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AND

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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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0. GENERAL GEOPHYSICAL SUBJECTS

9708. Adams, L. H. Some unsolved problems of geophysics: Am. Geophys. Union Trans., vol. 28, no. 5, pp. 673–679, Washington, D. C., 1947.

After a brief review of what is known about the whole earth, from the upper limit of the atmosphere several hundred miles above the surface to the very center at a depth of 4,000 miles, attention is called to six of the particularly baffling problems in geophysics. These are: The origin of mountain chains; the origin of geosynclines; the cause of igneous activity, including volcanism; the origin of deep-focus earthquakes caused at depths of as much as 400 miles below the surface; the origin of the earth's magnetic field; and the temperatures prevailing in the interior of the earth. It is urged that more effort be devoted to scientific investigations in the several branches of the physics of the earth, with the use of all possible theoretical as well as experimental methods.—*Author's abstract, condensed by V. S.*

9709. Diukov, A. I. Geophysical methods of exploration in the U.S.S.R. [in Russian]: Razvedka Nedr, vol. 13, no. 5, pp. 60–66, Moscow, 1947.

An outline is given of the development of methods of geophysical exploration in the U.S.S.R., from their inception in the work of the Special Commission for the Investigation of the Kursk Magnetic Anomaly in 1920 to the present time. Progress is noted in the establishment in 1923 of the Institute of Applied Geophysics (IPG); the work of the geophysical section of the All-Union Geological Institute (VSEGEI); the research of certain affiliates of the Academy of Sciences, such as the Institute of Theoretical Geophysics, the Seismological Institute, the Geological Institute, and the Urals Affiliate; the investigations of the Institute of Terrestrial Magnetism (NIIZM) and the Central Institute of Geodesy, Aerosurvey, and Cartography; the activities of the new organizations created since the war, such as the Institute of Applied Geophysics (NIIPG) established in 1944 in Moscow as a center of petroleum exploration and the All-Union Institute of Exploration Geophysics (VIRG) established in 1945 in Leningrad as a part of the Ministry of Geology; and the work of the educational institutions, factories, and shops training geophysical personnel and manufacturing instruments. Various achievements of exploration by different geophysical methods are indicated.—*V. S.*

9710. Maree, B. D. Geophysical work in South Africa, a review: Geophysics, vol. 12, no. 4, pp. 681–684, Tulsa, Okla., 1947.

Past and present geophysical prospecting in the Union of South Africa is reviewed briefly. It is found that gravimetric and magnetic methods are being used for the most part to explore metalliferous deposits, particularly gold. Electrical resistivity and electromagnetic methods also are employed, chiefly for investigations of underground water. The seismic method has been used only for experimental sufrveys. Recent exploration for gold by private companies was by gravitational and magnetic methods in the Orange Free State and in Transvaal. Generally, the geophysical problems encountered in the Union have a distinctive character and require a special adaptation of techniques and instruments, because important deposits occur mostly in pre-Cambrian formations. Post-Triassic formations are virtually absent.—*V. S.*

9711. The Precambrian. Geophysicists embark on broad study field: Vol. 20, no. 11, p. 10, Winnipeg, Manitoba, 1947.

Since the second world war, which depleted mineral resources but advanced scientific knowledge, geophysical methods have been used increasingly in exploration and research. For both, Canada is favorably situated: The pre-Cambrian shield is considered the biggest and richest region of metalliferous basement rocks in the world; large areas of oil-bearing rocks lie in the western part; and the northern magnetic pole, northern geographic pole, and magnetic axis are within or near Canadian boundaries. To investigate possibilities of scientific and exploratory work, an Associate Committee on Geophysics was established in 1945 by the Canadian Research Council. In 1947 gravitational, magnetic, seismic, and radioactivity methods were used in exploration between Sudbury and Kirkland Lake, an area well known geologically.—*V. S.*

9712. Tiratsoo, E. N. Geophysical exploration in India: World Oil, vol. 127, no. 6, pp. 263–267, Houston, Tex., 1947.

Geographical work done in India is reviewed briefly. In the middle of the last century calculations of plumb-line deflections caused by the Himalaya Mountains led to the formulation of the isostatic theory. Later the Punjab Irrigation Research Institute made surveys with the Eötvös torsion balance in the districts of Shahpur and Lyallpur to ascertain the thickness of alluvium. The Mysore State Geological Department carried out electrical surveys for estimating water-table depths and locating ore deposits. The Survey of India located a manganese reef in Nagpur with a gradiometer and prospected by electrical methods for mica-bearing pegmatites in Bihăr. Recently the Burma Oil Co. made an extensive gravity survey of Burma and northeastern India (*see* Geophys. Abstracts 130, no. 9333).—*V. S.*

9713. Van Tuyl, F. M., and Levings, W. S. Developments in geophysics [1946]: Colorado School of Mines Quart., vol. 42, no. 3, pp. 34, 76–97, 103–105, Golden, Colo., 1947.

Developments in geophysics during 1946 are reviewed on the basis of more than 100 select papers. The subjects considered include developments in instruments and techniques of gravitational, magnetic; seismic, electrical, radioactive, geothermal, geochemical, and other methods; interpretation of geophysical data; geophysical case histories; and studies of regional scope. Geophysical papers not covered by the review are listed in an extensive bibliography, and separate outlines are given of developments in the training of geophysicists and geologists and in aerial photography.—*V. S.* (*See also* Geophys. abstract 9912.)

1. GRAVITATIONAL METHODS

9714. Apsen, Boris. Ueber die Auswertung der zweiten partiellen Ableitungen des Schwerepotentials aus Drehwagenbeobachtungen nach der Methode der kleinsten Quadrate [Concerning the computation of the second partial derivatives of the gravitational potential from the observations with torsion balance according to the method of least squares]: Zeitschr. Geophys., vol. 17, pp. 188–197, Braunschweig, 1942.

The paper begins with a criticism of the procedure used in the computation of these derivatives by Professor Ansel in the Lehrbuch der

Geophysik, edited by B. Gutenberg. This is followed by an explanation of Apsen's original procedure of solving this problem. A method is presented to determine the values of the unknown derivatives as well as their mean errors. The article is followed by a short note by Professor Ansel in which he states his opinion that Apsen's method is based on erroneous assumptions and results in incorrect values of derivatives.—*S. T. V.*

9715. Boulanger, J. D. Concerning the dynamic temperature correction of invar-made pendulums: Acad. Sci. U.S.S.R. Bull. (Izvestiia), Sér. Géog. et Géophys., vol. 11, no. 3, pp. 283–292, Moscow, 1947.

A study was carried out in the Gravimetric Laboratory of the Seismological Institute of the Academy of Sciences of the U.S.S.R. of a pendulum instrument built by the Cambridge Instrument Co. The study was made to determine the precision of the instrument and to determine its general characteristics. As a result of the experiments it has been established that in spite of a very low value of the static temperature coefficient (less than 3×10^{-7} sec.) this instrument can have an appreciable dynamic temperature coefficient. This must be taken into account when a high rate of temperature change (2° per hour) takes place, if an error in the reduction period (up to 14×10^{-7} sec.) is to be avoided. The dynamic temperature coefficient of the instrument has been found to be 300 times greater than the static. During the experiments the pressure in the instrument's housing was kept at 650 mm. Hg, and the air was dried by calcium chloride.—*S. T. V.*

9716. Gabriel, V. G., and Rae, R. E. The use of gravitational methods for air navigation: Mines Mag., vol. 37, no. 10, pp. 25–26, Denver, Colo., 1947.

The use of gravity altimeter compasses and gravity speedometers for air navigation is examined tentatively in the case of flights over a terrain of relatively low and even relief, a terrain of high and rugged relief, and the ocean.

In the case of relatively low and even relief, gravity observations taken in two positions along the same parallel are considered sufficient for determining the difference in altitude, because the vertical rate of change of gravity can be regarded as constant for the elevations under 30,000 feet customarily used for flying. For these elevations, likewise, horizontal gravity gradients are independent of the altitude and become a function of the angle of latitude only, so that the speed of flying along the geographical meridian can be determined if the altitude is constant. Formulas for calculating the altitude and speed of flying in terms of gravity are given.

Flying over the ocean is regarded as similar to flying over terrain of relatively low and even relief, and flying over high and rugged relief is believed to be reducible to an equivalent condition with the aid of free air, Bouguer, and terrain corrections.—*V. S.*

9717. Gassmann, Fritz. Vom Gravitationsfeld des inhomogenen Rotations Ellipsoides im Aussenraum [Concerning the gravitational field created by an unhomogeneous ellipsoid of revolution in the outer space]. Inst. Geophys. Mitt., no. 2, pp. 36–43, Zurich, May 1945.

The author discusses the problem of determination of the gravitational potential created by an ellipsoid of revolution filled with a mass having

a density varying in accordance with a given law. The solution is given in the form of a convergent series. Taking the derivative of the resulting potential function with respect to the radius vector and making this radius equal to the corresponding coordinate of the ellipsoid itself, the intensity of the gravitational field at the surface is obtained. If we make the ellipsoid identical with the "geoid" of the geodesists, this derivative becomes the gravitational acceleration g at a particular point and can be determined by direct measurements. Thus a table of numerical values of g is obtained for the unknown function of the density distribution. This table can be of value for the interpretation of the results of surveys made by gravitational methods.—*S. T. V.*

9718. Gassmann, F., and Gutersohn, H. Kotenstreuung und Relieffaktor [Topographic elevation-dispersion and relief factor]: Inst. Geophys. Mitt., no. 6, 17 pp., Zurich, Switzerland, June 1947.

The concept of the potential energy of topographic relief (Reliefenergie) has no unequivocal significance if relative elevation is calculated only on the basis of two extreme points of relief, rather than according to the principles of energy employed in mechanics. Instead of the use of this concept, the shape of the relief's surface can be better characterized by an application of the new concepts of "dispersion of elevation" and "coefficient of dispersion of elevation" which have a simple mathematical relationship to each other. For the determination of numerical values, mathematical equations and a hypsometric curve are given, which have the advantage of eliminating all subjectivity. Examples show that dispersion of elevation expresses variations of relief along the vertical axis and that the coefficient of dispersion of elevation characterizes the shape of the relief.—*Authors' abstract, translated by V. S.*

9719. Heiskanen, W. Catalogue of the isostatically reduced gravity stations: Isostat. Inst. Internat. Assoc. Geod. Pub., no. 5, 140 pp, Helsinki, 1939.

There are about 4,000 isostatically reduced gravity stations in the world. To make the information regarding them generally obtainable and comparable, the present catalogue lists all these stations with available data. It gives the number, name, latitude, longitude, and elevation of the stations (for the sea stations, the depth of the water below), and the observed and the theoretical gravity according to the international gravity formula. For many of the stations the tables also furnish the correction for elevation and for Bouguer reduction; the sum of the correction for topography and for compensation; the free air and Bouguer anomalies; and the isostatic gravity anomalies according to at least one isostatic system, usually the Hayford-Bowie, with the depth of compensation 113.7 kilometers.—*V. S.*

9720. Inglada, Vincente. Resultados de las recientes investigaciones isostaticas [The results of recent isostatic investigations]: Rev. Geofis., vol. 4, pp. 163–207, Madrid, Apr.–June 1945.

This paper gives results of isostatic determinations based on the deviations of the vertical and on gravity anomalies, data on the thickness of the earth's crust derived from the propagation of seismic waves, and an account of the work of the Geodetic Institute of Finland.—*Cent. Nat. Rech. Sci., Bull. Anal., vol. 7, no. 6, pt. 1, p. 1052, Paris, 1946, translated by V. S.*

9721. Johansson, B., and Ravignani, G. Note sull' impiego dei gravimetri per ricerche geominerarie [Notes on the use of gravimeters for minerals exploration]: Centro Prospezioni Geominer., Tech. Paper 2, pp. 10–31, Milan, 1940.

Gravimeters are discussed with respect to advantages in ore exploration, classification by types, underlying theory, structural features, and interpretation of results. Special attention is given to the Bolidens and the Ising models. Examples of practical application in Sweden are described briefly with illustration by isoanomaly maps.—*V. S.*

9722. Kazinskii, V. A. On the division of the earth's gravitational field into zones: Acad. Sci. U.R.S.S. Comptes Rendus (Doklady), new ser., vol. 53, no. 7, pp. 611–613, Moscow, 1946.

The gravitational field of the earth has been divided by the author into zones on the basis of calculations accounting for local and regional gravity effects and excluding the influence of remote zones. The solution is effected by comparing values of the component T of the curvature gradient with those of anomalies of gravity calculated by Stoke's formula differentiated twice with respect to the coordinates x and y coincident with the principal sectional planes of the earth. As a result, an equation is obtained between values of the measured component T_{xy} and of the known anomalies Δg, which is not satisfied when zonal influences are disregarded. The latter condition is investigated by successive transformations leading to three formulas for the computation of zonal influences. The first two formulas are integral expressions for $2T_{xy}$ and T_Δ; the third formula expresses a relationship between the components of plumb lines and the anomalies of gravity. The mathematical derivation is presented.—*V. S.*

9723. Kheifets, M. E. The first test of field work with elastic pendulums [in Russian]: Sbornik Nauchno-Tekhnicheskikh i Proizvodstvennykh Statei po Geodezii, no. 1, pp. 119–131, Moscow, 1941.

A study is made of the precision of gravity determinations carried out with elastic pendulums. The data were obtained by field tests in southeastern Russia in 1939, in which 293 stations were occupied with Lejay-Rudakovskii instruments. The methods of observation and calculation are described, the thermal coefficients of the instruments are given, and the sources of errors in measurements are analyzed mathematically. It is found that elastic pendulums have a precision of 2 to 3 milligals and generally cause no marked systematic errors. They are light, small, and easily transportable and allow the occupying of 3 to 4 stations per day. Suggestions are made on the procedure of measurements.—*V. S.*

9724. Lejay, Pierre. Gravimétrie et tectonique dans les Indes Néerlandaises [Gravimetry and tectonics in the Netherlands Indies]: Soc. Géol. France Bull., ser. 5, vol. 16, nos. 7–9, pp. 525–540, Paris, 1946.

To advance the use of gravitational methods in tectonic studies the author discusses the possibility of determining the distribution of subsurface masses from measurements of gravity on the surface. A mathematically rigorous and unique solution is not possible, but for practical purposes useful approximations can be obtained.

It is generally recognized that a correlation exists between gravity anomalies and irregularities of surface relief. In localities where isostatic compensation is complete, its depth can be calculated from the anomaly values when these vary consistently with the relief, as in the case of the Alps and the Pyrenees. Where compensation is not complete, as happens over wide areas, the strong lateral tensions arising in the earth's crust modify the values of anomalies.

The latter case is considered in the light of the gravity data of Vening Meinesz for the Netherlands East Indies. It is found that the lateral shrinking of the earth's crust produced by an inward turning of folds, to which Meinesz attributes the investigated anomalies, is a general phenomenon illustrated by the Antilles, the Gulf of Tarente, and the Calabrian Coast. A geologic process is suggested to explain this inward folding.—*V. S.*

9725. Lejay, Pierre. La forme de la terre [The shape of the earth]: Rev. Questions Scientifiques, ser. 5, vol. 8, pp. 329–350, Louvain, Belgium, July 1947.

The history of research on the shape of the earth is reviewed briefly, the gains achieved are listed, and the unsolved problems are indicated. It is found that the only means of improving precision is by substituting for the Hayford system, cognizant merely of relative deviations of the vertical, a more rigorous system accounting for absolute deviation at least at one base station. This improvement can be effected at present by establishing a gravimetric network with a radius of 20° around such a station, but the attainment of the desirable precision of 10 meters in the determination of the distance of the geoid from the surface of reference must await a completion of the gravity net of the world. Details of irregularities in the shape of the earth also may be tentatively studied at present but will require corrections when the world net is extended to unexplored regions.—*V. S.*

9726. Meisser, O. Ein einfaches Rollbandgelenkpendel, dessen Schwingungsdauer auch bei grösseren Amplituden und bei geringen Bandlangungen annähernd konstant bleibt [A simple pendulum with a special roller joint whose period of oscillation remains approximately constant even with great amplitudes of oscillation and in the case of a slight stretching of the band]: Geofis. Pura e Appl., vol. 10, no. 3–4, pp. 81–101, Milan, 1947.

The author presents a mathematical analysis of the oscillation of a pendulum, suspended on a bicylindrical roller. Realization of such a design would be of great importance for gravitational measurements and for construction of precise astronomical clocks. A pendulum provided with such a suspension can oscillate practically isochronously, even with large amplitudes, without causing excessive frictional losses. The old attempt to attain isochronism of oscillations by providing the pendulum with a cycloidal suspension roller does not give the necessary accuracy and must be abandoned. The proposed new design would make it possible to satisfy the condition of isochronism even in the case of an unavoidable stretching of the band. No experimental verification of these claims is presented.—*S. T. V.*

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9727. Oil and Gas Journal. Geological study of Gulf coast Continental Shelf: Vol. 46, no. 32, pp. 82–87, Tulsa, Okla., 1947.

In 1947 the U. S. Geological Survey and the Office of Naval Research conducted a marine gravity survey on the Continental Shelf of the Gulf of Mexico south of Cameron, Louisiana. About 200 stations were occupied along profiles extending 75 miles off shore to a water depth of 120 feet. The measurements were made with the use of a diving chamber weighing 2,000 lbs., with operator and equipment, and withstanding pressures at water depths of 2,600 feet. This chamber carried a gravimeter, containers of oxygen and lithium hydroxide and a communication system for emergency, and was lowered from a ship of 178 tons displacement. The gravity readings were made at 2-mile intervals at the rate of as many as 24 readings in 26 hours. They were supplemented with data on bottom sediments, topography, geology, temperature, and salinity.—*V. S.*

9728. Scheffer, Vittorio. Misure gravimetriche di collegamente fra le stazioni pendolari di Genova-Torino-Milano eseguite con gravimetro [Connecting measurements of gravity made with gravimeter between the pendulum stations of Genoa, Turin, and Milan]: Geofis. Pura e Appl., vol. 3, no. 3, pp. 161–164, Milian, 1941.

A comparison is made between the measurements of gravity carried out with pendulums and with gravimeters between and at the base stations of Genoa, Turin, and Milan, and at 6 other stations in Piedmont, Italy. The pendulum measurements had been made during 1925, 1928, and 1939 in surveys conducted by G. Silva, L. Solaini, and M. Botez. The gravimeter measurements were carried out by the author in 1941 over the area of Liguria, Piedmont, and Lombardy with a Humble-Truman gravimeter having a precision of ±0.10 milligal and a Boucher gravimeter having a precision of ±0.15 milligal, both of American make. The comparison of results shows that all pendulum and gravimeter measurements agreed at least within limits of ±1.9 milligal, except for the stations of Milan and Genoa, where the difference was 7.9 milligals.—*V. S.*

9729. Schwinner, Robert. Die Schwere auf den Hawai Inseln [Gravity over the Hawaiian Islands]: Zeitschr Geophysik, vol. 17, no. 516, pp. 159–181, Braunschweig, 1942.

Important positive gravity anomalies found at all stations of the Hawaiian Archipelago (if the free-air reduction is applied) correspond quite accurately to an attraction of these flat basaltic cones. We have to assume that the cones are simply superimposed over the ocean bottom, which by itself is in a state of isostatic equilibrium. The masses balancing these volcanic formations could be deeply embedded "regional" masses. At any rate it is certain that the weight of the Hawaiian Islands is supported by the strength of the earth's crust. On the contrary, the submerged ridges rising from the bottom of the ocean along the San Francisco-Honolulu-Guam line are compensated isostatically to as much as two-thirds. In general, calculating the isostatic reduction in the usual manner, it was found that the predominant term is not the isostatic compensation but the topographic correction.

In the author's opinion, reductions computed in this rigid manner are not too promising for the elucidation of underground geology. A solution of such problems can be found only by an individual analysis of the given geologic conditions, successively eliminating independent factors, such as planetary, regional (continental), and finally local factors. The interpretation of the last two factors should be made on the basis of available geologic data.—*Author's abstract, condensed and translated by S. T. V.*

9730. Shneerson, B. L. On a method of differentiating between local and regional gravitational fields [in Russian, with English summary]: Acad. Sci. U.R.S.S. Bull. (Izvestiia), Sér. Géog. et Géophys., vol. 10, no. 5, pp. 449–454, Moscow, 1946.

The method offered for differentiating between local and regional gravitational anomalies consists in determining the theoretical effects of subsurface masses and comparing them with actual measurements. In the analysis equations of potential are applied for calculating the disturbing effects of two masses differing in size and located at different depths, and values of gravity and gradient are deduced for different levels. It is shown that a comparison of these values with local data observed for the same levels clarifies the causes of an anomaly, because the disturbing effect of each of the two masses decreases at a different rate depending on its depth. The comparison can also indicate whether a local anomaly is caused by a superficial or a deep mass. This method was employed for investigating gravitational anomalies in Bashkiria and in the region of the Samarskaia Luka on the Volga River.—*V. S.*

9731. Shreider, A. A. Concerning the barometric coefficient of chronometers [in Russian]: Sbornik Nauclino-Tekhnicheskikh i Proizvodstvennykh Statei po Geodezii, no. 2, pp. 107–109, Moscow, 1943.

In an investigation of the barometric coefficient of the pendulum apparatus of L. V. Sorokin, conducted in a hermetic chamber, a parallel study was made of the barometric coefficient of the Narden chronometer used for the measurements. Atmospheric pressure in the chamber was reduced by degrees during six 8-hour periods, and observations were made at pressures of 770 to 380 millimeters, corresponding to air densities of 0.945 to 0.452, with the temperature constant within 1° to 2° C.

The results are presented and plotted on a graph. They show that the relationship between air density and the variation in the rate of movement of the chronometer is linear. The barometric coefficient of the chronometer, obtained by measuring the slope of the plotted line, is $-1^s.04$ for a change of 0.1 in normal air density.—*V. S.*

9732. Siñeriz, J. G. Estudio critico del gravimetro Heiland-typo G. S. C. 1946 [Critical study of the gravimeter, Heiland-type G. S. C. 1946]: Rev. Geofis., vol. 6, no. 22, pp. 212–225, Madrid, 1947.

After a description of the new gravimeter, model G. S. C. 1946, of the Heiland Research Corp., Denver, Colorado, a critical comparative study is made of this instrument and the older spring-type gravimeters. By mathematical analysis it is shown that a greater accuracy can be attained by the new model, owing to an astatic arrangement of the

springs. The attainable accuracy of the new instrument is estimated to be greater than ±0.03 milligal, and the mean error in determination of the difference of gravity between two stations was found equal to ±0.025 milligal. It was also found that the drift of the instrument is negligible.—*S. T. V.*

9733. Subbotin, S. I. Utilization of curvatures in the interpretation of gravity data [in Russian]: Prikladnaia Geofizika, no. 3, pp. 150–158, Moscow, 1947.

A theory making use not only of the usually employed curves W_{xz} but also of the curves W_Δ is offered as a basis for the interpretation of the gravitational results of variometer measurements obtained by the field method of selective assortment. As illustrations, concrete examples are given of a combined utilization of gravity gradients and curvatures for the interpretation of the data of gravitational surveys in the Romny and Krivorozh'e regions of southern Russia.—*Author's abstract, translated by V. S.*

9734. Tauber, A. F. Reliefentwicklung und isostatische Hebung in Gebirgen und Hochflächen [Topographic development and isostatic uplift in mountains and elevated plateaus]: Akad. Wiss. Wien, Math.-Naturwiss. Kl., Sitzungsber., Abt. 1, vol. 150, nos. 7–10, pp. 202–210, Vienna, 1941.

The author discusses the changes in the relief of a region and the resulting geologic consequences, these changes having their inception in the erosion of an elevated tableland. This process, concomitant with the displacement of enormous masses over great distances, disrupts the initial isostatic equilibrium. It causes a raising of the base of the plateaus and a lowering of the valleys, which are covered with sedimentary deposits. In the initial phase this erosion even increases the absolute height of the eroded mountain, but in the final phase the plateau disappears and a leveling of the region takes place, because the isostatic compensation amounts to only about 5 percent of the height lost through erosion. Many geologic forms, long ago noticeable in Alpine regions, are, in the opinion of the author, explainable by this process of isostatic raising of the mountain base. As examples he points out the asymmetry of the Alpine valleys, the lateral displacements of the streams, and other features.—*S. T. V.*

9735. Thyer, R. F., and Dooley, J. C. A gravity survey over the northern basin of the Leigh Creek coalfield: Commonwealth Bur. Min. Resources, Geol. and Geophys., [29th] Rept., 1946, Melbourne, Australia, 1946; extract in Mining Rev., no. 84, 1946, pp. 146–150, Adelaide, South Australia, [1947].

To determine the outer edges of coal seams in the northern basin of the Leigh Creek coal field, South Australia, trial surveys were made by magnetic, electrical-resistivity, and gravity methods in 1946. Only the gravity survey with a gradiometer and a gravimeter proved useful, being aided by a substantial difference in density between coal and the formations enclosing it.

Comparisons of the calculated gradient curve with the shapes and positions of known coal wedges revealed that the maximum gradient occurs over the center of a wedge, that the two positions where gradient values are equal to half the maximum gradient correspond to the ends

of the wedge, and that the value of the maximum gradient may also depend to some extent upon the depth of the wedge.

The results are presented in the form of geologic sections with the corresponding gravity and horizontal gradient curves superimposed. They show that gravity methods are well suited for delineation of coal seams. However, the gradiometer work is slow, and the gravimeter barely registers the small gravity changes involved.—*V. S.*

9736. Thyssen, Stephen von. Ueber einige Gravimeter-Vergleichsmessungen [Some comparative gravimetric measurements]: Zeitschr. Geophys., vol. 17, no. 3–4, pp. 75–85, Braunschweig, 1941.

The author compares two gravimetric surveys covering the same portion of southern Pomerania, Germany, one made in the fall of 1937, and the other in 1938. The base stations, the field crews, and the instruments used in these surveys were different. Gravimeters of the Thyssen type were used in both surveys. Comparison of the results obtained shows that the discrepancies of the isogam contours are insignificant. Furthermore, no influence of the weather conditions on the gravimeters was observed. Finally, the use of different base stations resulted in a very small variation of the individual readings. The coefficient of correlation between the two series of readings was found to be equal to 0.996 ± 0.002; the average discrepancy of the 1937 and 1938 readings for any field point is equal to ± 0.200 milligal.—*S. T. V.*

9737. Tolstoy, Ivan. Punched-card computation of isostatic and topographic reductions: Am. Geophys. Union Trans., vol. 28, no 6, pp. 823–830, Washington, D. C., 1947.

Isostatic reductions for gravity stations can be made with the aid of punched-card methods. A discussion of the precision that is needed and of the results that can be obtained is included. The method may be applied to a large volume of data with a saving in time and cost.—*Author's abstract.*

9738. Vening Meinesz, F. A. Tables bidimensionnelles pour la réduction isostatique selon l'hypothèse d'Airy avee $T=30$ km. [Two-dimensional tables for isostatic reduction based on the hypothesis of Airy, with $T=30$ kilometers]: Assoc. Internat. Géod., Bull. géod., new ser., no. 2, pp. 55–73, Paris, October 1946.

