corporation of Delaware: U. S. patent 2,435,903, issued Feb. 10, 1948.

An apparatus for transmitting over a single channel a relatively continuous signal and a superimposed slowly increasing and sharply decreasing intelligible impulse signal, comprising a transmission channel, signal input means, means for introducing therein a relatively continuous signal, means for introducing therein a slowly increasing and sharply decreasing intelligible impulse signal, means by which the increase of the intelligible impulse signal reduces the sensitivity of the signal input means, said means permitting immediate return to normal sensitivity upon completion of said intelligible impulse signal. Claims allowed, 4.

10191. (3) Method for elimination of periodic stray signals from seismic signals. C. H. Johnson, San Marino, Calif., assignor to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,438,217, issued March 23, 1948.

A method of eliminating a fundamental undesired steady-state signal and its odd harmonics from a signal that it is desired to record that comprises the steps of introducing the composite signal into a main amplifier, diverting a portion of the composite signal from the amplifier to an auxiliary circuit, there amplifying the fundamental steady-state signal relative to the remainder of the composite signal, thereafter in the auxiliary circuit distorting the fundamental steady-state signal to introduce odd harmonics thereof, returning the amplified steady-state signal and its odd harmonics to the main amplifier respectively 180° out of phase with the fundamental steady-state signal and its odd harmonics in the undiverted portion to effect substantial cancellation of the steady-state signals whereby the output signal of the main amplifier will be substantially free of the steady-state signal and its odd harmonics. Claims allowed, 1.

10192. (4) Werkwijze en inrichting voor bodenonderzock [Method and apparatus for exploring the ground]. Standard Oil Development Co., New Jersey: Dutch patent 52,042, issued March 16, 1942.

Electric currents are sent into the earth, and their transient characteristics are observed in a receiving circuit by such means as a cathode ray oscillograph. For the accurate determination of the form of these phenomena high-frequency components can be observed separately by such means as a high-frequency oscillograph added to the first oscillograph. In surveys the current source is connected with two electrodes set apart in the ground, and the apparatus for determining transient characteristics is included in the circuit together with a resistance and a self-indicator, in such manner that the instrument for measuring transient characteristics is connected parallel with the resistance, and the instrument for measuring high-frequency components is connected parallel with the self-inductor—(Free translation from Dutch.) Claims allowed, 2.

10193. (6) Heat detection device. John Evans, Kingston, N. J., assignor to Radio Corporation of America, a corporation of Delaware: U. S. patent 2,426,494, issued Aug. 26, 1947.

A heat detector comprising an electrically insulating support, a membrane stretched over said support and supported so as to have a suspended central portion, a thin layer of a metallic oxide having a relatively high coefficient of resistance deposited on said membrane, and means for establishing electrical connections to spaced portions of said layer. Claims allowed, 15.

10194. (7) An improved electrical apparatus for the analysis or identification of gases, vapors, and the like. Geophysical Prospecting Co., Ltd., J. C. Templeton, and L. T. Winkler, all of London: British patent 554,792, issued July 20, 1943.

Apparatus for the qualitative or quantitative analysis or identification of mixed gases or vapors, comprising means for producing ions in the

mixture, means for grouping the ions of the different constitutent gases in accordance with their different ion-mobilities, means for selectively collecting a group or groups of the ions on different electrodes, and means for measuring the charge imparted to one or more of these electrodes, said charge being a measure of the quantity of gas present having that particular ion-mobility. Claims allowed, 6. (*See also* Geophys. Abstracts 125, no. 8637.)

10195. (7) Oil determination. J. J. Heigl, Tulsa, Okla., assignor to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,423,774, issued July 8, 1947.

A method for determining the amount of mineral oil of known character in a substance containing it, which comprises preparing a plurality of solutions of varying concentration of said oil in an oil solvent, determining the amount of light of a selected wave length from the near ultraviolet range absorbed by each solution, preparing a graph by plotting oil concentration in solution in the solvent against the log of Io/I, where Io is a figure representing the amount of light of the selected wave length absorbed by the solvent per se and I is the amount of light of the same wave length absorbed by any given solution, extracting the oil from the substance containing it with the same oil solvent as was used for preparing the graph, determining the amount of light of the selected wave length absorbed by said extract and determining by reference to the graph the concentration of the oil in the extract. Claims allowed, 3.

10196. (7) Method for analyzing gas. F. W. Crawford, Bartlesville, Okla., assignor to Phillips Petroleum Co., a corporation of Delaware: U. S. patent 2,427,261, issued Sept. 9, 1947.