The existing standard tables of isostatic reduction for a local and regional distribution of compensation are based on circular zones introduced by Hayford and require complex calculations in problems involving two-dimensional topographic forms. To facilitate the reduction of such topography the author presents new tables based on two-dimensional zones suitable for a number of reduction problems, notwithstanding their lower precision. Comparatively large zones ranging in size from 5 to 40 kilometers have been chosen, because isostatic compensation takes place at considerable depth and causes no localized effect at the surface. In view of their limited precision the tables have been derived from the data of the standard tables rather than by direct calculation. The underlying mathematical principles are discussed and the tables are given.—*V. S.*

9739. Wideland, Bror. Relative Schweremessungen in Süd- und Mittelschweden in den Jahren 1943–1944 [Relative measurements of gravity in southern and central Sweden during the years 1943 and 1944]: Rikets Allmänna Kartverk Medd., no. 6, 120 pp., Stockholm, 1946.

The author reports on a survey of relative measurements of gravity made in 1943 and 1944 over southern and central Sweden and the island of Gotland. After a short general introduction regarding gravity measurements, he discusses various reductions of observations and gives a description of the Nørgaard gravimeter (type DA) used in this survey, devoting special attention to temperature corrections and to the determination of the drift of the instrument. The observations reported were made at 800 stations with average intervals of 20 kilometers between them.

Topographic corrections were applied to the field readings. Extensive tables are given and two maps are appended, one representing the free-air anomalies and the other the Bouguer anomalies of the region surveyed. The author computes the mean error of the 15 main stations as ranging from ±0.27 to ±0.52 milligal. Mean error of the field measurements is given as ±0.53 milligal for the year 1943 and ±0.67 milligal for the year 1944.—*S. T. V.*

2. MAGNETIC METHODS

9740. Atanasiu, G. Cartes magnétiques de la Bucovine [Magnetic maps of Bukowina]: Annuar. Inst. Geol. Românei, vol. 21, pp. 465–472, Bucharest, 1941.

The author discusses the results of magnetic measurements made by him during the years 1938 and 1939 and by other investigators in Bukowina and adjoining localities and presents two magnetic maps of the region, one of the declination and another of the total horizontal component. Twenty-one stations were chosen in Bukowina. Only a portion of the readings were corrected for diurnal and secular variations; all readings were referred to July 1, 1939, and these data were used for the drawing of the provisional magnetic maps of Bukowina, which are attached to the paper.—*S. T. V.*

9741. Atanasiu, G. Cartes magnétiques de la Transylvanie [Magnetic maps of Transylvania]: Anuar. Inst. Geol. Românei, vol. 22, pp. 399–411, Bucharest, 1943.

The paper is a report on magnetic measurements made by the author during the years 1936–42 at different points in Transylvania. Measurements were made at 42 stations, where the declination and the total horizontal component were determined. The stations were distributed between 45°30′ and 47° north latitude and 23° and 25° east longitude, with an average density of 16 stations per square degree area (8,300 square kilometers).

Declination readings were corrected for diurnal variation. No corrections were made for accidental disturbances, which the author estimates did not exceed 4.0 seconds. The average secular variation is given as 8.3 seconds per year toward the east. Readings of the horizontal component were not corrected at all. In drawing magnetic maps of the region all measurements were reduced to July 1, 1938.—*S. T. V.*

9742. Bailey, H. C. Electronics in the Antarctic: Electronics, vol. 20, no. 8, pp. 82–88, New York, 1947.

An account is given of the effectiveness of radar, sonar, radio, teletype, and other electronic equipment employed during the U. S. Navy's expedition to the Antarctic in 1947, and a few remarks are added on the usefulness of the airborne magnetometer under Antarctic conditions. Magnetic profiles were traced during two flights over familiar terrain and gave wholly satisfactory data. As a result, suppositions as to the geology and topography of the area were partly confirmed and partly disproved, and the coast line was delineated.—*V. S.*

9743. Banukhin, L. S. Concerning the field inductor constructed by N. N. Trubiatchinskii [in Russian]: Nauchno-Issledovatel'ski Institut Zemnogo Magnetizma, Zemnoi Magnetizm i Elektrichestvo, pp. 38–46, Moscow, 1946.

Detailed tests were made of the field inductor of N. N. Trubiatchinskii constructed in 1938 for precision measurements of magnetic inclination. The instrument consists of a coil of soft iron set on an axis free to rotate in a frame. When the frame is oriented in the plane of the magnetic meridian, the coil turns to a position at the angle of inclination. In the tests the correction ΔI was determined with reference to the Magnetic Observatory at Vysokaia Dubrava. The procedure is described, and the instrument's sources of error, structural shortcomings, and sensitivity are discussed in the light of the findings. It is concluded that the inductor satisfies requirements of precision when galvanometers of a sensitivity of the order of 10^{-8}A are used, and that certain structural improvements would permit using galvanometers of a sensitivity of 10^{-7}A. The errors of the inductor proper seldom exceed $\pm 2'$ and usually lie within the limits of $\pm 1'$.—*V. S.*

9744. Barrio, D. M. Observaciones magneticas realizadas en ciudad Trujillo por el U. S. Coast and Geodetic Survey [Magnetic measurements made in the city of Trujillo by the U. S. Coast and Geodetic Survey]: Inst. Geog. y Geol., Sec. de Sismol., no. 44, 14 pp., Trujillo, Santo Domingo, 1946.

Magnetic measurements made during February 1946 in the city of Trujillo by W. E. Wiles of the U. S. Coast and Geodetic Survey gave the following results: Magnetic declination 3°47′ W., magnetic inclination 52°35′, horizontal intensity 0.2750 oersteds. Corresponding values obtained in 1941 for the same station were: Magnetic declination 3°32′ W., magnetic inclination 52°48′, and horizontal intensity 0.2735 oersteds. These measurements give annual variations of +3.1 minutes for magnetic declination, −2.4 minutes for magnetic inclination, and +20 gammas for horizontal intensity.—*S. T. V.*

9745. Bernard, Pierre. Sur la relation de certaines transformations cometaires avec les perturbations du champs magnétique terrestre [Concerning the relationship between certain cometary transformations and perturbations of the terrestrial magnetic field]: Acad. Sci. Comptes rendus, vol. 224, pp. 209–211, Paris, 1947.

The author has analyzed coincidences between the beginning of magnetic disturbances, as registered by different European observatories over a period of more than 60 years, and certain changes in

cometary appearances taking place simultaneously, such as the spontaneous increase of their brightness. The latter data were collected from the publications of astronomic observatories. For each such case of coincidence the corresponding position of the comet was determined in terms of heliocentric elliptic coordinates.

A high coefficient of correlation (0.89) was found between the distance of the comet from the sun and the time elapsed between the two studied phenomena. If this distance is greater than the distance of the earth from the sun, magnetic disturbance precedes the cometary transformation; the opposite takes place if the comet is nearer to the sun than the earth. The phenomena take place in such a way as to suggest that certain agents recede from the sun and successively cause a magnetic perturbance on our planet and a change in the appearance of the comet. The velocity of the propagation of this disturbance is such that the astronomic unit (distance betwen sun and the earth) is covered in 5 days. It seems reasonable to assume that the disturbing factor causing these phenomena does not come from the sun but is centered at a certain point away from the plane of the terrestrial orbit at an average distance of 0.8 astronomic unit.—*S. T. V.*

9746. Blackett, P. M. S. The magnetic field of massive rotating bodies: Nature, vol. 159, no. 4046, pp. 658–666, London, 1947.

A recent measurement of the magnetic field of the star 78 Virginis gave the same value as that calculated by the equation known to apply to the earth and sun and suggested a general law of the magnetic field of massive rotating bodies. According to this equation, demonstrated by Schuster, Sutherland, H. A. Wilson, and others, the magnetic moment and the angular momentum of a rotating mass are approximately proportional. The rough verification of the relationship for three bodies—the earth, the sun, and 78 Virginis—appears to point to a new and fundamental property of rotating matter that may connect electromagnetic and gravitational phenomena.—*V. S.*

9747. Burgaud, S. J. Activité magnétique et ses causes solaires [Magnetic activity and its solar causes]: Observatoire de Zi-Ka-Wei, Études sur le Magnétisme Terrestre 41–49, no. XI, 117 pp., Zi-Ka-Wei near Shanghai, China, 1947.

Nine studies made at the Zi-Ka-Wei Observatory, China, on the relationship between magnetic activity and solar phenomena are assembled in one volume. They deal with the magnetic storm of March 24, 1940; preliminary tremors registered on magnetograms; solar eruptions; the locus of the eruptions and its effects on magnetic storms; the time interval between eruptions and storms; storms with sudden starts and their frequency; storms registering preliminary starts; solar eruptions and the 27-day recurrence tendency in geomagnetism; and the origin of flocculi in its relation to magnetic recurrence. The data for the studies were drawn from the magnetic records of the Zo-Se Observatory, the Monthly Notices, the Bulletins Astronomiques of Meudon and of Ebre, the trimestrial notices from Zurich, and other sources.—*V. S.*

9748. Burns, W. W. Bahamas oil exploration—first major survey with airborne magnetometer: Petroleo Interamericano, vol. 5, no. 12, pp. 40–45, Tulsa, Okla., 1947.

An account is given of the airborne-magnetometer survey being made off the Bahamas over an area that is 90 percent submerged. The key device used is the magnetometer developed by the Gulf Research and Development Co. It is flown in a specially equipped DC–3 airplane. The use of Shoran stations established on boats permits the recording of all data, positional and magnetic, in the airplane itself, and consequently permits accurate correlating of all the factors and gives high precision to the surveying work. Points up to 300 miles apart are measured with a variation of only ±150 feet. The survey plane also carries a recording radio altimeter. About 2,400 square miles can be surveyed from one pair of stations.

Simultaneously with this magnetometric survey, several companies are conducting gravity meter, marine gravity meter, and seismic surveying. Local gravity anomalies found are extreme, making accurate geodetic positioning impossible by astronomical means. A well was drilled at Andros Island to a depth of 14,585 feet, but there was no show of oil.—*S. T. V.*

9749. Deel, S. A. Magnetic declination in the United States, 1945: U. S. Coast and Geod. Survey, Serial 664, 65 pp., 1 map, Washington, D. C., 1946.

In only a few places [on the earth] does the compass point truly north, and its direction at a given place is not constant. Hence a knowledge of its changes with place and time is needed by those who make use of it. The object of this publication is to supply this information for the United States. The change of declination with time since 1750, or since the date of the earliest observations, is given in tabular form for points distributed at intervals of 2° of latitude and longitude. Other tables are given to illustrate the manner in which the direction of the compass needle may change in the course of the day. Several methods of determining the true meridian are explained, so that the surveyor may determine the magnetic declination for himself at places where there is no meridian line or other true bearing available. The distribution of the magnetic declination at the beginning of the year 1945 and the latest available information on the rate of change are shown graphically on the isogonic chart.—*From Introduction, p. 2.*

9750. Diukov, A. I. Aeromagnetometrics in the United States [in Russian]: Razvedka Nedr, vol. 13, no. 2, pp. 45–52, Moscow, 1947.

The development in the United States of airborne magnetometers for the exploration of mineral resources is described on the basis of American literature. Attention is given to the principles and structural devices employed to meet requirements of high sensitivity, automatic stabilization, and continuous position fixing. The design and use of the Gulf instrument of V. Vacquier is primarily considered, and some details of the flight techniques developed by practice are indicated.—*V. S.*

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9751. Dudley, R. L. Flying magnetometer completing 80,000 square mile survey: Oil World, vol. 127, no. 7, pp. 247–251, Houston, Tex., 1947.

An account is given of the use made in 1947 of the Gulf airborne magnetometer for the exploration of an area of 80,000 square miles in the Bahamas Archipelago at an approximate cost of $1,000,000. With 90 percent of the surface covered with water, Shoran was employed to guide airplanes with a positional accuracy of about 150 feet on a grid with 2-mile spacing, and a continuous magnetic recording valid to better than 2 gammas was made with the saturated core flux-gate magnetometer oriented with the total field.

The ground network for operating Shoran consisted of a permanent ground station at Nassau and mobile stations set on boats. The boats were moored near various local points tied to the North American geodetic net and were moved to new positions as the survey advanced. The Shoran transmitter and receiver were carried aboard the survey plane, and the transponder was placed at the ground station. Shoran was also made to operate a direction indicator enabling the pilot to guide the plane along a chosen path. Other details of the organization of the work and of equipment are given.—*V. S.*

9752. Fanselau, G. Vorläufige Ergebnisse der erdmagnetischen Beobachtungen in Niemegk im Jahre 1940 [Preliminary findings from the magnetic observations made in Niemegk during the year 1940]: Zeitschr. Geophys., vol. 17, pp. 213–217, Braunschweig, 1942.

This paper is the second publication from the new observatory built in Niemegk, near Potsdam Germany, for study of terrestrial magnetism. It contains six tables of magnetic data. The first table contains the monthly averages of the elements of the magnetic field in Niemegk for the year 1940; these data are to be considered preliminary. The remaining tables give the normal values of the elements of the magnetic field and their secular variations for the years 1935 to July 1941. Finally, certain data are given on magnetic activity for the year 1940 and the days of the greatest magnetic disturbances of that year.—*S. T. V.*

9753. Glebovskii, Iu. S. Magnetic exploration with simple instruments [in Russian]: Razvedka Nedr, vol. 13, no. 2, pp. 53–55, Moscow, 1947.

Reconnaissance of strongly magnetic deposits does not require a measurement of the vertical magnetic component and use of precise variometers but can be made by determining magnetic declination with simple instruments at widely spaced stations. In 1943 the author used the vertical galvanoscope of Schmalkalder, sometimes in combination with a theodolite, for a survey of diabase dikes on the northern slope of the Aldan formation in Siberia. He found the work simple and economical, the precision superior to that of the Tiberg-Thalen magnetometer, and the results easily interpretable. The anomalies near the dikes reached 5° to 10°, and the accuracy of observations was ±10′. The requirements to be satisfied by the instruments and the field procedure employed are described, and certain adaptations of the galvanoscope made by the author are indicated.—*V. S.*

9754. Joyce, J. W. Manual of geophysical prospecting with the magnetometer, 2d ed., reprinted, 129 pp., Washington, D. C., Hobart Pub. Co., 1948.

The continued demand for this manual has indicated the desirability of reprinting the second edition, which was originally issued in 1938. While parts of the book should be revised to bring them up to date, other duties have so limited the author's time that to wait for such changes would unduly delay publication.—*Author's note.* (For abstract of first edition, *see* Geophys. Abstracts 87, no. 3277.)

9755. Kalinin, Iu. D. Theory of daily variations of geomagnetic disturbances [in Russian]: Acad. Sci. U.R.S.S. Comptes Rendus (Doklady), vol. 54, no. 8, pp. 685–688, Moscow, 1946.

In the light of the theories of S. Chapman, V. C. A. Ferraro, E. H. Vestine, and others, geomagnetic disturbances are explained at present as being caused by electric currents in the ionosphere, created by the passage of the earth through neutral ionized streams of solar particles. Chapman further suggests that the currents causing the daily variations of geomagnetic disturbances may be produced by the effect of the vertical component of the permanent geomagnetic field, provided the atmosphere is in horizontal motion during the disturbance.

This latter phase of the theory is developed mathematically by the author, who explains the daily variations of disturbances as a consequence of the atmospheric tides that are generated by the corpuscular flux producing the disturbance. The calculations are presented, and the values obtained for the current are tabulated. It is found that the results conform with the empirical distribution of daily variations of disturbances in the low and median latitudes. For the high latitudes the author adopts the explanation of Birkeland.—*V. S.*

9756. Karasik, M. A. The use of magnetic and electrical methods for geologic mapping and nickel-ore exploration in the Rezhevsk region of the middle Urals [in Russian]: Razvedka Nedr, vol. 12, no. 2, pp. 56–58, Moscow, 1946.

During 1932–43 the Rezhevsk region in the middle Urals was surveyed by magnetic and electrical methods with a view to geologic mapping and detection of nickel deposits. In all, 30,000 magnetic stations and 6,000 electrical stations were occupied, forming a magnetic net of spacings 500 by 200 meters to 100 by 20 meters, and an electrical net of spacing 50 by 20 meters.

The nickel ores in this locality are associated in part with zones of contact between serpentines and adjacent rocks and with zones of weathered serpentine. In the magnetic survey, aimed primarily at detecting these zones, abrupt and complex magnetic variations, particularly when latitudinal in direction, were found to correspond to serpentine contact zones; low magnetic values over extensive serpentine formations indicated weathered zones; and moderately high magnetic values over limestones pointed to their contact with serpentines. A nickel deposit was discovered.

Electrical exploration by resistivity methods was aimed at detecting the zones of thick porous material which were found to stretch over ser-

pentine contacts with limestone and to register low resistivity values. The electrical data alone proved insufficient for delineating nickel deposits.—*V. S.*

9757. Khalileev, P. A., Ponomarev, V. N., and Bulashevich, Iu. P. A new method of magnetic exploration [in Russian]: Razvedka Nedr, vol. 13, no. 3, pp. 42–44, Moscow, 1947.

When an ore body is weakly magnetic or differs little in magnetic properties from the surrounding rock, measurements of the geomagnetic components give uncertain data in exploration. Clearer information is obtained by determinations of the vertical gradient which provides differentiation because the magnetic field of a limited body changes faster vertically than does the field of the surrounding rock. To use measurements of the gradient of the vertical geomagnetic component in exploration for bauxite, manganese, and other ores, a special gradientometer of high sensitivity has been designed and tested in the Urals, U.S.S.R. The results of the tests are discussed and presented in curves showing the vertical gradient of Z at three horizons over a profile in the area of a manganese deposit and at two horizons over a profile in a manganese and pyrrhotite area. The readings of the gradientometer, considered free from the effects of magnetic variations, temperature, and mechanical causes, are believed to have a precision of the order of 0.5 gamma/meter.—*V. S.*

9758. Koulomzine, T., and Brossard, L. The use of geophysics in prospecting for gold and base metals in Canada: Geophysics, vol. 12, no. 4, pp. 651–662, Tulsa, Okla., 1947.

The Canadian shield is an area of pre-Cambrian rocks some 2,000,000-square miles in extent, which produces a half-billion dollars' worth of minerals per year. The geophysical prospecting methods of most use here are magnetic and electrical. Geophysical methods, after recovering from an earlier period of disfavor, are now beginning to be properly appreciated by the local mining industry. Several examples of important recent geophysical discoveries are presented. Future expansion in this field appears inevitable.—*Authors' abstract.*

9759. Lundberg, Hans. Magnetic surveys with helicopters: Inst. Min. Metallurgy Bull. 488, pp. 21–28, London, July 1947; Canadian Min. Met. Bull. 423, pp. 392–400, Montreal, Quebec, July 1947; Rhodesian Min. Jour., vol. 19, no. 243, pp. 233–237, Johannesburg, 1947.

In surveys with the airborne magnetometer the intensity of the magnetic field decreases rapidly with altitude, so that details valuable to prospectors are lost. To bring the magnetometer closer to the ground, the author tested helicopters over the Sudbury and Amos areas in Canada and found them very maneuverable. He also built a new magnetometer for the detailed mapping of local structures.

This instrument measures the vertical component of the magnetic field, found to give more accurate indication of magnetic bodies than the total intensity measured by the MAD detector. The pick-up unit is composed of a rotor, a stationary coil, and a compensating unit. When the rotor, driven by compressed air, encounters changes in the magnetic field, an electromotive force is developed and magnified in the stationary

coil. The earth's normal field is largely neutralized by the compensating unit, and the remaining part acts as a reference datum for the magnetic measurements. In aerial surveys a record is made of magnetic intensity, ground position, and elevation. Results of comparisons between aerial and ground magnetic surveys are presented, and a few suggestions are made on surveying technique. Electrical surveys from helicopters may also be possible.—*V. S.*

9760. Morelli, Carlo. Sulla rappresentazione cartografica del campo magnetico terrestre [On cartographic representation of the terrestrial magnetic field] : L'Universo, vol. 24, no. 7, pp. 1–8, Rome, 1943.

The author discusses the question of a rational and lucid presentation on a map of different characteristics of the terrestrial magnetic field, varying in space from point to point of the earth's surface and in time. He especially discusses the problem of regional magnetic mapping and the difficulties often arising from sharp local anomalies, usually discovered after measurements with a denser network of stations. Interpolation of data obtained from approximate surveys here would give wrong values for intermediate points. On the other hand a map should be so constructed as to reduce to a minimum the task of taking from it the necessary values of magnetic characteristics. Some possible procedures to satisfy these contradictory requirements are discussed by the author.

In treating the problem of the variations of magnetic properties with time, the author mentions the use of isopores (lines of equal secular variation) and also the method, proposed by Weinberg, of presenting on the same map magnetic curves corresponding to a certain epoch, and those of a particular subsequent time, thus making possible an interpolation for an intermediate date.—*S. T. V.*

9761. Morelli, Carlo. Studio geofisico della regione travertinosa a sud di Cerdomare (Sabina) [Geophysical investigation of the limestone region to the south of the Cerdomare (Sabina)] : Istit. Geofis. Trieste Pubbl., no. 185, 16 pp., Trieste, 1944.

The National Institute of Geophysics of Italy, in planning to erect a special observatory for studies of terrestrial magnetism, faced the problem of selecting a suitable locality. From the outset locations near great cities were excluded because of the magnetic disturbances caused by electric railways and transmission lines. Volcanic regions with their pronounced magnetic anomalies were considered unsuitable. Coastal regions affected by telluric currents of submarine origin were avoided also. Finally the region in the Sabina district, some 55 kilometers from Rome, was selected tentatively. The author presents the results of a detailed magnetic survey of this region made in the spring of 1943. The survey was carried out with extreme precision, being preceded by a study of the available instruments. Two Schmidt balances of the Askania Gf6 type were used. The constants of the scale of these balances were 9.783 and 9.511 gammas per division. Mean errors were found to be 0.017 and 0.025 gammas. Temperature correction was less than 0.01 gamma per 20° C. of temperature variation.

As a result of the survey important local anomalies were established ranging from —148 to +342 gammas making the proposed locality un-

suitable for the erection of the observatory. A detailed magnetic map of the surveyed area is appended.—*S. T. V.*

9762. Northern Miner. Geophysical aid: Vol. 33, no. 11, p. 22, Toronto, Ontario, 1947.

An electronic compass, considered superior in precision to conventional magnetic compasses, has been developed by a company in Minneapolis, Minnesota, U. S. A. It consists of a specially designed vacuum tube which houses a gunlike device firing a constant focused stream of electrons at four target plates. When the gun is pointed in the direction of the earth's magnetic field the stream is equally divided between the targets, but when the gun is deflected by a local influence some of the beams are bent and strike the targets unevenly. The electronic currents on each of the targets are measured through an electronic amplifier, and the difference is registered on the indicator dials. The compass determines both the direction and the intensity of the magnetic field and can serve for navigation and prospecting.—*V. S.*

9763. Quaile, J. E. Airborne submarine detector equipment: Military Engineer, vol. 39, no. 258, pp. 166–167, Washington, D. C., 1947.

The adaptation and application of the airborne submarine detector to magnetic exploration for mineral deposits, carried out by the U. S. Naval Ordnance Laboratory and the U. S. Geological Survey, are described briefly, and surveys conducted in Michigan, New York, Alaska, and over the Gulf of Mexico are listed. More than 40,000 square miles are reported to have been surveyed with the airborne magnetometer in the United States and Alaska.—*V. S.*

9764. Ramsay, B. P., and Yost, F. L. Facilities provided by the Kensington Magnetic Laboratory: Terres. Magn. and Atmos. Electr., vol. 52, no. 3, pp. 357–367, Baltimore, Md., 1947.

The Kensington Magnetic Laboratory in Maryland was established and operated during the second world war by the Department of Terrestrial Magnetism, Carnegie Institution of Washington, to carry out work for the U. S. Naval Ordnance Laboratory. Its equipment included magnetic generators of unusual size, design, and construction, essentially of the solenoid, Helmholtz coil, and gradhelm types, which are described. The program of work covered the simulation of magnetic fields of ships for determining the performance of magnetic mines; studies in the design of search coils and in problems of flux saturation; and measurements of basic magnetic sensitivity, of the influence of magnetic latitude, of the condition of magnetization of mine cases, and of effects of magnetic circuits and of eddy currents on the design of mines. Some of the methods developed have been adopted as standard and are being used in the magnetic and electric tests made on naval ordnance equipment.—*V. S.*

9765. Reich, H. Das Adolf Schmidt-Observatorium Niemegk [The Adolf Schmidt Observatory at Niemegk]. Geophys. Inst. Potsdam Abh., no. 1, p. 47, Berlin, 1939.

This is a general description of the new observatory for terrestrial magnetism, built to replace the Potsdam observatory when the transfer

of the latter became imperative because its undisturbed functioning was more and more endangered by continuous electrification of the suburban railways around Berlin. The new observatory is about 44 kilometers from Potsdam.

The booklet gives a description of the buildings and of the instruments used for different magnetic determinations. Most of the instruments were transferred from the old observatory.

A valuable addition to the equipment is an installation for the study of telluric currents, an addition made possible by a donation from the Rockefeller Foundation. The booklet is well illustrated by numerous photographs.—*S. T. V.*

9766. Rothé, J. P. Contribution à l'étude des anomalies du champ magnétique terrestre [Contribution to the study of anomalies of the geomagnetic field]: Univ. Paris, Faculté Sci. Thèses, ser. A, no. 1672, 111 pp., Paris, 1937.

Magnetic anomalies in France were surveyed by several methods with a view to testing principles of interpretation of magnetic data. The work was limited to measurements of the vertical geomagnetic component, made mostly with the Schmidt-Askania variometer. Various anomalies were chosen, both local, of importance in exploration, and regional, of significance in geomagnetic investigations. They included anomalies caused by eruptive rocks, such as the ophitic rocks of the Pyrenees, the basaltic rocks of Lorraine and Alsace, and the dioritic rocks of Neuntelstein Mountain, and also anomalies found in sedimentary terrain, such as those caused by the faults of the hercynian massif of the Vosges Mountains and those produced by the anticline of the Pays de Bray. The anomaly of the Paris basin was studied as an example of regional anomaly, in its relation to the seismicity of the basin.

The wide range of the data obtained is discussed in its magnetic and geological implications, in the light of the principles and precision of the Schmidt-Askania variometer.—*V. S.*

9767. Schneider, Otto. A nomograph for conversion of Fourier coefficients occurring in geomagnetic computations: Terres. Magn. and Atmos. Electr., vol. 52, no. 2, pp. 183–187, Baltimore, Md., 1947.

In 1920 the Batavia Observatory made changes in the tabulation form of its data. The calculations, required to transform the amplitude and phase of pairs of harmonic coefficients representing diurnal and semidiurnal variations on individual days, are discussed to explain the construction of a nomograph for simplifying these operations. It is found that with its use certain provisional amplitudes and phases, such as those corresponding to the approximate Fourier coefficients obtained by the conventional methods of harmonic analysis, may be used throughout for the transformation. Other features of the nomograph are indicated, and two examples of construction are given.—*V. S.*

9768. Shapley, A. H. The recurrence tendency and forecasts of magnetic activity: Am. Geophys. Union Trans., vol. 28, no. 5, pp. 715–721, Washington, D. C., 1947.

The recurrence tendency in magnetic character figures is evaluated by auto-correlation coefficients for various intervals up to 83 days for each year from 1890 to 1944. The strength of the 27-day recurrence pulse

varies during the 55 years, being generally strong from about 2 years after sunspot maximum through the minimum year. Evidence for persistent recurrence intervals other than multiples of about 27 days is very weak. The magnitudes of the correlation coefficients for short intervals indicate that the time unit of geomagnetic activity is 2 to 3 days. Formulas for the prediction of magnetic character figures by the method of least squares are based on the mean auto-correlation coefficients for intervals of 1, 26, 27, 28, and 54 days for stages of the sunspot cycle with weak and strong recurrence conditions. A prediction formula with a nonlinear term is also derived.—*Author's abstract.*

9769. Slaucitajs, L. Magnetic survey of Latvia, 1937–1943: Baltic Univ. Contr., Special ser., no. 1, 99 pp., 3 maps, Hamburg, 1946.

The Latvian Institute for the Exploration of Mineral Deposits conducted a magnetic survey of Latvia in 1937–43, in cooperation with the University of Latvia. Measurements were made of the declination, the horizontal component, and the vertical component at 15 base repeat stations and over a network of 220 field stations, with an average distance of 16.7 kilometers between stations. The Neumayer-Schmidt-Hildebrand declinator, Hildebrand theodolite, de La Cour quartz magnetometer, Askania-Schmidt field balance, and de La Cour zero balance were used for the measurements. The survey gave declination values of an accuracy $\pm 2'$, horizontal intensity values of an accuracy ± 3 gammas, and vertical intensity values of an accuracy over ± 25 gammas, including the probable error of reduction to epoch. The report deals with the standardization of instruments, the field work, the results obtained, and the interpretation of anomalies. Maps are appended.—*V. S.*

9770. Slichter, L. B., and Bullard, E. C. Frenkel's views on the origin of terrestrial magnetism: Nature, vol. 160, no. 4057, p. 157, London, 1947.

Criticisms are advanced of Frenkel's theory that terrestrial magnetism is generated by electric currents induced in the liquid metallic core of the earth by the thermal convection of the material of the core.

It is pointed out that the iron core model postulated should be more appropriately compared in composition with iron meteorites than with surface rocks. The view that viscosity cannot control the convection currents and that the control must be a dynamo action is questioned on the ground that turbulent motion should ensue with a Reynolds' number of the order of 10^6 and that the increased velocity gradients would enable viscosity to control the motion. It is also considered that, before the theory can be accepted, the entire argument must be reconciled with Cowling's demonstration that self-maintenance of a steady magnetic field by fluid motions is impossible with axial symmetry.—*V. S.* (For Frenkel's theory *see* Geophys. Abstracts 127, no. 8827.)

9771. Thellier, E., and Thellier, O. Sur les corrections d'aimantation induite et de température dans les mesures magnétiques [On corrections of induced magnetization and temperature in magnetic measurements]: Inst. Phys. du Globe Univ. Paris Annales, vol. 22, pp. 82–90, Paris, 1945.

A new method is offered for the determination of the corrections for induced magnetization and temperature in magnetic measurements, particularly important in investigations of the terrestrial field.

The correction for induced magnetization is determined by means of the induction apparatus of E. Tellier, consisting principally of 2 electric circuits formed by Helmholtz coils connected with a galvanommeter. The magnet to be tested, placed in the apparatus first longitudinally and then transversely, is subjected to magnetic fields of an increasing intensity, and the values of the magnetization induced in both positions are measured. The advantages of this procedure are discussed and illustrated by the results obtained.

The effect of temperature is measured with the same apparatus by determining the permanent magnetic moments of two similar magnets, one of which is kept at a freezing temperature for control while the other is gradually heated. The instrumental arrangement and procedure are described, and the results obtained are cited.

As an illustration, the precision of both types of corrections effected is discussed for the case of the relative determination of the horizontal geomagnetic component by the method of Gauss.—*V. S.*

9772. U. S. Coast and Geodetic Survey. Magnetograms, Cheltenham, Maryland, January–June 1946: Serial MG–C46.1, 66 pp., Washington, D. C., 1947.

A new series of semiannual reports, issued regularly within a few months after each half-year period, is inaugurated with this publication to mitigate the lag in the presentation of the magnetograms of the Cheltenham Magnetic Observatory. The magnetograms are presented in their entirety in quarter-size reproductions, with numerical data permitting the scaling of individual values. Introductory remarks deal with the magnetographs employed, methods of scaling, reproduction of magnetograms, monthly and annual means, and standard correction. Tables of related values are included.—*V. S.*

9773. Vacquier, V., Simons, R. F., and Hull, A. W. A magnetic airborne detector employing magnetically controlled gyroscopic stabilization: Rev. Sci. Instruments, vol. 18, no. 7, pp. 483–487, Lancaster, Pa., 1947.

An experimental type of an airborne magnetometer using three mutually perpendicular saturable-core magnetometers is described. Signals from two of these magnetometers are used to precess an air-driven gyroscope so as to aline its spin axis along the earth's total magnetic intensity, thus providing stabilization for the third magnetometer, which can then measure anomalies of a few gammas along the line of flight. This method of stabilization permits the use of the magnetometer in vehicles subjected to the most violent angular accelerations. It can also be made smaller than nongyroscopically stabilized airborne magnetometers.—*Authors' abstract.*

9774. Wienert, K. Preliminary report on the magnetic results of a journey to Sikkim and southern Tibet: Terres. Magn. and Atmos. Electr., vol. 52, no. 4, pp. 505–521, Baltimore, Md., 1947.

The main result is a table giving declination, horizontal intensity, and dip for 55 stations in Sikkim and southern Tibet, reduced to the epoch 1939.0. The data were obtained by the author on the Schaefer Expedition in 1938-39. Details are given on the instruments used and the manner of reduction. Linear formulas for a smoothed normal field in the area are derived for D, H, I, and Z. Numerous observations of

vertical intensity with an Askania field-balance are used for a preliminary description of local anomalies.—*Author's abstract.*

9775. Young, W. E. Iron deposits, Iron County, Utah: U. S. Bur. Mines, Rept. Inv. 4076, 102 pp., Washington, D. C., May 1947.

Iron ore crops out over a wide area in southwestern Utah, particularly in the section around Iron Mountain, Granite Mountain, and Three Peaks. In 1942–45 the U. S. Bureau of Mines explored a part of this section by drilling and by a magnetic survey over much of the local monzonite-sedimentary rock contacts. Grids were laid out parallel to the contacts, and readings were taken at 300-foot and 400-foot intervals for detailed work. A local magnetic map drawn in 1930 was of assistance. In several instances magnetic anomalies were discovered in areas where no ore outcrops existed. Whenever these anomalies were drilled, ore bodies were found. The geological, geophysical, and mining phases of the work are described and are illustrated by maps, cross sections, and tabulations.—*V. S.*

3. SEISMIC METHODS

9776. Alcock, E. D., and Waters, K. H. A shooting method for areas of difficult drilling: Geophysics, vol. 12, no. 4, pp. 576–589, Tulsa Okla., 1947.

A method of shooting is described, which may be used in areas where the drilling conditions are difficult to obtain a relatively large amount of information for each hole drilled. The method is a variant of the reflection-velocity profile when dips are small, but new methods of computation have been devised when steep dips are encountered.—*Authors' abstract, Geophysics, vol. 12, no. 3, p. 502, Tulsa, Okla., 1947.*

9777. Antokol'skii, M. L. Distortion of the seismic impulse by the registration channel [in Russian]: Prikladnaia Geofizika, no. 3, pp. 119–130, Moscow, 1947.

The form of a seismic wave may be distorted in the course of its seismographic registration. To aid the study of such errors a method is advanced for calculating the distortion of an impulse of definite form. By means of it the characteristics of the response of the registering channel, usually determined empirically, can be obtained instead from ordinary frequency and phase data.

The derivation of the method presupposes that all parts of the channel are related linearly and employs the response to an impulse of rectangular form for analyzing the relationship between the empirically determined characteristics and the frequency and phase chararcteristics. The inquiry leads to an examination of the errors involved in a transition from one type of characteristics to the other. Calculation of the distortion of an impulse from frequency and phase data is illustrated by examples.—*V. S.*

9778. Barrio, D. M. Directrices generales para la construccion de edificios destinados a estaciones sismologicas [General directions for construction of buildings of seismological observatories]: Inst. Geog. y Geol., Sec. de Sismol., no. 37, 3 pp., Trujillo, Santo Domingo, 1946.

This paper gives a short set of specifications to be taken into account in planning a building for a seismological observatory. The location of the observatory and the specific requirements of different installations

to be found in it are briefly discussed. Two sketches are included. One shows the plan of the seismological observatory of Harvard University, Cambridge, Massachusetts, and the other shows the main portion of a typical observatory.—*S. T. V.*

9779. Barrio, D. M. El servico sismologico de la Republica Dominicana [Seismological service in the Dominican Republic.] : Inst. Geog. y Geol., Sec. de Sismol., no. 45, 8 pp., Trujillo, Santo Domingo, 1946.

In accordance with the resolution of the second Pan-American Congress of Geography and Cartography held in Rio de Janeiro in August 1944, the government of the Dominican Republic decided to establish a special institute for the study of terrestrial magnetism and seismology. The present bulletin gives salient features of the seismological service of the Republic, now in process of organization, gives data on the equipment of a future seismological observatory, and describes measures taken with a view to more complete recording of earthquakes on the Island of Haiti.—*S. T. V.*

9780. Bernard, Pierre. Recherches sur l'agitation microséismique [Research on microseismic vibration] ; Assoc. Franc. Avance. Sci., Cong. Paris, vol. 11, pp. 282–285, Paris, 1945.

The author studies the relation between the appearance of a swell at the seashore and the registration of microseisms at Strasbourg and finds that the depressions of the Atlantic Ocean originate both phenomena. Accordingly, microseismic registration can serve as a warning for the rise of the swell at the seashore.—*Dominion Observatory, Ottawa, Biblio. Seismology, no. 1, p. 3, 1947, revised by V. S.*

9781. Bodle, R. R., and Murphy, L. M. United States earthquakes, 1945: U. S. Coast and Geod. Survey, Serial 699, 38 pp., 2 tilt graphs, Washington, D. C., 1947.

This summary of earthquake activity during the calendar year 1945 in the United States and the regions under its jurisdiction covers non-instrumental results for various States and regions, geodetic work of seismological interest, tidal disturbances of seismic origin, seismological observatory results, strong-motion seismograph results, and tilt observations. The material includes tabulations of epicenters, strong-motion seismograph data, instrumental constants, and related information. It is illustrated by maps of earthquake distribution, of epicenters, and of affected areas, by tracings of accelerograph records, and by tilt graphs.—*V. S.*

9782. Boni, Alfredo. I terremoti dell'Appenino Vogherese-Tortonese e la geologia della regione [The earthquakes in the Voghera-Tortona region of the Apennines and its geology] : Geofis. Pura e Appl., vol. 10, nos. 3–4, pp. 114–143, Milan, 1947.

The author studied the earthquakes which occurred in this region on June 14 and 29 and on December 15, 1945, with shocks reaching an intensity of 7.5 grades. Both the macroseisms and the microseisms were investigated on the basis of seismograms received from the observatories of Pavia, Prato, Venice, Chur, Neuchâtel, Zurich, and Basel. Coordinates of the epicenters were determined following the method of Caloi. The epicenters fall within the region of the Apennines studied. The

depth of the hypocenter of the earthquake of June 14 could not be determined with certainty, but that of June 29 was found equal to 9 kilometers from the seismograms of the macroseisms and to 25 kilometers on the basis of the microseismic waves. The depth of the hypocenter of the earthquake of December 15 was equal to about 25 kilometers, determined microseismically. The movement of the focus of all three seisms was of a sinking type. In determination of the hypocenters the author quotes the pertinent formulas of Inglada and Gutenberg and expounds his own method applicable to this problem and useful in deep seismic exploration.

As a probable cause of the earthquakes the author assumes deep subterranean rock bursts giving rise to the seisms which follow. The great amount of damage caused by these earthquakes is, in his opinion, due to the thin alluvial formations in this region.—*S. T. V.*

9783. Bungers, Rolf. Analyse eines mikroseismischen Sturmes [Analysis of a microseismic disturbance]: Zeitschr. Geophys., vol. 17, pp. 114–135, Braunschweig, 1942.

Microseismic wave motion is interpreted by the author as a superposition of two trains of Rayleigh waves coming from different directions with constant amplitudes. Based on this conception a method is developed which makes possible the determination of the directions of arrival of these waves from the records of one seismological station having three-directional seismograms. The method is applied to the anaylsis of the seismic disturbance of March 5–6, 1938, as recorded on the Galitzin seismographs of the observatories of Stuttgart, Strasbourg, DeBilt, and Uccle. The records of all these stations reveal certain "principal directions" of microseisms.

The results of the analysis have confirmed the assumptions made by the author. Phase displacements and the ratio of the amplitudes agree very well with the theoretical values, fully justifying the physical meaning of the assumed Rayleigh waves. The "principal directions" established on the seismograms of Stuttgart and Strasbourg observatories point to the Norwegian coast as the probable center of the seismic disturbance. This is in accordance with the hypothesis that the microseisms are caused by the beating of the ocean waves against the rocky coasts. It is important to emphasize that the beginning of the microseismic disturbance coincided with high winds in this region.—*S. T. V.*

9784. Byerly, Perry. The periods of local earthquake waves in central California: Seismol. Soc. America Bull., vol. 37, no. 4, pp. 291–297, Berkeley, Calif., 1947.

A hypothesis exists that all geographic localities have their own "free periods" and that earthquake damage can be avoided by building structures having periods different from these free periods. With a view to its verification, a statistical study was made of 18,636 earthquake records traced by Wood-Anderson seismographs at the University of California stations. No shock of an epicentral distance greater than 600 kilometers was employed, and all periods were assigned to three groups—*P*, *S*, and Coda.

The number of observations found under each measured period is tabulated, various average periods are derived, and the frequency of

occurrence of periods of *P* and Coda is plotted in curves. The analysis of the results tends to show that the localities of the stations used have no free periods of their own. The crests of the frequency curves are nearly the same for all stations. Generally, the periods increase with the magnitude of the shocks.—*V. S.*

9785. Caloi, Petro. Attività sismice in Italia nel decennio 1930–1939 [Seismic activity in Italy during the decade 1930–1939]: R. accad. d' Italia, Commissione Italiana di studio per i problemi del soccorso alle popolazioni, vol. 9, 140 pp., Florence, 1942.

The results of a detailed study of earthquakes observed in different parts of Italy during the years 1930–39 are presented. For each earthquake, its time, its intensity at various points of observation, the amount of damage caused, and the coordinates of its epicenter and hypocenter are given. In an introductory chapter the author discusses different methods of determining the coordinates of the epicenter, especially the methods of V. Inglada and A. Mohorovičič. In discussing the problem of determination of the depth of the hypocenter the author explains his own method, which is also applicable to deep seismic prospecting. Numerous maps, tables, and seismograms accompany the text.

In a separate appendix of some thirty pages the author discusses the damaging effects of an earthquake on buildings and presents a tentative theory concerning vibrations generated in a structure by movement of the soil. Corresponding stresses in various portions of the structure are computed. The author also discusses specifications of the last Italian Building Code covering the regions suffering from seismic effects.—*S. T. V.*

9786. Christie, N. J. Reflection seismograph exploration in coastal waters: Mines Mag., vol. 37, no. 11, pp. 37–40, 66, Denver, Colo., 1947.

The author gives an outline of the development of marine seismic reflection surveying to its present stage. He finds it difficult to condense the research of several years into a paper of limited length but feels that the main problems and their solution have been covered in brief. Research is continuing, particularly in the surveying field, where there are chances of attaining a greater range and accuracy by nonvisual methods.

With the additional equipment and personnel required for this work, the cost of a sea-borne seismic crew exceeds by far that of most of the land crews in operation. However, the high production achieved on the water in recent years has brought the expense per profile to a figure comparable to that usual for land surveys.—*Author's summary, condensed by V. S.*

9787. Coster, H. P., and Gerrard, J. A. F. A seismic investigation on the outflow of Windermere: Geol. Mag., vol. 84, no. 4, pp. 224–228, Hertford, Hertfordshire, England, 1947.

Lake Windermere in England has an outflow through the narrow Leven Gorge and not through the broad Cartmel Valley on the floor of which it is formed. To determine whether an outlet through the valley had ever been possible and to estimate the thickness of deposits near the existing outflow, seismic refraction surveys were made by exploding

charges of gelignite and recording the oscillations of six geophones placed in line with the shotpoint. The teledeltos type of recording was employed, which makes use of a special paper decomposing under the action of electric current passing through the stylus. The surveys are described.

The results showed that, at its present level, the lake could not have flowed out through the Cartmel Valley, because the bedrock at one point is 52±9 feet above that level. The only possible outlet at anything less than 50 feet above the present level is through the Leven Gorge. Other observations are given.—*V. S.*

9788. Coulomb, Jean. Tensions engendrées dans le globe terrestre par son refroidissement [Tensions engendered in the terrestrial globe by its cooling]: Ann. Géophys., vol. 1, no. 2, pp. 171–188, Paris, 1945.

Jeffreys' generally accepted formulation of the theory of thermal terrestrial contraction refers almost exclusively to the earth's crust and presupposes a complete elasticity of the core. If this theory is to be extended to the deeper tensions causing deep-focus earthquakes, it must be adapted to materials at greater depths which are supposed to have a certain plasticity. Calculations made on the assumption of a fluid magma at great depth were used by Niskanen and others as a basis for the theory of the Scandinavian isostatic uplift which has led to important quantitative results.

The author calculates the deeper tensions produced in a viscous terrestrial globe by its cooling in the light of both theories, adopting values close to those of Jeffreys for the physical constants and values close to Hansen's estimates for the viscosity data. The calculations are presented. The results show that the tensions caused by thermal contraction in the earth supposed to be viscous are infinitesimal in comparison with the tensions produced by the Scandinavian uplift interpreted isostatically.—*V. S.* (*See also* Geophys. Abstracts 126, no. 8647.)

9789. Crabtree, R. W. History of explosives, present relation to seismograph work [abstract]: Geophysics, vol. 12, no. 3, p. 493, Tulsa, Okla., 1947.

A brief introductory outline is given of the history of explosives, with particular reference to the difficulties involved in the development of a seismic explosive capable of meeting the varied requirements of reflection shooting. Attention is then given to deep shot-hole shooting, effects of pressure on general characteristics of seismic power, possible changes in rate of detonation and sensitivity, and uses of strong electric caps. The effects of changes in rates of detonation are studied both in relation to improved reflections in so-called dead areas and to the size of charges. Vibrations and their possible effects on water wells and oil wells are taken into consideration. The subject of directed energy is discussed briefly with reference to the shaped charge and its possible use in seismic exploration.—*Revised by V. S.*

9790. Due Rojo, Antonio. La agitación microsismica de largo periodo en Granada [Microseismic disturbances of long period in Granada]: Rev. Geofis., vol. 6, no. 22, pp. 197–211, Madrid, 1947.

The author analyses the records of microseismic movements of long period (*0.5 to 2 minutes*) as registered at the Cartuja Observatory in Granada during the years 1939–46. After examination of *probable causes*

of such an oscillatory movement of the soil a hypothesis is advanced concerning the existence of a critical temperature level of the ground, below which periodic contractions of the soil produce the observed movement. Statistical data covering the amplitude and frequencies of such oscillations are presented, and the reasons confirming such a hypothesis are discussed.—*Author's abstract, revised by S. T. V.*

9791. Epinat'eva, A. M. On hodographs of reflected waves in the case of a vertical gradient of velocity [in Russian]: Acad. Sci. U.R.S.S. Bull. (Izvestiia), Sér. Géog. et Géophys., vol. 10, no. 1, pp. 101–114, Moscow, 1946.

The author deduces the equations of hodographs of reflected waves for one inclined contact surface and a constant vertical gradient of velocity in the overlying medium. The hodographs in this case have the form of smooth curves asymmetrical with respect to the vertical axis passing through their minimum point. The customary methods of interpretation, based on the assumption of a constant velocity in the overlying medium and yielding hyperbolic hodographs, are examined and illustrated by examples. It is found that they can be used only for small angles of surface inclination, small values of the vertical gradients of velocity, and hodographs of limited length.

In cases of large values and long hodographs, the construction of the reflecting boundary is shown to depend in part on the vertical gradient. An approximate method of such construction is described, and its precision is compared with that of the methods presupposing a homogeneous overlying medium.—*V. S.*

9792. Fu, C. Y. On seismic rays and waves, part 1: Seismol. Soc. America Bull. vol. 37, no. 4, pp. 331–346, Berkeley, Calif., 1947.

The equations of an elastico-viscous medium in which the material constants vary with position are deduced. These can be put into the form of a wave equation only when the gradients of the constants are small. By the method of Sommerfeld and Runge these equations are compared with the equation of the characteristic function, whence the condition for the validity of the ray method is obtained. It is similar to De Broglie's criterion in wave mechanics. Expressed in terms of measurable quantities in seismology, the condition is applied to the data recently obtained by Gutenberg for the upper layers of the earth's crust. The equation of the characteristic function is used in deriving the forms of the ray paths for several particular velocity functions, following a method previously used by Epstein.—*Author's abstract.*

9793. Gaby, P. P. Grading system for seismic reflections and correlations: Geophysics, vol. 12, no. 4, pp. 590–617, Tulsa, Okla., 1947.

The modern reflection seismograph places progressively more emphasis on continuous profiling, which automatically makes possible the computation of dip and the plotting of dip cross sections. Accordingly, a practical method is needed for sorting and grading the accuracy of dip indications and of correlation, which should be based on substantially the same fundamentals in each case and should be as free as possible from the vagaries of personal judgment.

A system is outlined which is adapted to both purposes. In evaluating dip attitudes, the grade indicates the certainty with which the event may be identified as a true reflection, and the accuracy of the indicated

dip. Similarly, in evaluating correlation, the grade indicates the certainty with which the events being correlated are known to be correlatives, and the accuracy of the indicated correlation drop.

These grades, placed on the cross section, serve as a guide in sorting out any conflicting information at the time the interpretation and map are made. The use of such grades allows the concentration of all pertinent information in one place where any conflicting evidence can be weighed in terms of relative merit.—*Author's abstract, condensed by V. S.*

9794. Gamburtsev, G. A. Waves generated in a solid elastic medium by a moving source [in Russian) : Acad. Sci. U.R.S.S. Bull. (Izvestiia), Sér. Géogr. et Géophys., vol. 10, no. 1, pp. 31–44, Moscow, 1946.

At the boundary between two layers the seismic waves of Mintrop are somewhat analogous to ballistic waves produced by a projectile. To take advantage of this analogy and facilitate the understanding of Mintrop waves, a study is made of the more representative case of waves produced in a solid, homogeneous, elastic, and isotropic medium by a source moving in it with a velocity exceeding the velocity of longitudinal waves. Stokes' and Love's mathematical analyses of the case of an immobile source, serving as the basis of the inquiry, are expanded and adapted to account for the motion of the source, a kinematic chart being employed to determine the forms of Stokes' solution for successive moments of the motion. The general problem is clarified by the example of a point moving with constant velocity along a straight line under the impact of an instantaneous force, which is of importance in the adaptation of Stokes' analysis. The relation of the discussion to Mintrop waves will be considered later.—*V. S.*

9795. Gassmann, Fritz. Anwendung der Fourier-Sätze in der Theorie der Seismographen und Schwingungsmessern [Application of Fourier's series in the theory of seismographs and vibrometers] : Elemente der Mathemat., vol. 2, no. 3, pp. 58–63, Zurich, 1947; author's abstract in Soc. Helvétique Sci. Nat. Actes, 126th sess., pp. 80–81, Aarau, Switzerland, 1946.

It is possible to develop further the application of Fourier's integral to seismogram study, discussed by W. T. Born and J. M. Kendall in 1941. The author shows that an analysis can be made of periodic seismograms by means of Fourier's series and of unperiodic seismograms, as well as of vibrograph records, by means of Fourier's integrals. When several systems with known frequency characteristics are combined, the composite frequency characteristics of the resulting system is the product of the frequency characteristics of the constitutent parts. This composite characteristic can be calculated when the motion of the seismograph is given in the form of a linear differential equation with constant coefficients.—*V. S.* (For the paper by Born and Kendall *see* Geophys. Abstracts 106, no. 6193.)

9796. Gutenberg, B., and Richter, C. F. Seismicity of the earth [abstract] : Geol. Soc. America Bul., vol. 58, no. 12, pt. 2, p. 1252, Baltimore, Md., 1947.

Previous results are revised and extended. Most of the former conclusions are notably strengthened. Over 2,000 shallow shocks and about 1,000 deep-focus shocks are located. Magnitudes of deep shocks

are assigned for the first time. Ninety-two great earthquakes (magnitudes, 7.75 or over) have been identified for 1904–45, and 334 major shocks (7.0 to 7.7) for 1918–45. Geographical results are presented in a new set of maps.

The earth's surface consists of relatively inactive blocks separated by narrow active zones. The largest such block is the stable Pacific mass; each of the others includes a stable continental shield. The highest seismicity is associated with folding and thrusting in the structural arcs of the circum-Pacific belt. Those of the Alpine belt are less active. Both belts include sectors where the dominant processes now are block faulting and horizontal shearing. In other seismic belts these are the principal processes; active arcs are absent. The remarkable repetition of earthquakes from nearly the same hypocenters under the Hindu Kush (depths about 230 kilometers) and the Carpathians (depths 100–150 kilometers) suggests exceptional local conditions.

9797. Heinrich, R. R. The Ozark earthquake of October 8, 1946: Am. Geophys. Union Trans., vol. 28, no. 5, pp. 687–690, Washington, D. C., 1947.

On October 8, 1946, an earthquake was felt throughout an area of about 25,000 square miles in eastern Missouri, western Illinois, and northwestern Kentucky. The epicenter, determined from seismographic data, is in southeastern Iron County about midway between the towns of Chloride and French Mills, Missouri (37°28'N., 90°34'W.; $H=01^h12^m02.5^s$ U. T.). This point is roughly 50 miles northwest of the New Madrid seismic district. The epicenter is in the vicinity of the Hogan fault, which is postulated as delineating the southwest side of the structural block of the St. Francois Mountains (the major structural and physiographic unit of the northeastern Ozark Highlands).—*Author's abstract, condensed by V. S.*

9798. Hill, M. N., and Willmore, P. L. Marine seismic prospecting: Nature, vol. 159, no. 4047, pp. 707–708, London, 1947.

Marine seismic prospecting in deep water is handicapped by the difficulty of placing instruments and explosives on the sea bottom. Observations during the war indicated that it may be possible to overcome such handicaps by keeping instruments suspended in the water and by obtaining a transmission of the seismic waves from the bottom. This method has been tested by the authors, who compared the signals received by a geophone on the bottom with those received by a hydrophone in the water.

A moving-coil geophone was laid on the bottom, a quartz-crystal hydrophone sensitive only to pressure changes was suspended about 40 feet below the survey ship, and the output of each instrument was recorded at two levels of sensitivity by means of an Einthoven galvanometer. The arrangements are described, and a tracing is reproduced to illustrate the records.

The results showed that the arrivals of the ground wave are well defined and that the ratio of pressure to velocity agrees to within a factor of 2 with the theoretical value for plane waves in an infinite medium. The method is recommended for use in deep ocean.—*V. S.*

9799. Hodgson, J. H. An investigation into the value of the seismic methods in delineating structure in southwestern Ontario: Ontario Dept. Mines Ann. Repts., vol. 56, pt. 4, 32 pp., Toronto, 1947.