In a process for determining the content of methane in a gaseous mixture free from carbon dioxide and water but including free oxygen-containing gas and a relatively small amount of hydrocarbons including methane and ethane, the steps comprising passing said gaseous mixture at a subatmospheric pressure not greater than 20 millimeters of mercury absolute through a first cooling unit that is maintained at a sufficiently low temperature to condense and retain C_2 and heavier hydrocarbons and high enough to pass methane and free oxygen-containing gas in a gaseous state, transmitting the methane and free oxygen-containing gas not condensed in the preceding step through a combustion zone wherein the same is burned to oxidize the methane and form a mixture including carbon dioxide and water vapor, dehydrating the mixture by passing it through a body of absorption material for water vapor, passing the dried mixture through a second cooling and condensing unit that is cooled sufficiently to condense the carbon dioxide but not the other constituents of the mixture, withdrawing and discarding from the system the said other constituents whereby the carbon dioxide alone remains in the cooling and condensing unit, raising the temperature of the unit to vaporize the carbon dioxide, and making a direct determination of the carbon dioxide gas. Claims allowed, 2.

10197. (8) Anordning för geofysiska instrument [Device for geophysical instruments]. Bolidens Gruvaktiebolaget, Stockholm: Swedish patent, 107,247, issued Nov. 30, 1943.

A device to house gravimeters, seismographs, magnetometers, and other geophysical instruments in the course of drill-hole surveys, consisting of a container body movable in a certain direction or along a certain axis under the action of a force, such as gravity, and of a regulating arrangement balancing this force by a shock-absorbing system made up of springs or other devices, which act as two equal opposite-pressure forces and each actuate the movable body in a direction practically perpendicular to the direction of its movement.—Free translation from Swedish. Claims allowed, 7.

10198. (8) Method and apparatus for logging drill holes. Lyle Dillon, Los Angeles, Calif., assignor to Union Oil Co. of California, Los Angeles, Calif., a corporation of California: U. S. patent 2,425,868, issued Aug. 19, 1947.

A method for transmitting indications of physical conditions within a bore hole to the earth surface comprising varying the characteristics of an electric current in accordance with a function of the said physical characteristics in the bore hole, converting said electric current into mechanical vibrations of a character corresponding to the character of said current, and detecting and receiving said vibrations at the earth surface whereby the psysical conditions within the bore hole may be determined. Claims allowed, 21.

10199. (8) Method and apparatus for logging drill holes. Lyle Dillon, San Gabriel, Calif., assignor to Union Oil Co. of California, Los Angeles, Calif., a corporation of California: U. S. patent 2,425,869, issued Aug. 19, 1947.

Method of transmitting resistivity data from a subsurface prospecting instrument to surface apparatus that comprises creating an electrical oscillation at the prospecting instrument, altering said oscillation in accordance with resistivity data from said instrument, translating the electrical oscillation into mechanical vibrations, transmitting the vibrations to the surface, analyzing the vibrations at the surface to obtain the desired resistivity data, and operating the indicating apparatus in accordance therewith. Claims allowed, 14.

10200. (8) Method and apparatus for determining the dip of strata traversed by a borehole. H. G. Doll, Houston, Tex., assignor to Schlumberger Well Surveying Corp., Houston, Tex., a corporation of Delaware: U. S. Patent 2,427,950, issued Sept. 23, 1947.

In a method of determining the dip of the earth formations traversed by a bore hole containing a conducting liquid, the steps of disposing at least three small electrodes in the bore hole in close proximity to the wall thereof at locations that are angularly spaced apart about the axis of the bore hole, providing a path of free electrical communication between each of said electrodes and the small portion of the wall of the bore hole opposite thereto, substantially completely blocking off electrical communication between each of said electrodes and any bore

hole liquid outside of said path, so that each of said electrodes is substantially unresponsive to the electrical properties of the bore hole liquid but is significantly responsive to the electrical properties of a relatively small portion of the earth formation in the immediate vicinity thereof, moving said electrodes through the bore hole as a unit, maintaining the distance relationship between each of said electrodes and the wall of the bore hole substantially constant regardless of variations in bore hole diameter obtaining indications of the electrical resistivity of said relatively small portion of the earth formation in the immediate vicinity of each of said electrodes, and recording curves showing variations in the indications of electrical resistivity of the formations in said relatively small portions thereof in the immediate vicinity of said electrodes at various depths along said bore hole, whereby the dip of a formation may be determined from the longitudinal displacements of corresponding points on the curves so recorded. Claims allowed, 11.

10201. (8) Method and apparatus for investigating earth formations traversed by boreholes. H. G. Doll, Houston, Tex., assignor to Schlumberger Well Surveying Corp., Houston, Tex., a corporation of Delaware: U. S. patent 2,433,746, issued Dec. 30, 1947.

A method of locating permeable earth formations traversed by a bore hole containing a column of liquid, comprising lowering a body through the bore hole and producing at said body artificially periodically fluctuating pressure at a relatively rapid rate above that to which a direct current meter is appreciably responsive in the said liquid at the level of a relatively permeable formation, thereby creating periodically variable flow of the liquid into the permeable formation to generate variable alternating electrofiltration potentials in the vicinity of said permeable formation, simultaneously lowering an electrode with the said body and in such relation thereto as to be substantially at the same level as the body, placing a second electrode at a position where it is not subject to the same instantaneous, fluctuating, liquid pressure as said first electrode, transmitting to the surface alternating potentials picked up by said electrodes and produced by said generated alternating electrofiltration potentials, and obtaining indications of said alternating potentials. Claims allowed, 2.

10202. (8) Signalling system for radioactive well logging. Shelley Krasnow, Arlington, Va., and L. F. Curtis, Montgomery County Md.: U. S. patent 2,436,008, issued Feb. 17, 1948.

In an apparatus for the measurement of radioactivity in a deep narrow borehole, a holder of narrow lateral dimensions capable of fitting into the borehole and capable of being lowered to various depths therein, the said holder including a detector sensitive to rays from radioactive substances to produce responses thereto, and amplifying means to amplify said responses, a cable leading from the holder to the surface of the earth, a source of electrical energy connected to the said cable at the surface of the earth to provide the energy for transmitting signals up the cable, means carried by the said holder operated by the said amplifying means and controlling the energy conducted from the surface of the earth in such manner as to create within the

cable a pulsating signal having a property determined by the said rays, and means at the surface of the earth for receiving and recording the pulsating signal transmitted by the said cable. Claims allowed, 16.

10203. (8) Delayed well logging. J. Y. Cleveland, Scarsdale, N. Y., assignor to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,436,503, issued Feb. 24, 1948.

A method of positioning a perforator in a previously logged well that comprises the steps of simultaneously traversing the well with a well logging detector and a perforator which are maintained in vertically spaced relationship so that the detector will lead the perforator, said well logging detector producing electrical signals characteristic of the strata penetrated by the well as it traverses the well, transmitting the signals to the surface of the earth, delaying the signals a predetermined period of time, said period of time being that required for the perforator to reach the stratum where the signals were produced, and recording the signals in coordination with the depth at which they were produced. Claims allowed, 10.

10204. (8) Radiation absorption cell for optical testing apparatus. W. R. Flatford and F. W. Crawford, Bartlesville, Okla., assignors to Phillips Petroleum Co., a corporation of Delaware: U. S. patent 2,436,511, issued Feb. 24, 1948.

In an optical testing apparatus, a radiation absorption cell comprising in combination an outer cylinder, a first transparent plate closing one end of the outer cylinder, an inner cylinder in telescoping relationship with the outer cylinder, a second transparent plate closing the corresponding end of the inner cylinder, a bellows sleeve connecting the opposite end of the inner cylinder to the outer cylinder, whereby an expansible fluid-tight chamber is formed with relatively movable transparent walls, means to move the plates together and apart, means to supply fluid to the chamber under suitable absolute pressure, and means to indicate the distance between the plates. Claims allowed, 4.

10205. (8) Well logging. Alex Frosch, Houston, Tex., assignor to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,436,563, issued Feb. 24, 1948.

An apparatus for logging boreholes by making measurements of the variation with depths of a plurality of different kinds of properties of the strata traversed by the boreholes, comprising a bomb adapted to be lowered into said borehole, an oscillator arranged in said bomb, a plurality of means arranged in said bomb for measuring a plurality of properties in said borehole, means for connecting each of said measuring means, in sequence, to said oscillator in such a way as to modulate the output thereof, means for transmitting the output of said oscillator to the surface, and means at the surface for relating different portions of said oscillator output to said different measuring means in said bomb. Claims allowed, 4.

10206. (9) Method of examining earth substances by means of ultraviolet illumination. W. P. Rand, Pittsburgh, Pa., assignor to Gulf Research & De-

velopment Co., Pittsburgh, Pa., a corporation of Delaware: U. S. patent 2,435,843, issued Feb. 10, 1948.

A method of examining fragments of rock or other materials, which comprises removing external impurities from said fragment, gently immersing said fragment in a quiescent nonfluorescent solvent of petroleum under the illumination of ultraviolet light and immediately observing the ensuing reaction.. Claims allowed, 7.

10207. (11) Ground speed indicator. E. I. Anderson, Manhasset, and Allen Barco, Jackson Heights, N. Y., assignors to Radio Corporation of America, a corporation of Delaware: U. S. patent 2,422,064, issued June 10, 1947.

In a system for determining the speed of an object with respect to a reflecting surface, means for radiating pulses of radio energy from said object in two directions, means for receiving in two separate channels the pulses received from said two directions after reflection from said surface, a detector in each of said channels, an oscillator comprising a vacuum tube having a tuned grid circuit and a tuned anode circuit which are coupled to said detectors in the two channels, respectively, for producing intermediate-frequency signals in said two channels, and means for mixing said two intermediate frequency signals to obtain their beat frequency. Claims allowed, 5.