The discovery of new natural-gas fields in southwestern Ontario has failed lately to keep pace with production, and the gravitational and magnetic methods applied as aids to exploration have been largely unsuccessful (*see* Geophys. Abstracts 120, no. 7788). Accordingly, the author tested seismic methods in 1945–46, choosing the areas of Malden, the Camden Gore field, the Malahide field, and other localities considered typical of this part of Ontario. The principles of seismic methods, the local geology, the field work, and the results obtained are described.

Seismic refraction, employed for overburden determination, usually indicated two or three layers in the drift, with velocities ranging between 6,000 and 8,000 feet per second in zones below the low-velocity surface layer. Seismic reflection, applied for delineating structure, failed completely in almost all the areas tested, because no reflections were recorded. The failure appeared to be due both to subsurface and surface conditions, particularly to the presence of shale bedrock in some cases and of thick drift in others. The various causes are analyzed. It is concluded that seismic methods cannot be used to advantage in southwestern Ontario.—*V. S.*

9800. Housner, G. W. Ground displacement computed from strong-motion accelerograms: Seismol. Soc. America Bull., vol. 37, no. 4, pp. 299–305, Berkeley, Calif., 1947.

The author has made a comparative study of records obtained during the earthquake of October 2, 1933, by means of strong-motion accelerographs and ground-displacement meters at the same installation in Los Angeles, California. In the case of the accelerogram the ground velocity and ground displacement were computed by twice integrating a pantographic enlargement with a mechanical integraph. The initial shock was not recorded because of late triggering, and the base line necessary for integration had to be inferred from the zero position of the ground velocity. Other details of calculations are given.

The data derived for the components of the accelerogram and for the ground displacement made it possible to compare the curves of the computed and the recorded ground displacements. The results showed that a reasonable agreement exists between recorded ground acceleration and recorded ground displacement. Evidence was also found that a long-period ground displacement of relatively large magnitude may have taken place without being recorded by the ground-displacement meter.—*V. S.*

9801. Imperial Oil Review. Mountainside seismology: Vol. 31, no. 6, pp. 32–39, Toronto, Ontario, 1947.

Equipment used in seismic prospecting for oil in the Alberta foothills of the Rocky Mountains during the winters of 1945–47 is described briefly, and fundamentals of the seismic method are explained. On the densely forested mountain front, explored at an altitude of 5,000 to 6,000 feet, the cold was severe, and the powdery snow formed drifts 2 to 6 feet deep. Insulated trailers had to be built to house the crew; bulldozers were employed to make roads; water trucks coated with felt contained coiled exhaust pipes inside the tanks; and a tentlike cover with

a heater was used for the drilling truck. The cost of the crew was as high as $25,000 per month, compared with $13,000 to $16,000 on the plains.—*V. S.*

9802. Inglada, Vicente. Los ciclones y la agitacion microsismica [Cyclones and microseisms]: Rev. Geofis., vol. 6, no. 21, pp. 1–30, Madrid, 1947.

This part of Inglada's study discusses the investigations by J. Emilio Ramirez in 1938 on the nature and origin of microseisms (*see* Geophys. Abstracts 102, no. 5638) and gives a detailed description of the tripartite installation used for the measurement of seismic waves, as well as a description of the microbarographs used for the registration of pressure variation of the air. This is followed by a discussion of the study by D. L. Leet, Analysis of New England microseismic waves. (*See* Geophys. Abstracts 131, no. 9575.) A detailed description is given of the investigations by the United States Navy in 1944 and 1945 under the direction of M. H. Gilmore in Cuba, Puerto Rico, and Florida. (*See* Geophys. Abstracts 126, no. 8681.) On the basis of these studies Inglada concludes that many hurricanes registered on the maps of the U. S. Weather Bureau have produced intensive microseisms two or three days earlier in Puerto Rico. He states that the exploration of cyclones by measurement and registration of the microseismic oscillations has been successful, making possible an accurate prediction of the hurricanes. The seismograph has ceased to be an instrument for academic study, but has become a tool of applied physics.—*S. T. V.*

9803. Jones, O. A. The detection and tracking of cyclones off the Queensland coast: Australian Jour. Sci., vol. 10, no. 2, pp. 43–44, Sydney, 1947.

Cyclones cause much damage in Queensland, so that the early detection of their direction and speed is of great importance. As long ago as 1938, W. Bryan and E. Riek found in the seismograph records of the University of Queensland evidence of correlation between cyclones and microseisms. Subsequent investigations conducted along these lines by the U. S. Navy during the second world war achieved a large measure of success in the prediction and tracking of hurricanes. The methods, instruments, and results of the latter work are described on the basis of the papers of Macelwane, Sprengnether, and Gilmore, and desirable applications in Queensland are discussed briefly.—*V. S.* (*See also* Geophys. Abstracts 126, nos. 8681, 8682, 8694, and 8702.)

9804. Jones, W. M. Additional table of direction-cosines, for latitudes 41°–90°: New Zealand Jour. Sci. Technology, vol. 28, no. 5B, pp. 292–295, Wellington, 1947.

The table previously published, designed mainly for seismological work in the Pacific, giving direction cosines at 1° intervals in latitude and longitude, with a range of 60° in longitude, is here extended to cover the latitude range 41° to 90°.—*Author's abstract.*

9805. Kosminskaia, I. P. Application of the method of time fields in the case of variable seismic velocity [in Russian, with English summary]: Acad. Sci. U.R.S.S. Bull. (Izvestiia), Sér. Géog. et Géophys., vol. 10, no. 5, pp. 455–462, Moscow, 1946.

Application of the method of time fields to the two-dimensional interpretation of seismic hodographs is discussed for the case in which the

velocity is variable and a function of points on a rectilinear axis. The solution is achieved by constructing seismic-ray diagrams for the determination of Huyghens' fronts and by using the envelopes as isochrones of the time fields.

If a medium is composed of two parallel layers and the time curve is given for the velocity isoline, Huyghens' fronts can be obtained with the aid of a single ray diagram. If the time curve is given for an arbitrary line, families of Huyghens' fronts must be constructed by means of a separate ray diagram for each point.

In the case of a multilayered medium with arbitrary boundaries of separation, a time curve given for the X-axis can serve for the construction of isochrones in the n-th layer by means of a successive determination of systems of isochrones in each of the higher layers. The methods described are applicable to the interpretation of both refraction and reflection data.—*V. S.*

9806. Ladd, H. S., Tracey, J. I., Lill, G., Wells, J. W., and Cole, W. S. Drilling on Bikini Atoll, Marshall Islands [abstract]: Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, pp. 1201–1202, Baltimore, Md., 1947.

During a resurvey of Bikini Atoll in the summer of 1947, five holes totaling 4,510 feet were drilled on Bikini Island. One hole located on the seaward side of the island was drilled to 300 feet; three others on the lagoon side to 190, 1,346, and 2,556 feet; and a fifth hole at the south end of the island was drilled to 117 feet. Core recovery was fair above 300 feet but very poor at greater depths. A total of 812 feet was cored with a recovery of 135 feet (16.6 percent). Cuttings were collected at 5-foot to 10-foot intervals.

Preliminary studies show that late Tertiary corals and mollusks were encountered at 930 feet, and the top of the Tertiary section may be considerably higher. At a depth of 1,305 feet larger Foraminifera indicate a horizon well down in the Miocene. A total of 72 velocity determinations were made in the deepest hole at depths of 1,820 to 50 feet to aid in interpreting geophysical data obtained in 1946.—*Condensed by V. S.*
(For seismic data obtained in 1946 *see* Geophys. Abstracts 130, no. 9377.)

9807. Long, G. J. A velocity analysis of the east Coalinga nose area of California [abstract]: Oil and Gas Jour., vol. 45, no. 47, p. 126, Tulsa, Okla., 1947.

This paper describes a method which was used to apply a velocity correction to seismic reflection data obtained on the east flank of the Coalinga nose in Fresno County, California. Velocity information gathered from two well surveys within the prospect indicated the presence of lateral variations in vertical velocity of sufficient magnitude to cause errors in depth calculations in excess of 500 feet at horizons of interest. Velocity determinations were shot with the use of the $X^2=T^2$ method to supplement the well information. Using the latter data it was possible to construct variable brachistochrones from which each profile was calculated on the basis of an individual vertical velocity function. The purpose of the work was to outline the limits of production of an existing field of the stratigraphic type. The results indicated that this was done satisfactorily.

9808. Lynch, W. A., and Dillon, Vincent. Characteristics of Alaskan earthquake records at distances of 40° to 70°: Seismol. Soc. America Bull., vol. 37, no. 3, pp. 181–195, Berkeley, Calif., 1947.

One hundred and twenty-four Alaskan and Aleutian earthquakes have been recorded at Fordham in the years 1928–44. The Galitzin-Wilip three-component seismograph recorded 84 of these well enough to supply a basis for the present study. All epicenters lie at about the same azimuth with respect to Fordham, between 311° and 325°, and at distances of from 40° to 70°; the waves reaching Fordham therefore traveled over much the same continental path.

P was often late in terms of Macelwane's tables; emergences and impulses were almost equal in number, the former predominating slightly; often, an emergence was soon followed by a sharp impulse. *S* was usually sharp on both horizontals. No evidence of False *S* was found. Reflected phases were not prominent in the records, PR_1 being recorded on only about 20 percent of them, SR_1 on about 30 percent. The surface waves were confused and difficult to identify; only very general conclusions can be drawn about them, the most significant being a dominant period of 13.5 seconds in the coda.—*Authors' abtract.*

9809. Macelwane, J. B. When the earth quakes, 288 pp., Milwaukee, Bruce Pub. Co., 1947.

This book presents in nontechnical language the wealth of knowledge that has been gleaned from the scientific study of earthquakes and of their related phenomena, both natural and man-made. The author begins with a description of the earthquakes as they are seen and felt, illustrating different kinds of earthquakes with numerous photographs that show their effect on land and sea and on structures built by man. Following chapters are devoted to a discussion of the nature and causes of earthquakes and their relation to other geological processes, and to a description of different kinds of earthquakes, their intensity and distribution over the globe. The author discusses ultimate causes of earthquakes—shortening of the earth's crust by cooling and contraction, phenomena postulated by the theory of isostasy, and other factors. This is followed by a description of the methods of studying earthquakes with instruments, an account of the mechanics of propagation of seismic waves through the earth; and a discussion of the determination of the epicenter and hypocenter. Closing chapters are devoted to engineering seismology, to the study of the effects of earthquakes on structures, and to seismologic methods of exploring the ground with seismographs.—*S. T. V.*

9810. Medina, M. A. Sobre el origen de los batisismos [Concerning the origin of deep-focus earthquakes]: Rev. Geofis., vol. 6, no. 21, pp. 31–54, Madrid, 1947.

The article presents a hypothetical explanation of the geologic factors causing deep-focus earthquakes. After summarizing the most important concepts of modern geology regarding the constitution of the terrestrial crust in both continental and Pacific hemispheres, the author gives an account of the simatic subcrustal currents, caused by processes of radioactive disintegration, which are taking place deep in the earth's crust. The deep-focus seisms are assumed to originate in the following way: The simatic currents, which under the circumpacific continents flow

towards this great ocean, drag along in their movement the plastic sima and create a vortex at a depth of some 700 kilometers. Displacements of these huge masses create high stresses in the cross sections around the turning point of the vortex. These stresses can in certain cases cause a break of the moving sima, producing violent seisms by an elastic rebound. Localization of the deep seisms in the circumpacific coasts is explained by the existence of a very thin layer of sial on the bottom of the ocean. On the contrary, in the continental half of the globe the subcrustal currents cannot attain large proportions. A possible exception is the Himalyan Ridge, the formation of which can be explained by a current of simatic origin similar to the one described.—*S. T. V.*

9811. Mindlin, J. A. Propagation of waves over the surface of a circular cylinder of infinite length: Acad. Sci. U.R.S.S., Comptes Rendus (Doklady), vol. 52. no. 2, pp. 107–110, Moscow, 1946.

In investigating plane waves of a simple harmonic type propagated axially in a circular cylinder of infinite length, Pochhammer and Chree applied a frequency equation and found that, when the limit of the ratio of cylinder radius to wave length is zero, the velocity of waves over the cylinder surface is equal to the square root of the ratio of Young's modulus to density.

The writer reduces the frequency equation to a form demonstrating that, when the product of frequency and cylinder radius tends to approach infinity, the velocity of the surface wave becomes equal to the velocity of the Rayleigh wave. He also shows, by using a method previously applied to free elastic waves in a pipe of infinite thickness, that the frequency equation has one, and only one, root when the velocity of the surface wave is less than the velocity of the transverse wave but greater than the velocity of the Rayleigh wave.—*V. S.*

9812. Montandon, F. Les séismes du Valais en 1945 et 1946 [Seisms in the Valais during 1945 and 1946]: Rev. Étude des Calamités, vol. 9, pp. 50–63, Geneva, 1946.

Macroseismic studies are made of the earthquakes of November 10, 1945, January 25, 1946, and May 30, 1946, in the Valais, Switzerland. The author compares these seismic disturbances to a push of the earth's crust in a northwestern direction.—*Dominion Observatory, Ottawa, Bibliog. Seismology, no. 1, p. 10, 1947.*

9813. Moran, R. B., Jr. Spiral sweep oscilloscope timer: Electronics, vol. 20, no. 10, pp. 120–123, New York, 1947.

The spiral-sweep oscilloscope determines time differences between the initiation of two or more positive pulses with an accuracy of 0.05 microsecond by photographing their display on a single spiral trace revolving once every 2 microseconds and having a total length of 25 to 100 microseconds. The apparatus is described, and the interconnections of its principal circuit elements are illustrated by diagrams.—*V. S.*

9814. Morelli, Carlo. I terremoti in Albania [Earthqakes in Albania]: R. accad. d' Italia, Commissione italiana di studio per i problemi del soccorso alle popolazioni, vol. 10, no. 2, pp. 1–22, Rome, 1942.

This a historical and physical study of the earthquakes that have occurred in Albania through 1940. Albania is a most interesting region

for the seismologist, because of all European countries it has had the greatest number of disastrous earthquakes. The author subdivides the country into three zones, each one with distinct seismic characteristics. In the absence of seismic observatories in Albania the results of the study are to be considered as approximations. The results have been embodied in a seismic map of Albania, drawn on a scale 1 : 600,000. Several smaller maps give isoseismic lines of individual earthquakes.—*S. T. V.*

9815. Nevolin, N. V. On the problem of the geological structure and oil possibilities of the near-Caspian depression: Acad. Sci. U.R.S.S. Comptes Rendus (Doklady), vol. 55, no. 8, pp. 739–741, Moscow, 1947.

An analysis of new seismic data and a revision of the older geological and geophysical information are used to derive new conceptions of the geological structure and the oil-bearing possibilities of the near-Caspian depression. The most promising areas for oil production are considered to be the salt-domes and underlying structures. A map of the region, longitude 45–55° E., latitude 50° N., shows Stalingrad, Astrakhan, the Caspian Sea, Orsk, Uralsk, and Saratov, and indicates the locations of salt domes.—*G. H. B., Inst. Petrol. Jour., vol. 33, no. 286, p. 354A, London, 1947.*

9816. Poli, Silvio. Prospezione sismica in forme elementari di terreno accidentato [Seismic prospecting over a broken terrain, reducible to simple geometric forms]: Istit. Geofis. Trieste, Pubbl., no. 132, 32 pp., Trieste, 1939.

In seismic prospecting it is usual to consider the terrain between the point of explosion and the seismometric station as a plane surface. Quite often this is a very rough approximation to reality. To refine the method the author considers ten cases of deviation of the terrain from the plane, each one represented by a simple geometric configuration, reducible to rectangular and triangular forms. For every case he determines the travel time of the direct and reflected waves. Comparing the value of the travel time so obtained with that resulting from the simplified assumption of a plane terrain, it is possible to determine the influence of the ruggedness of the terrain. Thus it becomes possible to solve the inverse problem: from the observed travel time on a given uneven terrain, to find the depth of the reflecting layer in the ground.—*S. T. V.*

9817. Raitt, R. W., and Johnston, T. F. Transmission of explosive impulses in the sea [abstract]: Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, p. 1269, Baltimore, Md., 1947.

Underwater explosions produce short, intense, steep-fronted pressure pulses that have proved useful in the study of underwater transmission. Observations made at sea near San Diego by using electric blasting caps as sound sources demonstrate a number of significant features of sound transmission in the sea. During the measurements, the sea temperature near the surface generally decreased with depth, causing downward refraction of the sound rays. A theoretical "shadow zone" is cast by the sea's surface under these conditions. Oscillograms of the received pulses fall into three general classes, which are described.—*Condensed by V. S.*

9818. Richter, C. F. The Manix (California) earthquake of April 10, 1947: Seismol. Soc. America Bull., vol. 37, no. 3, pp. 171–179, Berkeley, Calif., 1947.

Instrumental epicenter and origin time for the Manix earthquake are 34°58′ N., 116°32′ W., 07 : 58 : 04 P. S. T. (15 : 58 : 04 G. C. T.), April 10, 1947. The probable error of location does not exceed a few kilometers. Certain aftershocks originated south of the main shock. Initial recorded compressions and dilatations are consistent with left-hand strike slip on a previously identified fault which trends about N. 70° E. Trace phenomena, to be reported later, were produced. Other effects, including damage, in the heavily shaken area are described.—*Author's abstract.*

9819. Riznichenko, Iu. V. Geometric seismology of stratified media [in Russian, with English summary] : Inst. Teor. Geofiz. Trudy, vol. 2, no. 1, 114 pp., Moscow, 1946.

The fundamental problems of the interpretation of seismic hodographs obtained in exploration by methods of reflected waves, refracted waves, and borehole observations are discussed in the light of the historical development of these techniques and the current practices. Consideration is given to the elements of seismogram analysis, relationships between reflections and refractions, and questions of correlation.

To advance the interpretation of multilayered media with complex boundaries of separation, an extensive inquiry is made into the foundations of a general method of time fields valid for different types of hodographs. The underlying equations, the principle of the time field, and the generalized hodograph are examined, and the construction of the field from a given hodograph is considered for the general case of a multilayered medium and for a homogeneous medium. Theoretical analysis is followed by a discussion of the application of the method to the interpretation of reflected, refracted, and borehole hodographs in exploration. A bibliography of 275 entries is appended.—*V. S.*

9820. Robinson, H. B. Recent earthquakes in Lassen Volcanic National Park [abstract] : Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, p. 1269, Baltimore, Md., 1947.

A swarm of earthquakes, many of which were felt locally, were recorded by the seismograph at Mineral from April 29 to May 5, 1946. The swarms started again early in June and continued into August. The sharpest quake was of such intensity that campers in the park, thinking Lassen Peak was erupting, left the area during the night. Based on existing faults, renewed hot-spring activity, local reports on felt quakes, and *S-P* intervals measured on seismograph records from Shasta Dam and Mineral, the source of these shocks appears to be in the Warner Valley section of Lassen Volcanic National Park.

9821. Rothé, J. P. Seismes et volcans [Seisms and volcanoes], 135 pp., 23 figs., Paris, Presses Universitaires de France, 1946.

An account is given of present-day knowledge of earthquakes and volcanoes. The contents cover macroseisms, seismic waves, structure of the earth, seismic geography, causes of deep-focus quakes, convection currents, and volcanology. The remoteness of the relation between

seismic and volcanic phenomena is emphasized. Presentation is intended primarily for the layman.—*V. S.* [A review appeared in Soc. Belge Géologie Bull., vol. 55 (1946), nos. 2–3, pp. 315–316, Brussels, 1947.)

9822. Rupnik, J. J. The constant level datum plane in areas of rough topography: Mines Mag., vol. 37, no. 11, pp. 63–64, Denver, Colo., 1947.

The use of a constant-level datum plane is advantageous in seismic reflection surveys over rough terrain, because the distance between the shot level and the datum level may increase owing to changes of elevation to the extent that variation of subweathering velocity over large areas renders an accurate choice of velocity difficult.

The error involved in using an unsuitable subweathering velocity is calculated for a theoretical case in which shot depths and datum elevations are shifted in position so as to obtain between them a distance ranging from +350 to −350 feet over 50-foot intervals. The analysis gives formulas for positions of the datum above shot level and the datum below shot level, with the use of which a graph is plotted of the amount of error for different shot to datum distances when the unweathered velocity deviates from a standard velocity of 6,000 ft./sec. The results show the need of a frequent check on changes in subweathering velocity when a constant datum plane is used for a variety of shot elevations.—*V. S.*

9823. Savarenskii, E. F. A diagram for the interpretation of deep focus earthquakes [in Russian, with English summary]: Seismol. Inst. Trudy, no. 114, 6 pp., Moscow, 1946.

A diagram is presented for the interpretation of deep-focus earthquakes, so plotted that the intervals *S-P* and *pP-P* or *sP-P* are arguments and epicentral distance and depth of focus are functions. Accordingly, any deep earthquake is represented by a point with coordinates *S-P* and *pP-P* or *sP-P*. By virtue of such a construction, the curves drawn for equal distances and for equal depths may be used for the determination of Δ and h, and a line joining two equal marks of *sS-P* lying on adjacent isobaths must pass through the point with coordinates *S-P* and *pP-P*. The principles and construction of the diagram are explained, and numerical examples are given.—*V. S.*

9824. Scholte, J. G. On the propagation of seismic waves, parts 1–2: Kon. Nederland. Akad. Wetensch. Proc., vol. 49, no. 10, pp. 1115–1126, vol. 50, no. 1, pp. 10–17, Amsterdam, 1946–47.

A calculation is made of the seismic movement caused by a normal pressure periodic in time and uniformly exerted on the surface of a monostratified medium. The method consists in the application of two Fourier integrations.

The first integration is used to transform the pressure distribution into a pressure concentrated in a point, and the corresponding surface movement is found by application of the saddle-point integration method. The results show that, at epicentral distances comparable to the depth of the layer, the same waves occur as in the case of a homogeneous medium. In addition to these waves several kinds of reflected wave systems reach the surface. As the distance increases, generalized Rayleigh waves begin to predominate.

The second Fourier integration changes the periodic normal pressure into a pressure lasting only a finite time. The amplitudes of the first impulses and the travel times of the major parts of the movement are calculated.

The method employed for the investigation is generally applicable to the propagation of seismic waves in any horizontally stratified medium. The calculations are presented.—*Author's summary, condensed by V. S*

9825. Sieberg, August. Neuere Untersuchungen der Reichanstalt für Erdbebenforschung Über bautechnische Erdbebensicherungen ?Recent investigations of the State Institution for Earthquake Studies concerning the safety of structures against earthquakes]: Zeitschr. Geophysik. vol. 17, no. 3–4, pp. 84–102, Braunschweig, 1941.

Study of the complicated mechanical problems connected with the effects of an earthquake on structures is necessary. The results of older experiments on models do not agree with the observed action of earthquakes on buildings. One of the causes of this discrepancy is the use of sinusoidal impulses in experiments with models, whereas the earthshocks have a very steep wave front. Recently the "oscillating table" of older experiments has been replaced by a "jerking table." Experiments were made on some models built of usual masonry and on others built of bricks without the use of mortar. The latter give an exaggerated picture of the results of the shocks.

The results of numerous experiments are presented in photopictures of the consecutive phases of destruction. Experiments were supplemented by extensive studies of the damage done by earthquakes to buildings in different countries. The author warns against overoptimism and declares that no building of any size can be considered entirely resistant to the destructive action of an earthquake. The author also discusses the influence of the subsurface geologic factors on the safety of buildings during an earthquake.—*S. T. V.*

9826. Sprengnether, W. F., Jr. Horizontal and vertical-component seismographs: Seismol. Soc. America Bull., vol. 37, no. 2, pp. 101–105, Berkeley, Calif., 1947.

Four new models of seismographs designed by the author are described and illustrated. The vertical-component seismometer, Series H, is an improved model of the short-period electromagnetic seismometer built for St. Louis University in 1940; it is essentially a vertical pendulum of the Galitzin type. The vertical-component seismometer, Series D-H, is a less expensive version of the Series H model, with many of the features retained. The long-period horizontal-component seismometer, Series D-H, was developed in 1946 as a low-priced instrument usable both for research and for public demonstration of earthquake recording. The short-period horizontal-component seismometer, Series D-H, differs from the long-period model essentially in that the mass of the boom is concentrated near the hinge line.—*V. S.*

9827. Staniukovich, K. P. On the reflection of a detonation wave front: Acad. Sci. U.R.S.S. Comptes Rendus (Doklady), new ser., vol. 52, no. 9, pp. 771–772, Moscow, 1946.

To determine the reflection of a detonation wave front from an absolutely rigid wall, use is made of the continuity equation, the con-

servation of impulse equation, and the energy equation written for the incident wave and modified by changes of the indices of parameters and the sign of the velocity to express the reflected wave of normal incidence. Further transformations of these and related equations give expressions of the velocity of the reflected wave and of the pressure and specific volume on the front of the wave. Specific values are calculated for certain explosives. It is found that the ratio of the pressure of the reflected wave to that of the incident wave is almost independent of the polytropic exponent.—*V. S.*

9828. Vadanianc, L. A. Earthquakes in the Caucasus and deep geology [in Russian: Izvestiia Vsesoiuznogo Geograficheskogo Obschestva, vol. 78, no. 2, pp. 201–206, Moscow, 1946.

The earthquakes that have occurred in the Caucasus can be divided into two groups. The first group corresponds to the class of "normal" earthquakes, as defined by Gutenberg and Richter. The hypocenters of this group have a depth of 27±5 kilometers. Thus the Caucasus occupies an intermediate position between the Crimea, where the depth of hypocenters is 21±5 kilometers, and Central Asia, where this depth is 30±5 kilometers. The focal plane of the Caucasian earthquakes coincides very nearly with the boundary surface between the sialic (granitic) and basaltic layers of the earth's crust. This shows that the thickness of the granitic layer beneath the Caucasian mountains is less than that beneath Central Asia.

The earthquakes of the second group correspond to the type called "intermediate" by Gutenberg and Richter. Their depth of focus is greater, attaining on the average 70 to 90 kilometers, but in no case is it greater than 150 kilometers. Seismographic observations confirm the assumption previously made about the existence here of several foci distributed along the main tectonic faults. The greatest seismicity occurs in the Akhalkalaki-Borzhomi region, where according to geologic theory the ancient Crimea-Caucasus-Iran delineation zone crosses the more recent Ponto-Taurian.—*S. T. V.*

9829. Vesanen, Eijo. Tibet-maanjäristys 23.X.1943 [The earthquake of October 23, 1943, in Tibet], with German summary: Terra, vol. 57, no. 3, pp. 100–107, Helsinki, 1945.

The author determines the location of the epicenter of the earthquake of October 23, 1943, in Tibet, Asia, by his seismogram type analysis. This method is based on a previously developed geographic subdivision of the earth's surface into epicentral regions, each characterized by its own distinctive type of seismogram. The procedure consists in classifying the seismogram of an earthquake under one of these types on the basis of its structural characteristics, thereby referring the earthquake to the type region of its origin (*see* Geophys. Abstracts 121, no. 7985). Such an analysis of the imperfect seismogram recorded in Helsinki on October 23, 1943, located the earthquake in southeastern Tibet and assigned to its epicenter the coordinates 96° E., 25° N. The seismological stations of Fordham and Jena at that time has tentatively placed the earthquake in southern Japan, India, or the Sea of Okhotsk.—*V. S.*

9830. Wolf, Alexander. Refraction surveying of salt domes: World Oil, vol. 127, no. 7, pp. 120–125, Houston, Tex., 1947.

In the exploration of the floor of the Gulf of Mexico for oil, test drilling is likely to encounter salt at times. For the determination of the position and shape of the domes thus revealed the author suggests the seismic refraction method of McCollum, pointing out that seismic reflection is not suitable for such purposes. The penetration and precision of McCollum's method are increased by the use of a seismometer lowered into the drill hole.

The instrument employed is a special three-component seismometer which can respond to waves arriving along a nearly horizontal trajectory, as often happens in investigations by this method. Shotpoints are disposed at intervals of 2,000 to 3,000 feet along lines radiating from the well, and shots are fired from all points along each line to a series of positions of the seismometer in the well, when the well is drilled into the salt. The determination of salt boundaries for the mapping of domes is discussed and illustrated by diagrams.—*V. S.*

4. ELECTRICAL METHODS

9831. Arzeliès, Henri. Sur le calcul de l'énergie électromagnétique dissipée dans un milieu absorbant selectif [Concerning the calculation of electromagnetic energy dissipated in a selectively absorbing medium]: Annales de Physique, ser. 12, vol. 2, pp. 536–554, Paris, 1947.

Dissipation of energy by a plane electromagnetic wave propagated in any selectively absorbing medium is studied mathematically in the light of a theory of reflection deduced by the author from the ionic hypothesis. It is found that in the problem of one surface of separation the equations of dissipated energy for both cases of polarization of the incident wave can be deduced either indirectly, by conventionally utilizing the Poynting flux vector, or directly, by calculating the work of vibrating ions by means of the equations of mechanics. The first method can furnish the energy dissipated in a given volume as a difference between the entering flux and the issuing flux, whereas the second method is believed to have the advantage of demonstrating the mechanism of the phenomenon and of checking calculations made by the first method. Consideration is further extended to the cases of parallel plane surfaces and prisms.—*V. S.*

9832. Bays, C. A., and Buhle, M. B. Ground-water exploration by electrical resistivity methods [abstract]: Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, pp. 1271–1272, Baltimore, Md., 1947.

The electrical-resistivity method is used primarily for the location of shallow water-bearing sand and gravel deposits in glacial drift and alluvium. The method delineates these deposits and provides the basic information for the economic location of test holes. Portable instrumentation using modified Gish-Rooney equipment with Wenner electrode configuration has proved the most useful method of field operation. Rapid and inexpensive surveying of areas of potential water-producing terrain is possible. Interpretation of the indirect electrical data is based on the available knowledge of the geologic conditions in any area tested and on the use of a number of empirical graphic methods of analysis.

9833. Bossolasco, Mario. Sulle correnti telluriche nelle regioni equatoriali [On telluric currents in equatorial regions]: Geofis. Pura e Appl., vol. 10, no. 1–2, pp. 41–53, Milan, 1947.

The paper deals with the results of observations of earth currents made at Mogadiscio during 1933. The analysis reveals elements for a new picture of the distribution of earth currents in the equatorial regions, particularly concerning the daily variation.—*Author's abstract.*

9834. Buchheim, W. Die Bestimmung des spezifischen elektrischen Widerstandes von anisotrop leitenden homogenen Medien nach der Vier-Punkt-Methode [Determination of the specific electric resistance of homogenous anisotropic conducting media using the method of four-point readings]: Geofis. Pura e Appl., vol. 10, no. 3–4, pp. 102–113, Milan, 1947.

The author discusses the determination of the specific electric conductivity of an anisotropic medium important in electrical prospecting. The conductivity of such a body can be represented by a tensor of the second rank. For three "principal" directions determined by the petrographic properties of the medium, the apparent specific conductivity, measured parallel to one of the principal directions of the conductivity tensor, is equal to the geometric mean of specific conductivities in two other principal directions. From this property can be derived the important relation for the determination employing the four-point method, namely, that the true principal specific resistances of an anisotropic conductor are inversely proportional to the squares of the apparent ones, measured parallel to the corresponding principal directions. In most cases the rock has the two specific resistances equal and the third principal value perpendicular to those. This simplifies the problem and makes necessary the determination of just two specific resistances. The author warns against the use of the apparent values even as approximations.—*S. T. V.*

9835. Epstein, P. S. Radio-wave propagation and electromagnetic surface waves: Nat. Acad. Sci. Proc., vol. 33, no. 6, pp. 195–199, Easton, Pa., 1947.

The propagation of radio waves along the surface of the earth was first investigated by A. Sommerfeld, who found that the Hertzian vector of an electromagnetic field comprises space waves and a surface wave. Later H. Weyl obtained a solution which contained only the space waves, and Sommerfeld agreed that the surface wave does not exist in this case.

The author demonstrates that both results are mathematically correct but represent two different physical phenomena. He shows that Sommerfeld's analysis allows also a second solution which does not contain the surface wave, but that the difference between the two possible solutions can serve as a basis for a third solution which represents a surface wave independent of the dipole radiation and not generated by the dipole.—*V. S.*

9836. Fritsch, Volker, and Forejt, Heinrich. Die Anwendung des Druckindicators in der Funkmutung [Use of a pressure indicator in radio prospecting]: Zeitschr. Geophys., vol. 17, pp. 217–225, Braunschweig, 1942.

Measurements of many quantities often can be made more precise and more convenient by replacing mechanical methods by electrical ones. By causing the length of a body to influence the capacity of an electrical

condenser, it is possible to determine the variation of this length from variations of the electric capacity. In this case the highly precise methods of electrical measurements are used.

The article describes the use of a capacity meter, used for the measurements of length variations as indicated above. It has been developed for measurements of mechanical pressure, but can be used very conveniently in electrical prospecting for determining the antenna capacity when placed over various points of a terrain under investigation. From determined values of the capacity it is possible to draw accurate conclusions about the geologic structure of the subsurface below the surveyed area. The article presents several examples in which the described method can be applied to geophysical prospecting and gives geological interpretation of the different characteristic curves obtained.—*S. T. V.*

9837. Golovtsyn, V. N. The use of a combined field in the electrical exploration of subsurface resources [in Russian]: Prikladnaia Geofizika, no. 3, pp. 101–105, Moscow, 1947.

Experiments with models, conducted at the Sverdlovsk Mining Institute, U.S.S.R., have led to the development of an electrode arrangement for prospecting by the method of d. c. equipotential lines which differs from the customary arrangement of Lundberg in substituting a point electrode for one of the linear electrodes. The procedure consists in laying out a single electrode line in the field and from its center, perpendicular to it, a battery cable to the point electrode. The length of the electrode line may be 500 meters and the distance to the point electrode 1,000 meters. Measurements are made on both sides of the electrode line by means of a galvanometer or potentiometer.

This arrangement is easily laid out and readjusted during the course of the work, and a placing of the point electrode over an anomally increases the penetration range of the method. The mathematical equations of the ensuing electrical field are given, and the findings of experimental tests are discussed.—*V. S.*

Karasik, M. A. The use of magnetic and electrical methods for geologic mapping and nickel-ore exploration in the Rezhevsk region of the middle Urals [in Russian]. *See* Geophys. abstract 9756.

Koulomzine, T., and Brossard, L. The use of geophysics in prospecting for gold and base metals in Canada. *See* Geophys. abstract 9758.

9838. Maillet, Raymond. The fundamental equations of electrical prospecting: Geophysics, vol. 12, no. 4, pp. 529–556, Tulsa, Okla., 1947.

Electrical prospecting has been used extensively in the Eastern Hemisphere, particularly by French geophysicists, and important theoretical studies have resulted from the work. The author outlines some findings, limiting himself to the use of direct electric current and to horizontal strata. Fundamental equations underlying electrical prospecting are reviewed, and a relationship is established between the law of repartition of conductivities in terms of the geologic level, expressed by the electrical logging curve, and the law of variation of apparent resistivity in terms of the dimension of the surface measuring device, expressed by the electrical sounding diagram. Consideration is also given to a third kind of diagram of the type of the "Dar Zarrouk curve" and to the phenomena of anisotropy, equivalence, and suppression. The simul-

taneous representation on logarithmic paper of the electric logging curve, the Dar Zarrouk curve, and the electrical sounding diagram is illustrated by examples.—*V. S.*

9839. Maziuk, V. V., and Rozanov, L. N. An experiment in rectifying geologic maps with the aid of electrical prospecting data in the Buguruslan oil region [in Russian]: Prikladnaia Geofizika, no. 3, pp. 181–194, Moscow, 1947.

Geologic exploration of the Bol'shoi Kinel' Valley in the Buguruslan oil region, U.S.S.R., was conducted by two field parties and gave conflicting results for adjacent areas. In order to reconcile the geologic maps obtained, use was made of the available data of electrical prospecting and logging interpreted in the light of geologic findings and electrical type-curves developed for the region. The technique of electrical type-curves, introduced by V. Pechernikov, consisted in this case of the use of four representative patterns of local electrical profiles as an aid to electrical interpretation. Its application is described.

The analysis made it possible to establish a relationship between electrical data and local stratigraphic horizons and to rectify the geologic maps. The work is discussed with a view to developing a standard procedure for this purpose.—*V. S.*

9840. Mukhin, A. V. Geophysical (electrical prospecting) work in the western regions of the Ukrainian S.S.R. [in Russian]: Razvedka Nedr, vol. 13, no. 1, pp. 31–35, Moscow, 1947.

A brief outline is given of magnetic, gravitational, and seismic exploration during 1929–39 in the fore-Karpatian Mountains and over the Podolian shield in western Ukraine, and attention is centered on two electrical surveys conducted in 1940 in the fore-Karpatian region by the method of vertical sounding.

The Dashava-Kalush gas district was surveyed by means of traverses laid along the geologic strike and perpendicular to it, with maximum intervals of 8 kilometers between the feeding electrodes. The results were uncertain, generally indicating 5 ground layers registering from 2 to 400 ohm-meters, and yielded two different maps of the roof of the underlying gypsum-anhydrite bed. The author draws a corrected map and interprets its principal features, noting a decrease of average resistivity from 3 to 5 ohm-meters in the upper layers in a northwest-southeast direction.

The Lvov-Zlochev-Stoianov coal district was surveyed over 6 traverses with a total length of 460 kilometers and intervals of 2 to 7 kilometers between the feeding electrodes. The maps of the basic horizon are discussed.—*V. S.*

9841. Müller, Max. Erzeugung sinusförmiger Wechselströme in dem unter dem Hörbarkeitsbereich liegenden Frequenzgebiet [Generation of sinusoidal alternating currents of frequencies below the audibility threshold]: Zeitschr. Geophys., vol. 17, pp. 181–188, Braunschweig, 1947.

The author emphasizes the importance of sinusoidal currents of low frequencies in geophysical prospecting, especially in cases when deep-seated deposits are to be explored, or when the deposits are covered with layers of highly conductive minerals. Low frequencies are important because the depth of penetration of the currents into the ground

varies inversely with the square root of the frequency applied. Also important is the fact that the reactive component in the case of low frequency becomes negligible. Two schemes of electronic generators are described with a detailed mathematical analysis of their operation. The lowest attainable frequency is 5 cycles per second. According to the author's computations the greatest depth explorable is 10,000 meters.—*S. T. V.*

9842. Ramachandra Rao, M. B. Notes on the underground water resources near Katharhal for the Chitaldroog water supply project—Explanatory note on the interpretation of the earth resistivity curves, Katharhal area: Mysore Geol. Dept. Records, vol. 40, pp. 59–80, Bangalore, India, 1942.

The author discusses the prospects of obtaining ground water by sinking wells in the beds of two small streams in the locality. In order to estimate the thickness of the alluvial formation, the source of the ground water, earth resistivity determinations were carried out by the expanding electrode method, using the megger earth-resistance tester. The measurements were made along two lines at right angles to each other. The resistivity determinations were carried out for electrode separations ranging from 10 feet to 100 feet in successive steps of 10 feet along each line. Results of these measurements are presented in the form of graphs. The true resistivities and depth of the layers were determined by the methods devised by G. F. Tagg and by Irwin Roman, as well as by the empirical rule of Gish-Rooney. The values obtained by these three methods agree very closely with each other and with the depth obtained in a test well sunk for this purpose.—*S. T. V.*

9843. Ramachandra Rao, M. B. Report on the geophysical survey near Guddadaranguvvanahalli in Chitaldroog district: Mysore Geol. Dept. Records, vol. 59, pp. 75–125, Bangalore, India, 1941.

This report records the results of the geoelectrical surveys carried out in the Chitaldroog district, India, during 1939 and 1940. The main object of these surveys was to study the practical applications of some of the electrical methods for the location of ore bodies. An outline is also given of the general principles of the electrical methods adopted. In this survey the following methods were use: Self-potential method; earth-resistivity method with different arrangements of electrodes; d. c. equipotential-line method; and d. c. potential-drop method.

The survey covered about 150 acres. The oxidized minerals appear to be chiefly iron and copper pyrites, galena, and stibnite with some arsenical pyrites. A very close agreement in the results was obtained by the different methods.

During the course of trenching and shafting operations, which were undertaken in conjunction with this survey, a confirmation of some electrical indications has been obtained. Later excavations have also given proof of the reliability of the electrical methods and their findings (*see* Geophys. Abstracts 120, no. 7857).—*S. T. V.*

9844. Tarkhov, A. G. The topographic effect in prospecting by the induction method [in Russian]: Razvedka Nedr., vol. 12, no. 5, pp. 28–33, Moscow, 1946.

Topographic relief has a marked effect on measurements by the method of electromagnetic induction, particularly in the case of strongly conductive surface sediments, but usually no correction is made other

than to ignore anomalies caused by marked irregularities. D. Sherman has calculated theoretically the electromagnetic field for an inclined position of the generating coil of the induction apparatus, and I. G. Mikhailov has obtained empirical curves of the angle of the major axis of the polarization ellipse of the magnetic field.

On the basis of these investigations, the author constructs a master chart for determining the angle of the generating coil and the distance between the generating coil and the receiving coil, by means of which it is possible to calculate the specific conductivity of the surface sediments and the correction for topography. The use of the chart is explained and illustrated by examples of curves for heavily sedimented valleys, frosted ground, bare rock, and ice on sea bays.—*V. S.*

5. RADIOACTIVE METHODS

9845. Brown, S. C., and Miller, W. W. Carbon-dioxide filled Geiger-Müller counters: Rev. Sci. Instruments, vol. 18, no. 7, pp. 496–500, Lancaster, Pa., 1947.

Efficient detection of the long-period carbon isotope, C^{14}, can be achieved when this isotope is oxidized to CO_2 which may then be used as a Geiger-Müller counter filling. The special problems which arise in CO_2 counters are discussed. Carbon dioxide ions produce undesirable effects, which are eliminated by small amounts of CS_2. The result of the investigation has been to develop a CO_2-CS_2 counter which has satisfactory properties for routine studies of C^{14}.—*Authors' abstract.*

9846. Davis, G. L. Radium content of ultramafic igneous rocks—I, Laboratory investigation: Am. Jour. Sci., vol. 245, no. 11, pp. 677–693, New Haven, Conn., 1947.

Measurements of the radium content of some ultramafic igneous rocks and of the constituent minerals have been made by a refinement of the vacuum-fusion technique. In general, the radium content of these rocks is considerably lower than previously reported. The apparatus used is described. Attempts were made to determine the distribution of the radium among the minerals comprising the rocks. Geological and chemical implications will be discussed in a later paper.—*Author's abstract.*

9847. Gignoux, M. La notion du temps en geologie [The concept of time in geology]: Rev. Sci. Nat. Auvergne, vol. 8, no. 1, pp. 1–18, Clermont-Ferrand, France, 1942.

A comparison is made between the concepts of time as used by the mathematician and by the geologist. The methods employed for evaluating geologic time in years are described, including measurement of the rate of sedimentation, estimation of the age of a moraine by determination of the rate of alluvial deposition by glaciers, methods of varves, and study of the radioactivity of rocks. Data are given on the last-named method.—*Cent. Nat. Rech. Sci., Bull. Anal., vol. 8, no. 8, pt. 1, p. 1726, Paris, 1947, translated by V. S.*

9848. Hershey, R. L. Tables of fluorescent and radioactive minerals: New Mexico Bur. Mines and Min. Resources, Circ. 15, 14 pp., Socorro, N. Mex., 1947. [Mimeographed.]

The text presents a few simple definitions, designates sources of ultraviolet light, and gives a nontechnical statement on radioactive ele-

ments, kinds of radioactivity, and methods of detection. About 100 fluorescent minerals or mineral varieties are listed, showing name, chemical formula, fluorescent color, strength of reaction, and whether it is found in New Mexico. A second list gives the names of about 100 minerals that are reported to be radioactive, with their chemical constituents, and indicates whether they are found in New Mexico. The lists were compiled from six references.—*H. Winchell, Am. Jour. Sci., vol. 245, no. 6, p. 400, New Haven, Conn., 1947, condensed by V. S.*

9849. Holmes, Arthur. The age of the earth: Endeavour, vol. 6, no. 23, pp. 99–108, London, 1947.

Past investigations on the age of the earth are reviewed briefly, and the present status of the problem is discussed. For an accurate measurement of so long a period it is necessary to find a natural process that has operated throughout geologic time and has produced measurable results at a known rate. The only known process answering these requirements is the decay of radioactive elements, which underlies the radioactive method. With the use of this method information has been accumulated on the isotopic constitution of rock lead as it was at various periods ranging back 25,000,000 to 1,330,000,000 years.

In terms of these data the problem now is to determine the relative abundances of Pb^{206} and Pb^{207} in the earth's primeval lead and to calculate the time that has elapsed since that lead began to be modified by radiogenic additions. Such a calculation is given by the author, and the results are plotted as curves for pairs of lead samples. The intersections of these curves, representing solutions, place the age of the earth at 3,350,000,000 years.—*V. S.*

9850. Marble, J. P. Annotated bibliography of articles related to the measurement of geologic time: Report of the Committee on the Measurement of Geologic Time, 1943 to 1946, pp. 10–56, Washington, D. C., National Research Council, August 1947.

This bibliography covers about 250 articles relating to the measurement of geologic time that have appeared in different countries during 1943–46. The entries are accompanied by annotations and occasionally by abstracts.—*V. S.*

9851. Morita, Shuji. The radioactivity of soils measured by means of a counting tube: Imp. Acad. Japan Proc., vol. 19, no. 10, pp. 659–661, Tokyo, 1943.

As soils are formed by the weathering of rocks containing radioactive elements, it is reasoned that soils must be radioactive. This hypothesis was tested by an examination of several soils with a Geiger-Müller counter. The walls of the tube were 0.8 millimeter thick to filter gamma rays but absorb beta rays. Twenty grams of finely pulverized sample were placed in a vessel attached to the walls, and the natural and total discharges were counted. The experiment was performed on C-horizon soils relatively unaffected by soil-forming agencies. The results obtained are tabulated. It is found that the soils from acidic rocks and schists contain substances that are highly radioactive.—*V. S.*

9852. Nogami, H. H., and Hurley, P. M. Experimental test of predicted absorption of alpha-rays in minerals [abstract]: Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, p. 1214, Baltimore, Md., 1947.

It was desired that the Bragg-Kleeman rule, giving the approximate range and thus the absorption of the various alpha rays from the U and Th series in different media, be checked experimentally to see if it was sufficiently accurate to make the correction for the "stopping power" of the minerals. For this purpose a number of pulverized mineral samples, previously analyzed for U and Th by Rn and Tn measurement, were tested for total emission from a plane surface of the powder on a source plate, the thickness of source exceeding the maximum alpha-ray range. The theoretical emission from each sample was computed from the Rn-Tn value, assuming the stopping power of the mineral to be proportional to the sum of the atomic fraction times the square root of the atomic weight of the elements in the mineral. It was found that the observed emission agreed with the predicted emission within 4 percent, over a range of mineral densities.—*Condensed by V. S.*

9853. Scherbatskoy, S. A., Gilmartin, T. H., and Swift, Gilbert. The capacitative commutator: Rev. Sci. Instruments, vol. 18, no. 6, pp. 415–421, Lancaster, Pa., 1947.

The design and construction of a vibrating capacitor-type electrometer is described. Experimental data are presented to show that this electrometer reaches, within a small factor, the theoretical limit of sensitivity. The principle of the electrometer is a time-varying capacitor at the input of the device, which inverts the low frequency signal to a relatively high frequency and raises its energy level, thereby simplifying the amplification of the voltage being measured, permitting the use of ordinary vacuum tubes, and producing an electrometer that is mechanically rugged and free from long period drift. Stabilization is obtained by negative feedback. The electrometer was originally developed for radiation well surveying in the petroleum industry, but other applications have been found for it in general radiation measurements.—*Author's abstract.*

9854. Senftle, F. E., and Keevil, N. B. Thorium-uranium ratios in the theory of genesis of lead ores: Am. Geophys. Union Trans., vol. 28, no. 5, pp. 732–738, Washington, D. C., 1947.

Thorium and uranium determinations by the thoron and radon methods have been made on 19 composite samples from 1,500 granitic and intermediate-type rocks from various parts of North America. Average Th/U ratios of 3.4 and 4.0 were found for granitic and intermediate-type rocks respectively. Such ratios lend no support to Arthur Holmes' theory that lead ores are derived from a source in the substratum below the zone of ordinary magmatic activity. Some regional variations in average Th/U ratios were noted, relatively more uranium being found in the northern part of the continent.—*Authors' abstract.*

9855. Simpson, J. A., Jr. A precision alpha-proportional counter: Rev. Sci. Instruments, vol. 18, no. 12, pp. 884–893, Lancaster, Pa., 1947.

An instrument is described which will detect and record the alpha-disintegration rate of prepared radioactive samples even when soft

beta-radiations up to 5×10^9 disintegrations per minute are also present. The counting losses arising from the detector, electronic amplifier, scaler, and recorder total 0.8 percent with an alpha-counting rate of 10^5 counts per minute.

The instrument employs a proportional counter through which slowly flows 99 percent of CH_4 at one atmosphere. The proportional counting region is approximately 300 volts in length, with 0.5 percent change in counting rate in an interval of 200 volts. Thin radioactive samples deposited on metal disks as much as 2.5 centimeters in diameter are easily inserted into the counter volume by means of a special gas lock. The counter detects 0.50 of the disintegrations from a thin radioactive sample.—*Author's abstract, condensed by V. S.*

9856. Technical News Bulletin. Diamonds used to detect atomic radiation: Vol. 31, no. 11, pp. 121–123, Washington, D. C., Nat. Bur. Standards, 1947.

Radioactive substances can be detected by means of diamond counters. L. F. Curtis, working at the National Bureau of Standards, has shown that diamonds are highly sensitive to gamma rays and may be used to discover this radiation in the same way as a Geiger-Müller counter. A diamond placed in a strong electric field initiates sharp electrical pulses when gamma radiation is absorbed, and a count of pulses gives an indication of the intensity of the radiation.

To be used as a counter, a diamond is clamped between two small brass electrodes maintained at a potential difference of about 1,000 volts. When a source of gamma radiation is brought within the range of the diamond, pulses of current pass across the electrodes and, upon amplification, are counted by the indicating device. An industrial diamond must be colorless and absolutely free of flaws to be usable. Diamond counters are practically indestructible, can be made very small in size, and cost about as much as Geiger-Müller counters.—*V. S.*

9857. Test, M. J. Two recent improvements in radioactivity prospecting apparatus [abstract]: Oil and Gas Jour., vol. 45, no. 47, pp. 125–126, Tulsa, Okla., 1947.

Details are given of an all-metal Geiger-Müller counter tube, in which a minimum of material is used for internal parts. This construction has improved mechanical ruggedness, at the same time lowering background count by preventing spurious charges. Such tubes have been successfully employed in geophysical exploration. Argon and alcohol vapor filling has enabled production of tubes having cosmic ray efficiencies of more than 99 percent, plateaus more than 200 volts long, and plateau slopes linear within 0.001 percent. A portable radioactivity detector is described.—*Condensed by V. S.*

9858. Trombe, Felix, and Henry la Blanchetais, Charlotte. Ionisation—Sur la Présence de radiations pénétrants telluriques dans la rivière souterraine de Saint-Paul, Haute-Garonne [Ionization—On the presence of a penetrating telluric radiation in the subterranean river of Saint-Paul, Haute-Garonne]: Acad. Sci. Comptes rendus, vol. 224, no. 3, pp. 207–209, Paris, 1947.

The water of this subterranean river has a temperature slightly higher than that of several adjoining streams in the same region. Having established this fact, the authors measured the electric conductivity

of the air in the caverns along this river and found it higher than normal. They also determined the intensity of the penetrating radiation of the water, using for this purpose Kohlhörster's apparatus. They found that the intensity of radiation was quite pronounced, approaching the radioactivity of the uraniferous deposits of Lachaux. It appears probable that the water of the river, coming from a great depth, brings to the surface radioactive gases dissolved in it. An exploration of the caverns of this river for radioactive substances appears to be promising.—*S. T. V.*

9859. Wickman, F. E. Isotope ratios, a clue to the age of certain marine sediments: Jour. Geology, vol. 56, no. 1, pp. 61–66, Chicago, 1948.

If an element A has a radiogenic isotope A_1 and a nonradiogenic A_2, the ratio A_1/A_2 is an index of the age of marine chemical sediments, if the content of the isotope B^* producing A_1 can be neglected. It is shown that the method can be used for strontium (and perhaps Pb^{203}) on limestone and anhydrites.—*Author's abstract.*

6. GEOTHERMAL METHODS

9860. Birch, Francis. Temperature and heat flow in a well near Colorado Springs: Am. Jour. Sci., vol. 245, no. 12, pp. 733–753, New Haven, Conn., 1947.

Temperature measurements are reported for a well near Colorado Springs at an elevation of 6,200 feet. This well is thought to penetrate the basement rocks for perhaps as much as 2,500 feet. A small flow of water, while complicating the interpretation of the temperatures, also affords a possibility of estimating roughly the conductivity of the rocks. The thermal gradient is determined to be 20° C./km.; the mean conductivity is thought to lie between 0.005 and 0.007 cal./cm. sec. °C., giving a value for heat flow between 1.0×10^{-6} and 1.4×10^{-6} cal./cm.^{2} sec. This is shown to be consistent with measurements in other Colorado wells.—*Author's abstract.*

9861. Lütschg-Loetscher, O. Beitrag zur Kenntniss des Wärmehauschaltes der obersten Bodenschicht der Schweizer Alpen [A contribution to the knowledge of the thermal balance of the upper soil of the Swiss Alps]: Schweizer. naturf. Gesell. Denkschr., vol. 77, no. 2, pp. 83–167, Zurich, 1947.

The study was undertaken to elucidate the relation between the solar irradiation and the thermal processes taking place in the soil of the Alps. Only the upper layer of the soil to a depth of 2.5 meters was investigated. Annual and diurnal variations of the temperature were measured and correlated with the temperature of the air, with the duration of the insolation, humidity of the air and of the soil, and other factors.

The original measurements were made from 1935 through 1938 in Les Avants, 983 meters above sea level, some 600 meters above Lake Geneva. Extensive excerpts are included from similar studies made by other investigators in different parts of Switzerland at points ranging in height from 1,025 meters to 2,490 meters above sea level.