10208. (11) Speed computing and map-reading device. H. J. Marschak, Chicago, Ill.: U. S. patent 2,424,763, issued July 29, 1947.

A speed-computing device comprising a housing having a base line, a pair of spaced rollers mounted in said housing, a strip map having a starting point and mounted on said rollers for linear displacement to indicate in an exposed position opposite said base line a selected location, a wheel mounted for engagement with said strip map and driven thereby as it is displaced, a pointer driven by said wheel away from the base position, and a chart mounted adjacent said pointer and carrying a plurality of columns of numbers, the values of the numbers of each column being a function of their distance from said base position, and means to shift said chart to expose one or the other of said columns for registry with the path traversed by said pointer, the values of the numbers in the different columns representing the average velocities of an airplane flight between said starting point and said selected location for different time intervals, whereby average speed for a given flight may be indicated by shifting said chart so that such column is exposed which corresponds to the time interval consumed in flying from said starting point to said selected location. Claims allowed, 5.

10209. (11) Recorder for radar system. J. P. Smith, Cranbury, N. J., assignor to Radio Corp. of America, a corporation of Delaware: U. S. patent 2,430,307, issued Nov. 4, 1947.

A recording system comprising an antenna system for radiating to the left and to the right, means including said antenna system for transmitting a periodically modulated radio wave to the left and to the right toward reflecting objects and for receiving alternately from the left and from the right the waves reflected from said objects, a cathode ray tube having a storage screen comprising a multiplicity of capacity

elements upon which a signal may be stored in the form of electric charges, said tube including means for directing an electron beam against said storage screen, means for modulating the beam by the received signals for storing them on said screen, means for deflecting said beam transversely across a portion of said capacity elements in synchronism with said periodic modulation whereby the stored signals are located at distances along a time axis that are representative of the distances to said reflecting objects, said deflecting means including means for deflecting said beam across one portion of said elements during reception from the left and across another portion of said elements during reception from the right, means for producing a second electron beam and means for causing it to scan alternately said two portions of said elements at a comparatively slow rate to produce a distance representative signal that may be recorded, a recorder which includes scanning means, and means for synchronizing said slow scanning of said screen with the scanning of said recorder. Claims allowed, 5.

10210. (11) System for locating obstacles. Hugo Benioff, La Canada, Calif., assignor, by mesne assignments, to Submarine Signal Co., Boston, Mass., a corporation of Delaware: U. S. patent 2,433,332, issued Dec. 30, 1947.

A system for surveying a given area by the use of waves and their reflections comprising signal-producing means for transmitting periodically wave impulses from a spot in said area to all sections thereof, a plurality of receiving means each sensitive to waves approaching from different small sections of said area combining to cover the area to be observed, indicating means having a plurality of relatively movable indicators each one corresponding respectively to one of said sections of said area and its corresponding receiver, and means operating and moving said indicators in cooperation with the signal-producing means for registering said indication at points on said indicating means corresponding to the points from which the reflections occurred whereby distance and direction of such points are determined. Claims allowed, 6.

10211. (11) Recorder system with electromagnetically attracted electric stylus. W. A. Marrison, Maplewood, N. J., assignor to Bell Telephone Laboratories, Inc., New York, N. Y., a corporation of New York: U. S. patent 2,433,382, issued Dec. 30, 1947.

In a recorder, for marking a moving electrosensitive record-receiving medium, a stylus adapted to be moved with respect to the medium, said stylus being normally substantially free of contact friction with respect to said medium, an electromagnet having a pole face disposed behind the medium to attract the stylus into firm, low-resistance, electrical contact with the medium, a source of low potential electrical energy, and means including said source for energizing the electromagnet and producing a current pulse through the medium between the stylus and the pole face. Claims allowed, 1.

10212. (11) Altimeter. E. C. Raney, Delaware County, Ohio, assignor to Ranco Inc., Columbus, Ohio, a corporation of Ohio: U. S. patent 2,435,289, issued Feb. 3, 1948.

In a measuring instrument, in combination, a member having graduated indicia; an index member for the graduated indicia; means for mov-

ing one of said members relative to the other, said means including a rotatable element for driving the movable member, means for imparting rotary movement to said rotatable element including an element responsive to changes in a condition, said last element having relatively movable parts, one of said parts being movable in response to changes in said condition and supported by and adapted when moved to impart rotational movement to the rotating element; a pivotally mounted dial; a cam attached to the dial and movable therewith; a cam follower riding on the cam, said cam follower being connected with the other part of the condition responsive device; and means for rotating the dial and cam. Claims allowed, 8.

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