One of the results of this study was the establishment of the fact that the temperature of the soil does not decrease uniformly with the height of the point of observation, but that a temperature-inversion takes place at a certain level, owing to greater insolation at higher levels. Further-

more the previous observation was confirmed that temperature variation of the soil decreases rapidly with depth. Thus diurnal variation in July was 26° C. at the soil surface and only 0.3° C. at a depth of 2.5 meters. Annual variation of the temperature at this depth was more pronounced but still only about one-third of that found at the surface.—*S. T. V.*

9862. Mangan, J. W. Temperatures of natural waters in Pennsylvania, 222 pp., Harrisburg, Pennsylvania Dept. of Forests and Waters, 1946.

The Pennsylvania Department of Forests and Waters, working in conjunction with the U. S. Geological Survey, has made a survey of temperatures of surface waters in Pennsylvania during the water year ending Sept. 30, 1945. The results are published together with long-time records collected by other agencies. They show that the average ground-water temperature at depths of 10 to 30 feet is approximately the same as the mean annual air temperature. Most water wells averaging between 100 and 300 feet in depth produce water that is 3° to 7° F. warmer than the mean annual air temperature. Below 60 feet the temperature of ground water increases about 1° F. with each additional 60 to 100 feet in depth. Temperature of ground water from any one well, uninfluenced by surface supply, rarely varies more than 2° to 3° F. during the year. Other data are given on ground water, springs, and surface water.—*V. S.*

9863. Misener, A. D. Geothermal measurements in the Canadian shield [abstract]: Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, p. 1209, Baltimore, Md., 1947.

To obtain a complete geothermal picture of the part of the Canadian shield lying between Kirkland Lake and Timmins, Ontario, measurements of temperature gradients, thermal conductivity, specific heat, and density are required. Temperature gradients were determined from rock temperatures measured to 0.02° C. at 33 underground positions in mines with wide distribution both laterally and vertically to 7,000 feet. The other constants are determined by laboratory measurements on specimens taken from these positions and from surface specimens characteristic of the district. The average heat flow at the surface is calculated, and certain anomalies in the temperature gradients are discussed.

9864. Ovchinnikov, A. M. On the hydrothermal conditions of the earth's crust: Acad. Sci. U.R.S.S. Comptes Rendus (Doklady), new ser., vol. 53, no. 7, pp. 645–648, Moscow, 1946.

If one considers the part of the earth's crust accessible to investigation as constituting fundamentally the subsurface hydrosphere, geothermal conditions in the crust become essentially hydrothermal. Adopting this viewpoint, the author studies questions of the heat balance of the earth's surface and its variation in time, the geothermal calculation of the depth of rocks, the depth of the zone of constant secular temperature, and the variation in average normal hydrothermal depth.

Observations in areas of permafrost, according to which the depth of penetration of solar heat is considerably greater than the zone of constant annual temperature, appear to indicate that the depth of the heat wave equals that of the cold wave and thus place the zone of constant secular temperature at a depth of about 1,000 meters. They suggest that the average normal hydrothermal depth, when put at the generally ac-

cepted value of 33 m./° C., does not adequately characterize the actual state of the heat flow for various regions and that its true value actually may vary within a wide range, from 1 to 200 m./° C. The view that in young folded areas the zones of high temperature lie everywhere at shallow depths is questioned. Other conclusions are given.—*V. S.*

9865. Tuttle, O. F., and Bowen, N. L. New hydrothermal quenching apparatus [abstract]: Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, p. 1235, Baltimore, Md., 1947.

A simple apparatus has been developed for the study of equilibrium relations at high temperatures and pressures in mineral systems including volatile components. Investigations have been carried to pressures of 30,000 pounds per square inch (approximately 4.5 miles depth) at temperatures up to 900° C. Results relating to the system K_2O-Al_2O_3-SiO_2-H_2O show that a water pressure of 15,000 pounds per square inch lowers the temperature of the liquids about 100° C. in the orthoclase field. In compositions approaching the quartz-orthoclase join a pressure of 30,000 pounds per square inch gave relatively insignificant additional lowering.

7. GEOCHEMICAL METHODS

9866. Altieri, V. J. Gas analysis and testing of gaseous materials, 567 pp., New York, American Gas Assoc., 1945.

This book on gas analysis is designed for chemists, physicists, and engineers in the gas industry. The contents cover the general theory of gas analysis and testing of gaseous materials; methods for the measurement of gas quantity, flow, and sampling; techniques of gas analysis by the apparatus of Hempel, Orsat, Elliot, and others; determinations of small amounts of various gases; gas liquefaction and distillation; examination of light oils obtained from gas; analysis of waste gases; and related subjects. Descriptions of indicators and recorders are also included, and auxiliary information is given in appendixes.—*V. S.*

9867. Bench, B. M. Bacterial activity and its relation to petroleum: Mines Mag., vol. 37, no. 11, p. 50, Denver, Colo., 1947.

Prospecting for oil can be guided by the presence in the soil of bacteria known to be associated with petroleum deposits. Research has recently shown that facultative anaerobes play a significant part in the transformation of organic matter into petroleum hydrocarbons. They split oxygen, nitrogen, sulfur, and phosphorous from various organic compounds; reduce sulfates in the presence of oil with a generation of hydrogen sulfide; and release oil from sediments by manifold processes. It is also known that bacteria found in petroliferous sediments can grow in temperatures of 0° to 85° C. and are not injured by hydrostatic pressures existing in deep strata up to 150,000 pounds per square inch. The end products of bacterial activity upon hydrocarbons are little known, except that carbon dioxide and bacterial protoplasm are produced.—*V. S.*

9868. Ginzburg-Karagicheva, T. L. Biogene factors in the genesis of petroleum and natural gas [in Russian]: Internat. Geol. Cong., 17th, U.S.S.R., Rept., vol. 4, pp. 319–333, Moscow, 1940.

The author discusses the role of micro-organisms in the formation of oil-bearing and gas-bearing deposits of several Soviet oil fields, as

well as their role in the formation of present-day ooze in the Black Sea, and concludes that petroleum and natural gas are formed as a result of bacterial processes under favorable physico-chemical conditions. A discussion is given.—*Ann. Bibl. Econ. Geol. 1946, vol. 19, no. 1, p. 51, Urbana, Ill., 1947.*

9869. Kaveiev, M. S. About certain geochemical processes in the Permian deposits of the Sarabikulovo oil pool: Acad. Sci. U.R.S.S. Comptes Rendus (Doklady), vol. 55, no. 5, pp. 425–427, Moscow, 1947.

The oil accumulations discovered in the vicinity of Sarabikulovo village in the Shugurov district, Tataria, are mainly confined to the top of the Ufa series of the Permian deposits. Based on detailed analyses of well waters and gases, the geochemical processes responsible for the particular features of the deposits of the region are described.—*G. H. B., Jour. Inst. Petroleum, vol. 33, no. 285, p. 328A, London, 1947.*

9870. Leach, Paul. Simple chemical tests to aid prospectors: Eng. and Min. Jour., vol. 148, no. 10, pp. 78–79, New York, 1947.

Prospectors can use simple chemical tests in their search for ore deposits. The geochemical unit of the U. S. Geological Survey has made field experiments to ascertain the possibilities of quantitative analysis of water, plants, residual and alluvial soil, and glacial till. The findings show that one man with a few bottles of chemical reagents, a test tube, and a graduate is able to estimate the metal content of natural waters in extensive areas in a few days without recourse to bulky and expensive equipment.

Examples are given of geochemical and geobotanical findings relating to prospecting for zinc, copper, and lead. In tests of natural water for zinc and copper a solution of dithizone in carbon tetrachloride is shaken with the water, and a pink hue is obtained when the metals are present. Further addition of weak hydrochloric acid brings the zinc-dithizonate into the aqueous phase. The resulting color in the carbon tetrachloride phase is an indication of the amount of copper in the sample. Other procedures and results are indicated briefly.—*V. S.*

9871. Maliuga, D. P. Chemical composition of soils and plants as indicators in prospecting for metals [in Russian]: Acad. Sci. U.R.S.S. Bull. (Izvestiia), Sér. Géog. et Géophys., vol. 11, no. 3, pp. 135–138, Moscow, 1947.

Chemical analyses of soils, especially the pertinent investigations of V. J. Vernadsky and T. Berthaud, have shown that the presence in the parent rocks of heavy metals, such as iron, manganese, nickel, and cobalt is associated with an unusually high content of these elements in the derived soil. The soil itself and the plants growing on it in such cases show as much as a hundredfold amount of the metals in question, as compared with the normal content. Thus, the ashes of the plant *Thlaspi calaminare* Lej contain as much as 13 percent of zinc oxide, the ashes of *Nicotiana tabacum* as much as 60 percent of potassium oxide, and the pulp of *Populus tremula* can contain as much as 73 percent of calcium oxide. Chemical analyses of the ashes of plants collected over the nickel deposits of the Ural Mountains have shown an enormous concentration of nickel and cobalt. The author concludes that plants and soils with a high content of certain metals indicate proximity of the corresponding ores and thus emphasizes their importance in prospecting.—*S. T. V.*

9872. Ramberg, Hans. Kjemisk likevekt i gravitasjonsfeltet og dens betydning for jordskorpens differensiasjon [Chemical equilibrium in the gravitational field, and some geological implications], with English summary: Dansk Geol. Fören. Medd., vol. 11, no. 1, pp. 13–29, Copenhagen, 1946.

Because of gravitational attraction terrestrial laws governing vertical mechanical flow and chemical diffusion differ from laws expressing horizontal motion. In a vertical direction chemical equilibrium depends on conditions of balanced diffusion and chemical stability attained when downwardly directed partial-tension gradients obey a relationship that is expressed by a deduced equation. According to this equation the chemical forces balancing the gravitational attraction, to which migrating elementary particles are subjected, appear to be stable vertical partial-tension gradients.

The variable factors that may affect partial tensions at different levels in the crust under conditions of thermal stability are, essentially, changing pressures and concentrations. Therefore, combinations of the first-mentioned equation with equations governing the relationships between partial tension, pressure, and concentration must express entirely chemical equilibrium in the gravitational field. The conditions thus obtained for chemical equilibrium show that the stable structure of the earth is realized when the different immiscible phases are arranged in concentric shells with density increasing from the surface toward the center. Other geological implications are discussed.—*V.S.*

9873. Rankama, Kalervo. Some recent trends in prospecting: Mining and Metallurgy, vol. 28, no. 486, pp. 282–284, New York, 1947; summary in Skillings' Mining Review, vol. 36, no. 10, p. 11, Duluth, Minn., 1947.

The limitations of existing geophysical methods, particularly in the search for ores, have recently led to the development of several geochemical approaches.

Microchemical and spectrographic analyses of samples of soil and ground water were studied by T. Vogt in Norway in 1939–43. The barium chloride reaction revealed the presence of dissolved sulfates in creeks receiving water from sulfide-ore occurrences and proved useful for prospecting in the Roros area in Norway. Spectrographic chemical analyses of the limonites found in lake and bog ores indicated the composition of the products of mineral disintegration present in the respective water-catchment areas.

A new geochemical approach was evolved in 1937 from the Goldschmidt enrichment principle denoting the concentration of trace elements in topmost layers of forest soils by processes of evaporation and filtration incidental to the growth of plants. This principle is known to apply to Ag, Au, Be, Zn, Cd, Sc, Tl, Ge, Sn, Pb, As, Mn, Co, and Ni. It was used for exploration in Sweden, Norway, Finland, Canada, and Greece.

Geobotanical methods were brought into existence by the discovery that mineral deposits create soil conditions favorable to the growth of certain plants. In Australia the *Polycarpaea spirostylis* is associated with copper deposits; in central Europe the *Viola calaminaria*, with zinc deposits; and in Missouri the *Amorpha canescens*, with galena deposits. Other geochemical approaches are indicated.—*V.S.*

9874. Stadnichenko, T. M. Modern aspects of geochemistry and their application to economic geology [abstract]: Am. Mineralogist, vol. 31, no. 3–4, pp. 206–207, Lancaster, Pa., 1946.

In the last 20 years, particularly in Russia, the application of the new principles to the study of geochemical processes helped in formulating the important rule of geochemical associations, in forecasting the distribution and accumulation of the various elements, and in suggesting better means in solving prospecting, mining, and technological problems.—*Excerpt, p. 207.*

9875. Tikhomirov, N. I., and Miller, S. D. On the physicochemical method of search for molybdenum in conditions of the near-desert climate of the northern Balkhash region [in Russian]: Razvedka Nedr, vol. 12, no. 2, pp. 34–39, Moscow, 1946.

In the region to the north of Lake Balkhash, Kazakh S.S.R., conditions are unfavorable for geologic exploration of molybdenum. The pre-Quaternary strata are almost completely covered by alluvial-diluvial sediments, and molybdenite is alkalized in the oxidation zones of deposits. Accordingly, a test was made of physicochemical prospecting in the eastern Kounrad area, which contains molybdenum and tungsten. Sedimentary samples of 200 grams, collected at intervals of 0.5 to 5 meters from near the surface along 8 traverses and pulverized to 150–200 mesh, were subjected to spectral analysis for comparison with standard samples of the locality.

The results are plotted in profiles of molybdenum and tungsten concentration and in an iso-contour map for the central section. They show a high and comparatively even molybdenum content distinctly correlated with the distribution of ores. The arid climate does not prevent the formation of metallic aura on the surface. Other findings are given. It is concluded that spectro-metallometric exploration for molybdenum can succeed even in areas of intense surficial alkalization of the metal, but has to be restricted to a detailed survey of small areas of known deposits. It may prove useful for the search of rare metals in general.—*V.S.*

8. DRILL-HOLE METHODS

9876. Abadie, H. G. Thermal surveys applied to oil field problems: Petroleum Engineer, vol. 18, no. 9, pp. 47–48, Dallas, Tex., 1947.

Geothermal logging has been used for two new applications in oil drilling and production work at the Kettleman Hills North Dome field, California.

The possibility of locating leaks in casing or tubing in an oil well was demonstrated by the detection of a leak in a water string. The well had a protective string of casing cemented at 5,533 feet, a water string cemented at 7,029 feet, a liner, and tubing. In preparation for the survey the well was gas-lifted with a compressor for 18 hours to ensure equilibrium conditions, and a thermal log was made on a high-temperature photographic film over the interval from 4,700 to 7,200 feet. The curve showed a thermal anomaly of 13° F. at 5,535 feet. Subsequent tests by water circulation under pressure revealed a leak between depths of 5,538 and 5,540.

Detection by geothermal logging of points of lost circulation, necessary in the drilling of 10,000-foot wells, was successful on several occasions. In the case described the casing had been set at 6,286 feet in a Temblor section, and circulation was lost during the drilling at 9,319 feet in Kreyenhagen shale. Before the logging operation, considerable mud was pumped into the well to establish a pronounced thermal anomaly at the point of loss, and an anomalous change of 52° F. was recorded at 6,500 feet, effectively locating the point of circulation loss.—*V. S.*

9877. Barnes, B. A., and Livingston, Penn. Value of the electrical log for estimating ground-water supplies and the quality of the ground water: Am. Geophys. Union Trans., vol. 28, no. 6, pp. 903–911, Washington, D. C., 1947.

This paper gives a brief summary of studies made in Texas by the U. S. Geological Survey and cooperating parties on the value of the electrical log for estimating ground-water supplies and the quality of water in them.

The electrical log has been found to be especially valuable in the Coastal Plain region of Texas, where the rocks consist mostly of a succession of clays or shales, or sandy clays or shales, interbedded with sands or sandstones. In that region the electrical log has been found to be more useful than the driller's log for correlating the principal water-bearing horizons over wide areas. The log by itself is not an indicator of the permeability of the water-bearing beds, nor a safe guide as to the quality of the water in them, but if it is studied in connection with other data, it reveals interesting and instructive information. Thus far in Texas no extensive studies have been made of the value of the electrical log in limestone aquifers or in sand or sandstone aquifers associated with limestone.—*Authors' abstract.*

9878. Bush, R. D. Summary of operations, California oil fields: California Dept. Nat. Res., Oil and Gas Div. Rept., vol. 32, no. 2, July-Dec. 1946, 150 pp., San Francisco, Calif. [1947?].

This issue includes a description of the Trico gas field, by W. C. Bailey and R. M. Barger, illustrated by structural maps and electrical logs of wells; a description of the West Newport oil field, by C. H. Corwin, with a tabulation of formations encountered in the field, as well as structural maps and electrical logs of the wells; and various statistics and related information on California oil fields in 1946.—*Mines Mag., vol. 37, no. 11, p. 78, Denver, Colo., 1947, condensed by V. S.*

9879. Doll, H. G., Legrand, J. C., and Stratton, E. F. True resistivity determination from the electric log—its application to log analysis: Oil and Gas Jour., vol. 46, no. 20, pp. 297–310, Tulsa, Okla., 1947.

In electrical logging the true resistivity of the undisturbed formations must be distinguished from apparent resistivity found in the zone immediately surrounding the drill hole. The discrepancy between the two values depends on electrode spacing, bed thickness, hole diameter, mud invasion, ratio of true resistivity to mud resistivity, and other local characteristics. Large electrode spacing reduces the discrepancy but obliterates details on logs.

The various factors are examined in relation to the conditions existing in wells and the procedures involved in measurements, with a view to increasing the precision of logging. Consideration is given to

different electrode arrangements, the equation of G. E. Archie, and the effects of electrode spacing. As regards accurate log interpretation, the determination of true resistivity from resistivity departure curves is discussed for the cases of no mud invasion, mud invasion in an oil-bearing formation, and mud invasion in a water-bearing formation.—*V. S.* (*See also* Geophys. Abstracts 130, no. 9412.)

9880. Gile, R. E. Formation logging: Petroleum Engineer, vol. 18, no. 9, pp. 93–96, Dallas, Tex., 1947.

A composite chemical log can be made in exploratory oil wells on the basis of drilling mud and formation samples with the use of recently perfected equipment installed in a trailer. The operations performed comprise determination of hydrocarbon content, microscopic examination of lithology and porosity, recording of drilling rate, correlation of formation samples with depth, titration of solubles in the drilling fluid filtrate, and mud tests.

A vacuum treatment has been added to establish a pressure differential sufficient for liberating residual gaseous hydrocarbons from samples, and suitable solvents are used for releasing liquid hydrocarbons. The formation sample, collected at 2-foot intervals in a well, is washed, sealed in a container, and placed in a gas analyzer, which consists of a vacuum pump, an agitator, and a Wheatstone bridge. The bridge measures variations in resistance in a detector circuit under varying conditions caused by ignition of hydrocarbon gases. The use of the equipment is described, and composite log tracings are shown.—*V. S.*

9881. Guyod, Hubert. Electrical logging developments in the U.S.S.R., Part I, Resistivity of non-invaded formations: World Oil, vol. 127, no. 8, pp. 231–235, Houston, Tex., 1947.

The paper discusses different methods of electrical logging introduced and developed in the U.S.S.R., as presented in books by L. M. Alpin and V. N. Dakhnow. It also discusses resistivity departure curves with two and three electrode arrangements for the case of an unintruded formation and the method of obtaining from them the true resistivity of the petroleum reservoir. The latter quantity is one of the factors determining petroleum saturation. This method is not basically new to American petroleum geologists, as it has been used for many years in surface exploration and is discussed in a paper by Irwin Roman. (*See* Geophys. Abstracts 96, no. 4838 and 107, no. 6302.)

This is the first of the new series of articles written by the author, who has already published many papers on electrical methods of exploration for oil.—*S. T. V.*

9882. Kilkenny, J. E. Geological interpretation of radioactivity well logs: Petroleum Engineer, vol. 18, no. 12, pp. 137–138, Dallas, Tex., 1947.

Radioactivity is manifested in the form of alpha rays, beta rays, and gamma rays which are emitted by the radioactive elements uranium, thorium, potassium, and rubidium. Most common radioactive minerals are indicated, and the radioactivity of igneous and sedimentary rocks is discussed briefly.

In radioactivity logging the measurement of gamma rays has proved the most successful. When an ionization chamber is subjected to the action of gamma rays emitted from the walls of a well, the chamber's gas

is ionized, and the flow of electricity between its electrodes may be recorded on a radioactivity log. When, on the other hand, a shielded neutron source is used for bombarding the walls of the well to stimulate radioactivity, the ionization chamber records a neutron log. In the San Joaquin Valley, California, sporbo and phosphatic nodules have been found to be radioactive, whereas some of the brown organic shales have not shown high radioactive values.—*V. S.* (*See also* Geophys. Abstracts 127, no. 8882.)

9883. Morse, R. A., Terwilliger, P. L., and Yuster, S. T. Relative permeability measurements on small core samples: Pennsylvania State College, Min. Industries Exper. Sta., Tech. Paper 124, 6 pp., State College, Pa., 1947.

The relative or fractional permeability of a porous medium to one of several fluid phases present, as a function of the fluid saturations, is a very important relationship in both primary and secondary recovery. Such data are useful in predicting the rate and quantity of recovery, the rate and quantity of displacing fluid needed, and the connate water saturation. Valuable as such information can be for an engineering analysis of an area, comparatively little application has been made of it primarily because of the difficulty and expense of obtaining the data. This paper describes a simple, rapid, and accurate method of determining such data by using small laboratory core samples. The results on several cores are given, and the rates and recoveries predicted by this method are shown to agree with the data obtained from more complex and time-consuming experiments on long cores.—*Authors' abstract.*

9884. Petroleum Engineer. X-ray oil field from the laboratory: Vol. 18, no. 9, p. 53, Dallas, Tex., 1947.

The Gulf Oil Corp. has developed a technique of X-raying rock samples from oil fields to study oil flow and predict oil recovery. A 3-inch core is saturated with oil, gas, or water under artificial pressures, while at the same time a special X-ray apparatus for determining permeability saturation makes pictures of the progress of these elements through the rock. The progress is rendered visible by an opaque tracer mixed with the liquid or gas, similar to practice in X-raying organs of the human body through the use of opaque barium.

Several flow experiments, designed to reproduce conditions created in the investigated well by various recovery methods, are made in this manner in order to chart the effects of gravity, of capillary attraction, and of the initial amount of oil, gas, and water characteristic of a core. The procedures must be repeated on a number of cores taken from different layers in the well. From the data obtained it is possible to determine how natural pressure, artificial gas injection, or water flooding will move oil through various strata of the field under study.—*V. S.*

9885. Pirson, S. J. Electric logging—A study of the self-potential curve: Oil and Gas Jour., vol. 46, no. 22, pp. 72–88, Tulsa, Okla., 1947.

The physical principles underlying the measurement of electrical potential in wells are examined, and the investigations of Kruyt, Freundlich, Ettisch, Bull, Gorter, Gillingham, Byck, Mounce, Rust, Dickey, and the author are reviewed briefly. It is found that the self-potential curve obtained by the logging of a well is the composite of three main potentials: The streaming or electrofiltration potential de-

pending on rock texture, rock surface, and well electrolyte; the diffusion potential or concentration-cell effect at the sand face due to the salinity contrast between well water and formation water; and the Mounce potential of the formation. In addition to these main elements the self-potential curve also reflects the electrode potential and the stratigraphic potential. The combined effect of all these components, obtained in actual measurements, is illustrated by a theoretical example of the logging of a shale section in a cable-tool well.—*V. S.*

9886. Pirson, S. J. Electric logging—The resistivity curves: Oil and Gas Jour., vol. 46, no. 25, pp. 94–97, Tulsa, Okla., 1947.

In electrical logging the relation between the true resistivity of formations and the apparent resistivity actually measured depends upon how measurements are made. To clarify the efficacy of existing practices, different types of electrode systems used for the resistivity logging of wells are examined with the aid of formulas of the potential created at a distance from the source of current in the case of a half infinite medium and a total infinite medium. Attention is given to three-electrode systems of the standard, inverted, reversed, and reversed-inverted type; to symmetrical four-electrode systems of the normal type with equal and unequal electrode spacing, and of the inverted type with equal spacing; to two-electrode systems of the normal and inverted type; and to the single-electrode system. The operation of each of these systems is expressed by equations of the potential and of resistivity and is illustrated graphically.—*V. S.*

9. UNCLASSIFIED GEOPHYSICAL SUBJECTS

9887. Barnett, R. E. Effectiveness of geophysical explorations at Fort Randall Dam, South Dakota [abstract]: Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, pp. 1165–1166, Baltimore, Md., 1947.

Seismic and electrical-resistivity methods of subsurface explorations were used at Fort Randall Dam, South Dakota, to test the applicability of each method to engineering investigations in flood-control projects along the Missouri River. Fort Randall Dam was selected because of the variety of geologic conditions in the area and because of the abundance of drill holes against which the data might be checked. The rocks of the area are relatively soft shales, chalk, and quartzite. The overburden is made up of alluvial sand and gravel, glacial till, and loess. These materials were investigated individually and in various combinations.

The tests gave results of varying reliability depending upon the combination of materials investigated. On the whole, the electrical-resistivity method gave little information that could be correlated with known conditions. The seismograph gave information of considerable value on depths to the top of rock. The accuracy of these determinations also varied with the materials investigated.—*Condensed by V. S.*

9888. Bartram, J. G. Past and future of oil exploration in Rocky Mountain area: Oil and Gas Jour., vol. 46, no. 23, pp. 178–179, Tulsa, Okla., 1947.

By the end of 1946 the older known oil-bearing structures in the Rocky Mountain region had been fairly well explored, and new anticlines

were sought during 1947 in the less known early Tertiary basins. The local geology and geophysical activity are outlined briefly, and maps are given to show the progress of oil search, the location of the Tertiary basins, and the distribution of geophysical operations in July 1947. During this month there were 57 seismic crews, 25 gravimeter crews, and a few magnetic and core-drilling crews in the field. The cost of a seismic reflection party in the Rocky Mountains is about $15,000 a month and of a gravimeter party $5,000 a month, so that the total expense for current geophysical work has approximated $1,000,000 a month.—*V. S.*

9889. Bohdanowicz, Karl. The activity of the Geologic Institute of Poland in the year 1946 [in Polish], 87 pp., Warsaw, 1947.

This is the first postwar account given by the Geologic Institute of Poland on its activity; it relates to the 9 months, April to December 1946. Reorganized after the war, the Geological Institute includes a division of applied geophysics and a seismological observatory.

The division of applied geophysics concentrated its effort on preparing for publication the geophysical material salvaged from destruction during the war, on restoring the geophysical field work in the immediate future, and on acquiring the necessary scientific equipment. It has renewed the work on the gravimetric map of Poland and prepared for publication the results of the gravimetric surveys made in 1937–39 by E. W. Janczewski, comprising 1,160 field stations. The field work of a geophysical nature, accomplished in 1946, includes the measurements of magnetic inclination and of the vertical component of the magnetic force and magnetic surveys of certain regions characterized by pronounced magnetic anomalies. A total of 3,186 field stations have been covered by magnetic surveys.

The seismological observatory renewed its normal activity on June 13, 1946, and recorded seismograms of several important earthquakes, such as the earthquakes of Peru on November 4 and the earthquake of Japan on December 21, 1946.—*S. T. V.*

9890. De Ment, Jack. Ultraviolet light in mercury prospecting: Mineralight News Bull., no. 8, 2 pp., Los Angeles, Calif., Ultraviolet Products, Inc., 1945(?).

The ultraviolet lamp is suitable for mercury prospecting in the field and can be used for laboratory tests. Its light provides a means for detecting mercury in any material, particularly in ores and minerals. Alone, the lamp can serve for identifying only a few mercury minerals, which are neither widespread nor valuable. Most of the other mercury minerals, including the important cinnabar and the metal itself, require the use of the lamp in combination with a fluorescent screen.

The method of the fluorescent screen is based on the ability of mercury vapors to absorb ultraviolet light. The lamp's light is projected on the screen through the medium of vapors emitted by the rock samples heated for test. As long as the light is not absorbed by the vapors, it strikes the screen and causes it to fluoresce, indicating the absence of mercury in the samples. When, however, a shadow appears on the screen, the sample is proved to emit absorbing vapors and to contain mercury.—*V. S.*

9891. Donabedov, A. T. Geophysical methods of exploration in their relation to the problems of the Donbas [in Russian]: Internat. Geol. Cong., 17th, U.S.S.R., 1937, Rept., vol. 1, pp. 461–464, Moscow, 1939.

Since 1929 the Donbas region of the U.S.S.R. has been explored by gravitational, magnetic, seismic, electrical, and geothermal methods in quest of coal, oil, gas, metal, and other deposits. On the basis of the geophysical data obtained tentative maps have been drawn of the carbonaceous beds and the crystalline substratum of the basin, changes in the physical properties of the coals have been studied in relation to the local geologic characteristics, and salt domes and other local features have been detected. The geologic findings are discussed briefly with reference to geophysical observations; a few magnetic, seismic, and electrical features are noted; and conclusions are advanced on the geology and the coals of the basin.—*V. S.*

9892. Fagin, K. M. Oil prospecting in Alaska: Petroleum Engineer, vol. 18, no. 12, pp. 43–48, Dallas, Tex., 1947.

Geologic exploration and drilling work in the U. S. Naval Petroleum Reserve No. 4 in Alaska is outlined, with incidental references to geophysical surveying. The 35,000 square mile reserve is now being surveyed for the fourth consecutive year.

Geologic reconnaissance in 1944 indicated a large anticline near the oil seeps at Umiat, and a well drilled in 1945 revealed shows of oil in the Upper Cretaceous sandstones.

Seismic and geologic work in 1946 confirmed the existence of a structure at Umiat, and a second well was begun near the first well. Seismic work in 1946 also showed a structure at Cape Simpson in the north of the reserve, where surface studies are difficult. In 1947 a reflection survey delineated the Oumalik anticline, which had been indicated in the Ikpikpuk area by an aeromagnetic survey in 1946, and another reflection survey traced a traverse of about 90 miles southward from Smith Bay.

Gravitational reconnaissance conducted in 1947 covered two-thirds of the reserve. A Cessna airplane equipped with skis and pontoons transported a gravimeter from station to station and made possible six or seven readings per day.—*V. S.*

9893. Ferris, J. G. Ground-water hydraulics as a geophysical aid [abstract]: Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, p. 1273, Baltimore, Md., 1947.

It is shown that the method of images, which is time-honored in its application to problems in the conduction of heat or electricity, is applicable to the solution of similar problems in the flow of ground water in aquifers of finite areal extent. Although this method requires considerable simplification of field conditions to permit its use, the results obtained are of inestimable value in the prediction of aquifer performance and in the interpretation of the probable geologic structure.

Observational data are presented, and an analysis is made to indicate the differences between a geologic cross section of a drift-filled channel, as determined by test drilling, and the idealized cross section, as determined by the hydraulic evidence. The possibilities of this method as a geophysical aid in locating several types of geologic boundaries are out-

lined with due references to the limitations of the method.—*Condensed by V. S.*

9894. Gassmann, Fritz. Näherungsmethode zur Bestimmung der Quellen von Potentialfeldern in der Geophysik [An approximate method for the determination of sources of potential fields in geophysics, abstract]: Soc. helvétique sci. nat. Actes, 126th sess., p. 81, Aarau, Switzerland, 1946.

An approximate method is indicated for an improved determination of the supposed distribution of the sources of a potential field when this distribution deviates in some respects from the field measured on the surface of the earth. The underlying principle had been suggested previously. The method is based on Taylor's series expansion of a field in terms of the coordinates and the strength of the sources. It consists in calculating improved determinations for separate groups of sources rather than for the entire distribution at once, whereby the number of unknowns in the resolving linear systems of equations can be kept so small that the amount of calculation is not disproportionate to the limited precision attained.—*V. S.* (*See also* Geophys. Abstracts 128, no. 9075.)

9895. Grandry, G. de. Conrad Schlumberger et son oeuvre [Conrad Schlumberger and his work]: Rev. Univ. Mines, ser. 8, vol. 18, no. 9, pp. 387–393, Liége, Belgium, 1942.

A brief biographic account of Conrad Schlumberger (1878–1936), proponent of the electrical method of geophysical prospecting, is given, followed by a discussion of the principles of electrical prospecting and of electric and thermal logging.—*Ann. Bibl. Econ. Geol. 1946, vol. 19, no. 1, p. 66, Urbana, Ill., 1947.*

9896. Haalck, Hans. Das Gleichgewicht der Kräfte in Innern des Erdkernes und die sich daraus ergebenden Folgerungen [The equilibrium of forces acting within the earth's core and some inferences to be drawn therefrom]: Zeitschr. Geophys., vol. 17, pp. 135–146, Braunschweig, 1942.

Assuming that the core of the earth consists of free ionized iron atoms, which are in rapid thermo-kinetic movement and at the same time are highly compressed, the author analyzes the equilibrium conditions of forces acting on individual atoms and electrons. From these conditions it is possible to deduce the rate of the bulk compressibility of the matter as a function of the pressure and the intensity of a positive electric charge of the core.

The first physical constant, computed in this manner by the author, is in good agreement with the values generally assumed by seismologists. Using the second result the author determines the intensity of telluric currents, generated by the rotation of the globe, and the intensity of the resulting magnetic field. For the magnetic moment of this field the author computes a value which is in agreement with the experimental data.

The same considerations applied to the sun make the determination of its magnetic field possible. The obtained value is close to the known results of the experimental determinations made by Hale.—*Author's abstract, condensed and translated by S. T. V.*

Hershey, R. L. Tables of fluorescent and radioactive minerals. *See* Geophys. abstract 9848.

9897. Jones, Gordon. Geophysics and diamond drilling in the Quebec fields: Mines Mag., vol. 37, no. 5, pp. 23–25, 31, Denver, Colo., 1947.

A review of present conditions in Canadian mining is accompanied by brief remarks on the progress of geophysical exploration and diamond drilling. Magnetic surveys in 1944 led to the discovery of the Quemont, East Sullivan, and Louvicourt gold fields in Quebec. Geophysical surveys also aided in the discovery of the Lynn Lake nickel deposit in Manitoba and of a large iron deposit in Labrador, about 300 miles north of the Gulf of St. Lawrence. Diamond drilling has been advanced by improvements in equipment.—*V. S.*

9898. Meinzer, O. E. Report on ground water by the Research Committee of the Society of Economic Geologists: Econ. Geology, vol. 42, no. 7, pp. 672–675, Lancaster, Pa., 1947.

Considerable investigation has been in progress on the application of various methods of geophysical exploration in ground water investigations. Tests were made of electric-resistance and seismic methods; of electric logging of wells; of deep-well current meters; of apparatus for determining conductivity, temperature, and other characteristics of the water in wells; and of equpiment for measuring the depth of casing and diameter. Work of this type has gradually increased the effectiveness of both the hydrologic and geologic phases of ground-water investigation. It should be continued aggressively in order to make available every possible facility for future investigation.—*Excerpt, p. 674, edited by V. S.*

9899. Migaux, L. L'Importance économique de la geophysique appliquée [Economic importance of applied geophysics]: Houille, Minerais, Petrole, vol. 1, no. 3–4, pp. 116–123, Paris, 1946.

The article gives an appraisal of services rendered by geophysical methods of exploration and a comparison of economic gains with the expenditures made by different countries in searching for oil and minerals. Data are given on expenditures required for different methods of prospecting together with the necessary information on the corresponding organizational schemes in connection with such exploration. Most of the statistical data are based on the practices of the petroleum companies of this country.—*S. T. V.*

9900. National Oil Scouts and Landmen's Association. Oil and gas field development in United States, 1946: Yearbook, 1947, vol. 17, 943 pp., Austin, Tex., 1947.

The development of oil and gas fields during 1946 in 29 States and the United States as a whole is outlined with respect to geological and geophysical prospecting, land and leasing activities, wildcat exploration, proved field work, oil and gas production, pipe lines, and refineries. The information is arranged by States and includes reviews, statistical data, and maps. The text is prefaced by a general summary by W. L. Baker and has an appendix of statistics on various branches of the petroleum industry.

The scope of geophysical prospecting is indicated in the data for most of the States, and the relative success of geophysical and other methods in locating productive holes is given in a review of exploratory drilling by F. H. Lahee.—*V. S.*

9901. Wilson, J. T. Geological and geophysical study of a part of the Canadian shield [abstract]: Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, pp. 1241–1242, Baltimore, Md., 1947.

By informal cooperation of the Geological Survey of Canada, the Dominion Observatory, the Ontario Department of Mines, and the University of Toronto, a study has been started of a triangular area lying across the Ontario-Quebec boundary and including Sudbury, Timmins, and Val d'Or, with the object of learning the structure, tectonics, and physical properties in three dimensions of this well-investigated part of the Canadian shield.

The problem is being tackled in several ways. The geology is being recompiled and combined with information obtained from vertical air photographs. A series of traverses have been made with vertical magnetometers and with gravimeters. About 1,000 determinations of the radioactivity of rocks in the area have been made, and 800 more are contemplated. Temperature gradients, thermal conductivities, and heat flows have been measured in three mines to depths of about 7,000 feet. Determinations of the thicknesses and properties of crustal layers are in progress by the recording of earthquakes and rock bursts with specially arranged seismographs.

9902. World Petroleum. Magnolia testing off-shore formations in the Gulf: Vol. 18, no. 3, pp. 60–61, 110, New York, 1947.

The article gives a short description of the underwater drilling of a well in the Gulf of Mexico about 5 miles offshore, started by the Magnolia Petroleum Co. It was brought to a depth of 12,874 feet. The article gives many structural details about the platform and derrick equipment, built with a floor level some 20 feet above the water and designed to withstand the hurricanes that sweep across the Gulf with a wind velocity of as much as 100 miles an hour. Difficulties encountered are described, as well as some of the technical and organizational problems that have arisen in relation to the project. Twenty-six men operate the well-drilling equipment, 64 men are constantly at work on the project, and 17 men carry on seismic exploration. A second exploratory test, foundations for which are being constructed, will be made 29 miles offshore.—*S. T. V.*

10. RELATED GEOLOGICAL SUBJECTS

9903. Evrard, Pierre. Statistical relation between TiO_2, Fe_2O_3, and FeO in rocks and ores during differentiation of a titaniferous magma: Geol. Soc. America Bull., vol. 58, no. 3, pp. 197–210, Baltimore, Md., 1947.

This paper presents the results of a statistical study of the relations that hold between Ti and Fe during the process of magmatic differentiation in the anorthositic and gabbroic series of rocks and ores of the Adirondacks. It is shown that in the course of differentiation for each series the total number of molecules of TiO_2, FeO, and Fe_2O_3 as a whole and of the number of TiO_2 molecules have increased continually. A simple mathematical expression is derived which expresses the manner of variation of TiO_2 relative to $TiO_2+Fe_2O_3+FeO$.—*Author's abstract.*

9904. Foster, W. R. Useful aspects of the fluorescence of accessory-mineral zircon [abstract]: Geol. Soc. America Bull., vol. 58, no. 12, pt. 2, p. 1181, Baltimore, Md., 1947.

The mineral zircon has long been known to exhibit fluorescence when exposed to ultraviolet radiation. Hitherto little practical use appears to have been made of this phenomena. Its application is here recommended in the inspection of commercial concentrates of zircon, and of other minerals containing zircon as an impurity. Comparison of the fluorescent behavior of grains of zircon from igneous rocks of different ages, and from igneous as compared to sedimentary sources, reveals certain contrasts. The possible usefulness of such contrasts in the solution of a number of petrological problems is discussed. Reference is also made to the fluorescence of accessory-mineral apatite, and of certain other minerals found in association with zircon.

9905. Grim, R. E. Relation of clay mineralogy to origin and recovery of petroleum: Am. Assoc. Petroleum Geologists Bull., vol. 31, no. 8, pp. 1491–1499, Tulsa, Okla., 1947.

The clay-mineral concept of the nature of clays and shales is briefly discussed in its relation to problems of the origin and recovery of oil and gas. It is found on the basis of available data that the character of the clay minerals making up a sediment is to a considerable degree the result of diagenetic changes in the environment of accumulation. In argillaceous sediments the relation of clay minerals to organic material suggests that some clay minerals under certain conditions are the key factor in the transition of organic matter to petroleum. In the light of the studies made of the effects that water containing electrolytes exerts upon any clay, the properties of clay minerals appear to be significant factors in the recovery of oil. Other effects of properties of various clay minerals are discussed.—*Author's abstract, condensed by V. S.*

9906. Nuss, W. F., and Whiting, R. L. Technique for reproducing rock pore space: Am. Assoc. Petroleum Geologists Bull., vol. 31, no. 11, pp. 2044–2049, Tulsa, Okla., 1947.

A practical method of reproducing rock pore space in visible form has been developed. Casts of the porosity of Permian and Devonian reservoirs of west Texas, the Hunton of Oklahoma, the Arbuckle of Kansas, and the Woodbine of east Texas have demonstrated the usefulness and practicability of plastic models in the study of petroleum-reservoir permeability. Full-color pictures and slides of the models have been used successfully for demonstration of continuity in limestone reservoirs.—*Author's abstract.*

9907. Pressler, E. D. Geology and occurrence of oil in Florida: Am. Assoc. Petroleum Geologists Bull., vol. 31, no. 10, pp. 1851–1862, Tulsa, Okla., 1947.

The Apalachicola embayment of south Georgia and west Florida is considered to have a maximum sedimentary fill of clastic sediments in excess of 15,000 feet, and the south Florida embayment, comprising the area of south Florida, the Bahamas, Cuba, and the intervening areas, a maximum fill of nonclastic sediments approaching 20,000 feet;

the area of the Great Bahama Bank is supposed to be underlain by a sedimentary section in excess of 10,000 feet. In the two embayments anticlines are probably the most prevalent type of structure according to present data, though faulting is undoubtedly present, and conditions are favorable for the formation of stratigraphic traps. Oil production has been developed on the south Florida segment of the embayment, and additional drilling is under way. Gravity and core drill are the most widely used methods of prospecting. Further experimental work is necessary to develop a proper seismograph technique.—*Author's abstract, condensed by V. S.*

9908. Robinson, G. D., and others. Alaskan volcano investigations, report No. 2, Progress in 1946; prepared by the Geological Survey for the Chief of Engineers, U. S. Army; 105 pp., 8 maps, Washington, D. C., 1947.

In 1946 the U. S. Geological Survey began a series of volcano investigations in the Aleutian arc at the request of the U. S. War Department. The general objective of the program is the collection and interpretation of geologic information of military value, with the ultimate aim of developing techniques for predicting the nature, location, and time of volcanic eruptions. Studies are planned for establishing regional and local patterns of eruption on the basis of the geologic history of the arc and for developing day-to-day predictions of the activity of individual volcanoes by geological and geophysical methods.

The work carried out during 1946 is described in reports on the Pavlov Volcano, Umnak Island, Great Sitkin Island, northern Kanaga Island, and some western Aleutian islands. The investigations on Umnak Island included seismic, electrical, and geothermal studies.—*V. S.*

9909. Rodionov, P. V. On exploratory indications of lead-zinc deposits on the Karatau Ridge (in Russian): Razvedka Nedr, vol. 13, no. 3, pp. 3–8, Moscow, 1947.

The Karatau Mountain Ridge in Kazakhstan is an important lead-zinc province of the U.S.S.R. where deposits are scattered over an area 200 kilometers in length. Geologic exploration conducted during 1932–38 brought to light various diagnostic indications by means of which these deposits could be detected. Tested criteria useful as guides in local prospecting are described. It is found that direct signs in the form of various types of outcrops will be of little value in the future and that chief attention should be given to indirect geologic indications. Among the latter only the lime breccia of hydrothermal origin promise to localize deposits within reasonably narrow limits.—*V. S.*

9910. Sullivan, C. J. Geology as an aid to ore-finding: Chem. Eng. Min. Rev., vol. 39, pp. 95–100, Melbourne, Australia, 1946.

The exploratory value of microscopic and chemical studies of zones of alteration, of mineral zoning, of the relation of depth of ore deposition to depth of erosion, of the origin of ore deposits, and of trace elements, in addition to considerations of structural geology, is illustrated by a number of Australian examples.—*L. J. J., British Abstracts, A1, April 1947, p. 131, London, 1947.*

9911. Swesnik, R. M., and Wheeler, R. R. Stratigraphic convergence problems in oil-finding: Am. Assoc. Petroleum Geologists Bull., vol. 31, no. 11, pp. 2021–2029, Tulsa, Okla., 1947.

Onlap, involving loss of beds at the base of a transgressing sequence, and truncation, by which beds are leveled off by differential erosion, are regarded as the important factors in stratigraphic convergence. These processes are quantitatively formulated with reference to the rates of dip in the case of the upper beds, the unconformity, and the lower beds. The applications of convergence formulas to reconstructing paleogeology, to locating belts of wedge-out reservoir rocks, and to detecting structural anomalies are discussed with especial emphasis on the possibilities for cooperation between seismologists and geologists in finding stratigraphic traps.—*Authors' abstract.*

9912. Van Tuyl, F. M., and Levings, W. S. Review of petroleum geology in 1946: Colorado School of Mines Quart, vol. 42, no. 3, 316 pp., Golden, Colo., 1947.

The rapid expansion of the literature on petroleum geology and allied subjects, as well as on the supporting sciences, renders a complete survey of new developments a difficult task. Many important contributions worthy of more serious consideration are listed in the classified bibliography.

The review of published information is supplemented by statements from many leading workers in the oil industry regarding improvements in techniques, special investigations, developments in specific areas, and other topics. An attempt is made to predict trends in petroleum exploration and to survey authentic opinions regarding the future of the oil industry.—*Authors' abstract.* (The bibliography covers 115 pages.)

11. TECHNICAL AIDS TO EXPLORATION

9913. Deegan, C. J. New land surveying tool: Oil and Gas Jour., vol. 46, no. 29, pp. 75–77, Tulsa, Okla., 1947.

In gravity surveys the need of special terrain corrections at some of the stations can be met with W. O. Bazhaw's new elevation-measuring instrument, which substitutes a 35-millimeter camera for the usual telescope and vertical-arc equipment on the surveying transit. The camera has a horizontal and a vertical lens for focusing respectively on the stadia rod and on the magnetic needle, and a photographic record is made instead of customary entries in notebooks. All computations of elevation can be carried out directly from this record examined through a magnifying device. On a recent 6-mile traverse made under conditions resembling those of gravimeter work the surface closure error was 20 feet and the elevation closure error was 0.21 foot in a total range of elevation differences of 182 feet.—*V. S.*

9914. Ickes, H. E., and Cannon, T. L. The odograph: Military Engineer, vol. 39, no. 259, pp. 200–201, Washington, D. C., 1947.

Odograph is the name of a new navigational instrument for use in reconnaissance operations and general control of troop movements. It automatically plots a line on a map, indicating the course taken by the vehicle in which it is mounted. It was developed and widely used during World War II and was considered very valuable. The whole assembly weighs about 125 pounds. It performs with a range of error of less than 3 percent. The basic element of the instrument is a pre-

cision magnetic compass designed by the Carnegie Institution of Washington. Its reading is transferred to a plotting unit through a linkage controlled by two photoelectric cells, a mirror, and a thyratron tube. The plotting unit integrates two displacement components of the vehicle and the distance traveled. The reading recorded by the plotting pencil on a map is the product of the distance traveled and the sine and cosine of the angle of azimuth. The scale of the recording may be varied by adjusting various controls. It is believed that the instrument will be found valuable for survey work.—*S. T. V.*

9915. Razvedka Nedr. The application of aerial methods in geologic exploration [in Russian] : Vol. 13, no. 5, pp. 81–83, Moscow, 1947.

An account is given of the session held by the Technical Council of the Ministry of Geology, U.S.S.R., in the summer of 1947 on the application of aerial methods for the execution of the current 5-year plan of geologic mapping designed to cover an area of 5 million square kilometers. The reports submitted to the session are outlined, and the recommendations of the council are given. The measures adopted dealt with the concentration, preservation, and use of aerophotographic data ; the technical supervision of aerogeologic and aeromagnetic surveys : the development of aerial methods of geologic exploration ; and the instruction of personnel.—*V. S.*

9916. Riehl, Nikolaus. Physik und technische Anwendungen der Lumineszenz [The physics and technical applications of luminescence], 218 pp., Berlin, Verlag von J. Springer, 1941 ; lithoprinted by Edwards Bros., Inc., Ann Arbor, Mich., 1944.

Recent advances in the field of luminescence, brought about in part by the unpublished work of industrial laboratories, prompt the author to give a systematized account of present-day knowledge and its technical applications. Presentation covers the physics of inorganic luminescent substances, theory and properties of luminescence, methods and instruments employed for application, various uses, and related subjects. Principal attention is given to the luminescent substances in the crystalline-phosphor group (Kristallphosphore), such as zinc and zinc-cadmium sulfides, silicates, and tungstates, which are being developed with particular success in industry.—*V. S.*

9917. Sommer, A. Photoelectric cells, 102 pp., New York, Chemical Pub. Co., 1947.

This book deals with the emission-type photocell, the construction of which is based on the phenomenon of the liberation of photoelectrons in an electrostatic field, effected by light impinging on the cathode. The subjects covered include photocathodes, vacuum and gas-filled cells, the multiplier photocell, and the applications of photocells. Presentation is intended for readers interested in fundamental principles. A bibliography of noteworthy writings published during 1931–45 is appended.—*V. S.*

9918. Speert, J. L. Survey-net adjustment by electrical analogue : Am. Geophys. Union Trans., vol. 28, no. 6, pp. 831–837, Washington, D. C., 1947.

This paper describes how the equivalent of a least-squares adjustment of a level or traverse net may be obtained by electrical measurements

in an analogous electrical net. The lengths of the survey lines are replaced by proportional electrical resistances; the survey closures are replaced by proportional small d. c. voltages; and the adjustment corrections are read as electrical potentials at the various junction points. The resistances, power units, and junction jacks of the electrical net are mounted on a panel and are interconnected by jumpers. The closure and correction voltages are determined with a special type feed-back voltmeter.—*Author's abstract.*

9919. Stuart, A. H. Electrical conductivity: Petroleum, vol. 10, no. 8, pp. 174–175, 194, London, 1947.

It was once the common practice to divide substances into the two categories of electrical conductors and nonconductors or insulators. That was an over-simplification of a very complex problem, for it is now known that the so-called nonconductors are only bad conductors, some being worse than others. Most industries are affected by this problem, since it is desirable to make the conductors that are used as good as possible while choosing those substances for insulators whose conductivity approaches zero. The petroleum industry is chiefly concerned with the latter part of this problem, such as insulation in transformer and cable oils.—*Author's abstract.*

9920. Wengerd, S. A. Newer techniques in aerial surveying—photogrammetric processes: World Oil, vol. 127, no. 5, pp. 49–54, Houston, Tex., 1947.

In aerial surveying it is difficult to make truly vertical photographs, and various photogrammetric processes must be employed to correct vertical photographs for tilt. The procedures for finding the isocenter, the radial-line techniques for horizontal control, and the uses of the Zeiss Multiplex and the KEK stereoscopic plotter for preparing contour maps are described. To illustrate the work with the Multiplex and the KEK plotter, examples are given of application in the aerial surveys of Alaska.

The oblique aerial view is more easily interpreted as to ground features than the vertical view, but photogrammetric measurements on oblique photographs generally are more difficult to convert to map data. The use of the Canadian grid-process, of various graphic methods, and of the Wilson photo-alidade and the Honman oblique height-finder for such conversion are outlined.—*V. S.*

12. PATENTS

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

9921. (1) Gravitatiemeter met horizontaal torsiedraad [Gravimeter with horizontal torsion wire]. Bataafsche Petroleum Maatshappij, The Hague: Dutch patent 52,295, issued April 15, 1942.

A body is rigidly attached to a horizontal wire in such a manner that the body's center of gravity lies outside the axis of the wire. Being in an unstable position, the body is set off balance by any torsion of the wire, and the amount of the body's rotation serves as an index of the force of gravity. At some distance from the first-mentioned body a second body is rigidly attached to the wire, and the center of gravity of the second body is also located outside the axis of the wire. The mutual positions of the two bodies in the apparatus are so chosen that the absolute sensitivity of the instrument is practically uniform throughout the

range of measurement. The two bodies are rigid and are immersed in a liquid, the weight of the bodies being equal to the weight of the liquid displaced by them. Claims allowed, 3.

9922. (2) Method and apparatus for magnetic testing. F. B. Doane, Wilmette, Ill., assignor to Magnaflux Corp., Chicago, Ill., a corporation of Delaware: U. S. patent 2,421,775, issued June 10, 1947.

The method of magnetizing a test piece including the steps of applying a direct current magnetizing force tending to magnetize the test piece in one direction, simultaneously applying another direct current magnetizing force tending to magnetize the test piece in another direction, and varying the values of the direct current magnetizing forces. Claims allowed, 4.

9923. (2) Magnetic field strength indicator. E. P. Felch, Jr., Chatham, N. J., and Thaddeus Slonczewski, Glenwood Landing, N. Y., assignors to Bell Telephone Laboratories, Inc., New York, N. Y., a corporation of New York: U. S. patent 2,427,666, issued Sept. 23, 1947.

A system for indicating the field strength of magnetism comprising in combination three magnetometer cores of magnetic material having their principal magnetic axes mutually perpendicular, windings for each core, a source of alternating current coupled to said windings whereby second harmonic voltages are induced therein of magnitudes proportional respectively to the product of the field strength and the direction cosine of the angle formed between the principal axis of each core and the direction of the magnetic field, an electric squaring means responsible to the three second harmonic voltages, said squaring means comprising three harmonic generators, one coupled to each magnetometer, an output circuit for each generator, an electric circuit connecting in parallel the output circuits of the three harmonic generators, a filter included in said output circuits capable of passing only current equal to the fourth harmonic of said alternating current whereby the three fourth harmonic output currents from the harmonic generators are effectively added together, and an indicator responsive to the sum of the added currents. Claims allowed, 21.

9924. (2) Magnetic compass. W. G. White, Waban, Mass.: U. S. patent 2,428,346, issued Sept. 30, 1947.

A magnetic compass comprising a truly spherical bowl, a shallow saucer-shaped member nearly large enough to cover a complete equatorial plan through the bowl, a cardanic mount arranged to suspend said member substantially in the normal horizontal equatorial plane of the bowl, a compass card smaller in area than that of the member, a universal pivot mount carried by said member in position to support the compass card closely adjacent and parallel to the member, and a liquid filling the bowl, there being substantially equal volumes of liquid on either side of said member. Claims allowed, 12.

9925. (2) Method and apparatus for magnetic testing. Cecil Farrow, Bainbridge Township, Geauga County, Ohio, assignor to Republic Steel Corp., Cleveland, Ohio, a corporation of New Jersey: U. S. patent 2,434,203, issued Jan. 6, 1948.

A circuit for non-destructive testing which comprises a primary signal circuit for generating a signal, a secondary circuit for picking

up said signal and including a pair of serially connected pick-up coils adapted to have an article being tested passed through or near them to affect the picked-up signal and having a common terminal, the electrical potential of which is referred to for reference as zero-potential, a pair of parallel branch circuits, each connected in series with the signal coils and including resistive and reactive elements with an output terminal at an intermediate point in the circuit, means for relatively adjusting the impedances of said elements for normally producing zero-potential at the output terminal, output connections for each of said parallel circuits between the said zero-potential coil terminal and said output terminals, and means connected to said output connections to measure a change from zero-potential difference upon a change in phase of said signal in the pick-up coils. Claims allowed, 10.

9926. (2) Inrichting voor geophysische metingen, voorzien van een electronenstraalbuis, welke cardanisch of gyroscopisch is opgehangen en waarbij de afbuiging van den electronenstraal een maat is voor de intensiteit van het aardmagnetische veld [Apparatus for geophysical measurement, with an electron tube, cardanically or gyroscopically suspended, in which the deflection of the electronic ray is an index of the intensity of the earth's magnetic field]. Ludwig Machts, Marburg, Germany: Dutch patent 53,399, issued Nov. 16. 1942.

An electron tube is equipped with a single annular or cylindrical electrode. The electron current, generated on the electrode, is dependent upon the deflection of the electronic ray and can be read directly, amplified or not, on an indicating or recording instrument. Claims allowed, 1.

9927. (3) Electroacoustic transducer. Hugo Benioff, La Canada, Calif., assignor, by mesne assignments, to Submarine Signal Co., Boston, Mass., a corporation of Delaware: U. S. patent 2,419,197, issued April 22, 1947.

In an electroacoustic device, in combination, a vibratory mounting unit comprising a longitudinally vibrating element having a free end, a mounting reed projecting laterally from the longitudinally vibrating element near its free end, said reed having a flat surface parallel to its length dimension, piezoelectric crystal elements, means cementing said piezoelectric crystal elements on the mounting surface of said reeds, said piezoelectric crystal elements having electrodes extending parallelly to said mounting surfaces, and a radiating member on which said longitudinally vibrating element is mounted substantially normally thereto, said vibrating reed and said longitudinally vibrating element being tuned substantially for the desired frequency at which said electroacoustic device is to operate. Claims allowed, 5.

9928. (3) Vibration recorder. W. W. Young, Beaumont, Tex., assignor to Sun Oil Co., Philadelphia, Pa., a corporation of New Jersey: U. S. patent 2,420,025, issued May 6, 1947.

Vibration recording apparatus comprising in combination, a blasting machine having an operating handle movable to and from a detonating position, an oscillograph adapted to indicate the presence of vibration, means including a source of current and lights to illuminate electrically for photographic purposes said oscillograph indications, a camera

adapted to record on moving film said oscillograph indications, relay circuit means for controlling the operation of said camera and said electric illumination means, said relay circuit means including a manually operable switch for simultaneously operating a relay and said camera, said relay being operable to disconnect said lights from said source of current, and a second relay being operable in response to the movement of said blasting machine handle to its detonating position to connect said lights to said source of current and provide illumination of said oscillograph indications. Claims allowed, 4.

9929. (3) Lowering device. O. W. Lundblad, Ishpeming, Mich., assignor to Hercules Power Co., Wilmington, Del., a corporation of Delaware: U .S. patent 2,420,182, issued May 6, 1947.

In a device for lowering explosive cartridges the combination of a hook; a cutter slidably retained in said hook; a hanger rod in slidable preloaded attachment to said hook and adapted to actuate the cutter to sever material retained by the hook upon application of sufficient reactive force to the rod to cause relative movement between the hook and said rod; and adjustment means whereby the amount of preloading can be regulated. Claims allowed, 5.

9930. (3) Vibrating device. H. S. Wenander, Riksby, Stockholm, Sweden, assignor to Vibro-Plus Corp., Wilmington, Del., a corporation of Delaware: U. S. patent 2,422,639, issued June 17, 1947.

In a vibrating device, a vibratory member. a rotatable shaft having a weighted member adjacent one end thereof. a bearing for the other end of said shaft carried by said vibratory member, said weighted member having a surface of revolution contacting with a surface of revolution fixed relatively to said vibratory member, said bearing and shaft being so constructed and arranged that said weighted member forms the outer end of a conical pendulum rotatable about the axis of said shaft and movable circularly relative to the vibratory member, the mass of said conical pendulum being eccentric relative to the axis of said shaft, the eccentricity of said mass being of such magnitude that, when the shaft is rotated at approximately normal speed, sufficient centrifugal force is exerted on said pendulum to move the surface of revolution of said weighted member out of stable sliding contact, and into rolling contact, with the surface of revolution of said vibratory member. Claims allowed, 4.

9931. (3) Phase measuring system employing frequency modulation. S. A. Scherbatskoy, Tulsa, Okla.: U. S. patent 2,428,180, issued Sept. 30, 1947.

In a method of comparing phases of two alternating electrical signals, the step of translating each of the alternating signals into another signal of a frequency varying in synchronism with the said alternating signal, the said varying frequency being large as compared with the frequency of the said alternating signal, and the step of determining the frequency difference of the two variable frequency signals as an index of the phase conditions of the said two alternating signals. Claims allowed, 4.

9932. (3) Automatic volume control for seismograph amplifiers. R. G. Piety, Yonkers, N. Y., assignor to Phillips Petroleum Co., a corporation of Delaware: U. S. patent 2,430,246, issued Nov. 4, 1947.

In a seismic prospecting system of the type described, the combination comprising a plurality of low frequency vacuum tube amplifiers, each comprising a plurality of multi-electrode vacuum tubes having coupled input and output circuits, independent geophones as signal sources for applying signal currents to each of said amplifiers, a plurality of independent rectifiers connected to the output circuits of said amplifiers respectively with each alternate rectifier output reversed in phase whereby the tendency of the circuit to oscillate is minimized, a single mixing and filtering circuit connected to the output circuits of all of said rectifiers, a connection from the output of said mixing and filtering circuit to an input circuit of each of said amplifiers to control the gain thereof, and voltage indicating meters respectively, energized by said amplifiers to indicate the relative strength of the applied signals. Claims allowed, 2.

9933. (3) Seismic amplifying system. Herbert Hoover, Jr., Sierra Madre, Calif., assignor, by mesne assignments, to United Geophysical Co., Inc., Pasadena, Calif., a corporation of California: U. S. patent 2,430,983, issued Nov. 18, 1947.

In combination with am amplifier having a vacuum tube provided with a control element, the D. C. voltage on which determines the gain of the amplifier, and means for biasing said element from a source of D. C. voltage; connections adapted to apply different values of voltage from the source to the control element and timed control means for selecting said connections, said control means comprising tandem-arranged relays and timing circuits between successive relays, whereby the successive relays are energized at predetermined time intervals from the preceding relay, and means for selecting a different one of the connections upon energization of each successive relay. Claims allowed, 3.

9934. (3) Seismic exploration with control of directional sensitivity. Alexander Wolfe, Houston, Tex., assignor to Texaco Development Corp., New York, N. Y., a corporation of Delaware: U. S. patent 2,431,600, issued Nov. 25, 1947.

In a seismic exploration system for suppressing reflections from horizontal or gently dipping beds without materially reducing sensitivity to reflections from steeply dipping beds, a source of seismic waves, a plurality of seismic wave detectors disposed along the earth's surface in series alignment with said source, an amplifier connected to receive the output of each detector, an indicating device connected to each pair of detectors, the distances between each of said pairs of detectors connected to one indicating device being the same, a separate impedance in the connection between said device and each detector to which the device is connected, and a pair of impedances connected across each indicating device, the center point between each of said pairs of impedances being grounded, the value of each impedance in said pairs being less than the value of each of said impedances connected between an amplifier and an indicating device so that each of said devices will indicate the difference between the outputs of the amplifiers to which it is connected. Claims allowed, 1.

9935. (3) Means for positioning explosives in bore holes. J. L. Bisch, Valencia, Pa., assignor to Atlas Powder Co., Wilmington, Del., a corporation of Delaware: U. S. patent 2,433,543, issued Dec. 30, 1947.

A device for lowering into bore holes explosive packages comprising a body of explosive material and a wrapper for the same having a crimped-over top, said device consisting of a tonglike structure comprising a plurality of substantially parallel legs provided with inturned upwardly directed hooks adapted to be thrust into the sides of the explosive package through the wrapper thereof, said hooks being substantially triangular shaped in cross-section and sufficiently sharp upon their upper edges to slit the wrapper and cut through the crimped top thereof when given a sharp upward jerk with respect to the explosive package, the lower sides of said triangular shaped hooks being sufficiently wide to support the weight of the explosive package without cutting out of the same in the absence of such sharp upward jerk. Claims allowed, 2.

9936. (3) Compressional wave translating device. R. L. Peck, Jr., Short Hills, N. J., assignor to Bell Telephone Laboratories, Inc., New York, N. Y., a corporation of New York: U. S. patent 2,434,285, issued Jan. 13, 1948.

A compressional wave translating device comprising a cylindrical core including circular end portions and a plurality of parallel legs of magnetostrictive material connecting said end portions, said legs being of small cross-sectional dimensions relative to the spacing between adjacent legs, means mounting said core for longitudinal vibration, and a coil electromagnetically coupled to said core. Claims allowed, 8.

9937. (4) Apparatus for measuring the ratio or product of two alternating voltages. J. E. Owen, Tulsa, Okla., assignor to Geophysical Research Corp., New York, N. Y., a corporation of New Jersey: U. S. patent 2,419,852, issued April 29, 1947.

Apparatus for measuring the ratio or product of two independent alternating current voltages comprising a first and a second alternating current voltage attenuator controlled by impressing direct current voltage thereon and having direct current voltage input terminals, means for impressing one of said independent voltages only upon said first attenuator, means for impressing the other of said independent voltages only upon said second attenuator, voltage-responsive means connected to the output of said first attenuator, a vacuum tube amplifier connected to the output of said second attenuator, means for rectifying at least a part of the output of said amplifier and supplying direct current voltage thus obtained to said input terminals of each attenuator. Claims allowed, 20.

9938. (4) Electrical ratio indicating instrument. H. D. Jackes, Bloomfield, N. J., assignor to Wright Aeronautical Corp., a corporation of New York: U. S. patent 2,422,240, issued June 17, 1947.

An indicating system comprising an armature shaft, a pair of coils rotatable with said shaft, a common source of electric energy for said coils, means operable to supply electric current to one of said coils in a series of current impulses, means operable to vary the frequency of said current impulses in response to changes in a condition, means operable to supply electric current to the other of said coils in a series of current impulses, means operable to vary the frequency of the current impulses to said other coil in response to changes in a second condition,

means cooperating with each coil to subject said coils to opposed shaft-rotating torques in response to the current flow through the coils, and means operable to vary the magnitude of the current impulses to one of said coils in response to changes in a third condition. Claims allowed, 5.

9939. (4) Device for measuring electromagnetic field intensity. R. M. Redheffer, Cambridge, Mass., assignor, by mesne assignments, to the United States of America, as represented by the Secretary of War: U. S. patent 2,429,843, issued Oct. 28, 1947.

A radio frequency probe for exploring the strength of a field of electromagnetic energy of radio frequency comprising a coaxial line, one end of which is to be inserted in the radio frequency field, the outer conductor of said line having an outward flare at said one end, and a Wollaston wire spiralling outwardly connecting the center to said outer conductor at said one end. Claims allowed, 2.

9940. (4) Frequency indicating cathode-ray oscilloscope. C. W. Earp, London, England, assignor to Standard Telephones and Cables Ltd., London, England, a British company: U. S. patent 2,434,914, issued Jan. 27, 1948.

A frequency measuring arrangement comprising an input circuit adapted to be supplied from a variable frequency current source under measurement, a cathode ray oscillograph comprising a fluorescent screen and elements for controlling the path of a luminous trace on said screen, control circuits for applying potentials to said last-mentioned elements, a pair of parallel electrical paths coupled between said input circuit and said control circuits, and a phase distorting network comprising a resistance-capacity delay network in at least one of said paths for producing a phase difference in the outputs of said two paths. Claims allowed, 9.

9941. (4) Werkwijze en inrichting voor het bepalen van een onder de aardoppervlakte gelegen geologisch structuur [Method and apparatus for determining geologic structure below the earth's surface]. Standard Oil Development Co., New Jersey: Dutch patent 51,131, issued Oct. 15, 1941.

Alternating current is passed into the ground at a given place, and the voltage generated at the place explored is measured on the surface of the earth with the use of two electrodes which are compensated by an a. c. comparison voltage having a wave form modified to correspond with that received from the earth's surface. To that effect, an a. c. source is connected with two current electrodes, while two voltage electrodes are inductively connected with an indicating instrument, preferably a cathode ray oscillograph, in turn inductively connected with a second a. c. source. The voltage component registered in the indicating instrument by the second source can be modified as to phase, frequence, amplitude, and wave form, so as to obtain for it a trace corresponding to the trace of the component registered in the instrument by the voltage from the earth's surface. Claims allowed, 3.

9942. (5) Geiger-Mueller tube. Edward der Mateosian and Michael McKeown, Washington, D. C.; U. S. patent 2,427,663, issued Sept. 23, 1947.

A Geiger-Mueller tube characterized by its long life and rapid counting response to penetrating radiation comprising, in combination, a radia-

tion permeable envelope enclosing an anode and cathode, and an atmosphere containing methylene bromide vapor. Claims allowed, 3.

9943. (5) Radiation intensity meter. M. J. Test, Kansas City, Mo., and Shelley Krasnow, New York, N. Y.: U. S. patent 2,434,297, issued Jan. 13, 1948.

In an apparatus for measuring radioactivity, a measuring element having a medium whose electrical properties are modified in relation to the radioactivity impinging thereon, whereby the said element will give at its output an electrical response related to radioactivity, amplifying means to amplify the output of the said element, a current indicating meter operable from the output of the said means, and adjustable bucking circuit connected to the said current meter and serving to apply a voltage counter to that produced by the amplifying means, the said bucking circuit providing means for setting the meter to a predetermined value for a given value of radioactive intensity. Claims allowed, 12.

9944. (7) Ionic gas analysis. S. S. West, Tulsa, Okla., assignor to Stanolind Oil and Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,427,484, issued Sept. 16, 1947.

An ion source for a mass spectrometer including a low-pressure zone, means for admitting into said zone a substance to be analyzed, means for bombarding at least part of said zone with electrons whereby ionization of said substance is effected to produce ions having no initial kinetic energy and ions having finite initial kinetic energy, a first electrode at least in part bounding said zone and having a slit through which ions formed in said zone may pass, a second electrode adjacent said first electrode and exterior of said zone, a slit in said second electrode displaced from a projection of the slit in said first electrode on said second electrode, said projection being normal to said first electrode for passing only ions possessing initial kinetic energy, and means for maintaining said electrodes at different electric potentials, thereby defining a path between said slits along which said last-mentioned ions can pass. Claims allowed, 5.

9945. (7) Improvements in and relating to apparatus for gas analysis. British Thomson-Houston Co., a British company, London: British patent 541,386, issued Nov. 25, 1941.

A gas analyzer comprising a member composed of a metal adapted to react with one of the gases in a mixture to be analyzed, means for heating the metal to progressively higher temperatures at different portions of its surface, the metal member being adapted to have its surface exposed to gas to be analyzed, and means for comparison of the extent of the surface remaining unaffected with the extent of the surface of the metal reacting with the active gas in the mixture to be analyzed. Claims allowed, 9.

9946. (8) Process of detecting oil dispersed in well drilling fluids. G. L. Ratcliffe, Los Angeles, Calif., assignor to National Lead Co., Los Angeles, Calif., a corporation of New Jersey: U. S. patent 2,422,852, issued June 24, 1947.

The process of detecting oil during drilling of a well by the employment of a drilling fluid, comprising, contacting the drilling fluid from the well with successive parts of a record base preferentially affected

by oil and marking the successive parts of the record base with the well depths corresponding to the marking of the medium by the oil. Claims allowed, 12.

9947. (8) Method and apparatus for logging bore holes. Hubert Guyod, Houston, Tex.: U. S. patent 2,428,155, issued Sept. 30, 1947.

Apparatus for determining anisotropy of strata penetrated by well bores comprising a plurality of elongated magnetizable members having outwardly extending and angularly spaced pole pieces thereon, magnetizing coils for said members, a source of polyphase current connected to said coils, the ends of said members opposite the pole pieces being displaced from the pole pieces a distance whereby the resultant field proximate the pole pieces is a substantially unipolar rotating field operable to produce an area of current conduction in and about the well bore, and means for measuring the variations in potential at a point within the area of current conductions. Claims allowed, 3.

9948. (8) Well logging apparatus. Gerhard Herzog, Houston, Tex., assignor to The Texas Co., New York, N. Y., a corporation of Delaware: U. S. patent 2,433,554, issued Dec. 30, 1947.

In a well logging apparatus in which an ionization chamber for measuring penetrative radiation is passed through a well, said ionization chamber being capable of generating an electrical current of approximately 10^{-11} to 10^{-13} amperes proportional to the intensity of said radiation, a resistor of the order of 10^{12} ohms connected in the output circuit of said ionization chamber, an instrument for measuring the voltage drop across said resistor, and temperature controlling means for maintaining said resistor at a predetermined temperature during the passage of the instrument through the hole. Claims allowed, 1.

9949. (8) Method and apparatus for determining the location of producing horizons in wells. A. J. Teplitz, Oakmont, Pa., assignor to Gulf Research & Development Co., Pittsburgh, Pa., a corporation of Delaware: U. S. patent 2,433,718, issued Dec. 30, 1947.

A method of determining the source of fluid entering a well which comprises placing in the well opposite the producing formation a known configuration of solid radioactive material removable by the produced fluid, allowing the well to produce for a period sufficient to remove a portion of said radioactive material and subsequently determining the distribution of radioactive material remaining in the well. Claims allowed, 8.

9950. (8) Magnetic field well logger. Standard Oil Development Co., New Jersey, a corporation of Delaware: British patent 544,676, issued April 23, 1942.

Apparatus for logging the variations of a magnetic field, e. g., in a bore hole, comprising in combination, an indicator adapted to have electric currents induced therein when disposed in a magnetic field, means for moving said indicator over the path to be logged through said magnetic field, and means for collecting and measuring the current induced in said inductor by said magnetic field. Claims allowed, 7.

9951. (8) Oil-bearing horizon penetrator detecting method. J. G. Campbell, Houston, assignor to R. H. Fash, Fort Worth, both in Texas, U. S. A.: Canadian patent 407,890, issued Oct. 6, 1942.

The method of determining the penetration of an oil-bearing horizon in the drilling of a well, which consists in obtaining samples of the drilling fluid entering and approximately the same drilling fluid leaving the well, respectively, adding equal amounts of ethyl ether per unit surface area to the surface of each sample to form a relatively thin layer over the surface to extract thereby a quantity of the oil from the surface layer of the sample, subjecting the ethyl ether layer on the surface of each sample of the drilling fluid to the action of ultra-violet light to cause the oil content thereof to fluoresce, the intensity of the fluorescence of said layers being in direct proportion to the oil content thereof, observing the fluorescence of said ethyl ether layers, and noting any increase in the fluorescence of the said layer over the surface of the discharge drilling fluid as compared to the fluorescence of the ethyl ether layer over the surface of the drilling fluid entering the well, to detect thereby the presence of an oil-bearing horizon. Claims allowed, 7.

9952. (9) Fluorescent hand lamp. A. D. Sobel, Brooklyn, N. Y., assignor to Paramount Industries, Inc., New York.: U. S. patent 2,435,164, issued Jan 27, 1948.

A portable fluorescent lamp comprising: an elongated open U-shaped wall member having a seating groove extending longitudinally of each open edge, top and bottom flanged closure members engaging opposite ends of said wall member and adapted to be secured thereto, a translucent front member retained in position by said seating grooves and said closure members, an elongated unitary fluorescent tube support and reflector assembly having longitudinal edges terminating in said grooves and retained in position by said front member and said closure members. Claims allowed, 4.

9953. (11) Transducing system. R. W. Raitt, Altadena, Calif., assignor to Geophysical Engineering Corp., Pasadena, Calif., a corporation of Delaware: U. S. patent 2,418,953, issued April 15, 1947.

In a variable reluctance differential electromagnetic transducing system, a permanent magnet comprising laminations, assembled to form a rectangular block, a pair of clamping blocks to hold said laminations, a mass comprising a rectangular block of laminations of high magnetic permeability, clamping plates for said laminatitons, said rectangular mass being spaced from said permanent magnet to present a gap between the substantially plane face of the rectangular block forming said permanent magnet and the substantially plane face of said block mass, a pair of return magnetic paths composed of laminated blocks of highly permeable material, means for rigidly connecting said return paths parallel to said permanent magnet, each of said return paths extending beyond said permanent magnet, said mass being mounted between said return paths and so spaced from each of said return paths to present a gap between one end of said block mass and one of said return paths and another gap between the other end of said block mass and the other of said return paths, a plurality of springs, said block mass being mounted on said springs, said springs being also adjustably mounted on said

assembly of said permanent magnet and said return paths, coils in said return paths. Claims allowed, 5.

9954. (11) Course-recording camera. Jacob Rabinow, Washington, D. C., assignor to United States of America, as represented by the Secretary of War and his successors in office: U. S. patent 2,420,339, issued May 13, 1947.

In a camera of the character described, a lens, a shutter disc mounted on a plane transverse to the axis of the lens and revoluble on an axis eccentric to the lens and having a substantially continuous concentric slotted portion arranged within but transmitting only a small proportion of the light passing through the lens, said shutter having also an opening of a size to pass a predetermined full proportion of the light passing through the lens, means to operate the shutter at a predetermined speed and frequency, a stationary photosensitive image recording material at the focal plane, a focal plane shutter before the recording material movable horizontally and having a vertical slot therein, said shutter being spring biased to an initial position at one side of the camera and means to move the shutter and to synchronize its movement with the image of the object moving across the field of view. Claims allowed, 7.

9955. (11) Diversity combining circuit. M. G. Crosby, Riverhead, N. Y., assignor to Radio Corporation of America, a corporation of Delaware: U. S. patent 2,420,868, issued May 20, 1947.

A diversity receiving system comprising a plurality of spaced antennas, a receiver coupled to each antenna and including an amplifier, a rectifier coupled to the output of said amplifier, a low pass filter in the space current path of the rectifier, a resistor in shunt to said filter, a diode tube having its cathode connected to a point on said resistor for deriving a negative voltage therefrom during the passage of current through the rectifier, direct connections between the anodes of the diode tubes in circuit with the different receivers; a resistor having one terminal directly connected in common to the anodes of said diode tubes and its other terminal connected to a source of positive potential, and an audio frequency amplifier having its input circuit coupled to said resistor. Claims allowed, 17.

9956. (11) Odograph. C. D. Lake, Binghamton, and G. F. Daly, Endicott, N. Y., assignors to International Business Machines Corp., New York, N. Y., a corporation of New York: U. S. patent 2,421,628, issued June 3, 1947.

In a navigating instrument for a vehicle, a set of four coaxial ratchets, one for each of the cardinal points of the compass, a gear coaxial with said ratchets, a driving pawl for each ratchet carried by said gear, means for operating said gear and pawls continuously in the same direction in accordance with the speed of the vehicle, shielding mechanism coaxial with said ratchets for controlling the extent of engagement of the related ratchets and pawls, and compass controlled means for selectively positioning said shielding mechanism and for oscillating the said shielding mechanism within a predetermined angle at its selected position to enable rotation of the ratchet or ratchets related to the direction of movement of the vehicle and to control the extent of movement of each. Claims allowed, 11.

9957. (11) Position indicator for aircraft in flight. E. D. Glatz, Kenmore, N. Y.: U. S. patent 2,421,783, issued June 10, 1947.

An instrument for indicating the position of an aircraft in transit, comprising a section of a map covering the territory to be covered, an indicator movably mounted over said map, a motor operatively connected with said indicator to drive the same, and in circuit with a source of current supply, a rheostat interpolated in the circuit, and an air pressure responsive device connected with the rheostat to adjust the speed of the motor to the air pressure created by the aircraft in transit whereby the indicator is caused to move across the map to indicate the position of the aircraft. Claims allowed, 4.

9958. (11) Means for reading the indication of measuring instruments. G. C. Hartley, London, England, assignor, by mesne assignments, to International Standard Electric Corp., New York, N. Y., a corporation of Delaware: U. S. patent 2,426,209, issued Aug. 26, 1947.

Electro-responsive means for indicating when the pointer of an indicating instrument is in a given position comprising in combination with the pointer a piece of fine wire mounted on the pointer and insulated therefrom, a commutator consisting of an undivided segment and a divided segment arranged in juxta-position to the path of movement of said wire and to be bridged thereby, circuit means for applying a potential across the segments through said wire, high resistances connecting the divided segments to ground, a uni-selector having a series of contacts, connections from the divided segments to the series of contacts, a wiper for the series of contacts of the uni-selector, means for applying a potential intermittently to step the wiper, a cold cathode gas filled discharge tube having a control electrode connected to said wiper whereby the potential of the control electrode with respect to the cathode is raised by passage of the spark to one of the divided segments when the wiper is connected to the corresponding contact of the uni-selector, means energized by the circuit of the gas discharge tube for indicating the closing of the circuit through the divided segment, means controlled by said indicating means for effecting stopping of the wiper movement, and means for opening the circuit of the gas discharge tube. Claims allowed, 2.

9959. (11) Vibrational energy transmitter or receiver. Frank Massa, Cleveland Heights, Ohio, assignor to The Brush Development Co., Cleveland, Ohio, a corporation of Ohio: U. S. patent 2,427,062, issued Sept. 9, 1947.

In a transducer for radiating and/or receiving vibrational energy and having main and secondary directional lobes, a substantially circular piston of radius R_1, and a substantially annular piston of inner radius R_1 and outer radius R_2 surrounding and lying in the same plane as said circular piston, said circular piston being adapted to vibrate at a given frequency and with an amplitude A_1, and said annular piston being adapted to vibrate in phase with said circular piston with an amplitude A_2, the ratio of R_1 to R_2 being substantially .61, and the ratio of A_1 to A_2 being substantially 2.4 whereby the ratio of the main lobe energy radiated substantially normal to the plane of the said pistons to the secondary lobe energy is maximum. Claims allowed, 8.

9960. (11) Submersible exploration barge. H. A. Hansen, Long Beach, Calif.: U. S. patent 2,430,014, issued Nov. 4, 1947.

In a submersible exploration barge adapted for surface travel over a body of water to a point where exploration of the bottom or submerged land is desired, a submersible hull, a tower supported on said hull and having a height greater than the depth of the water where exploration is to be made, means for flooding said hull to nullify its buoyancy and submerge it until the hull rests on the bottom as a foundation for the tower, a buoyant working platform mounted on the tower so that it may float apart from said hull whereby exploration operations may be carried out therefrom when the hull is bottomed, and means for pumping the water out of the hull to restore its buoyancy for ascension to the surface of the body of water. Claims allowed, 23.

9961. (11) Radio distance and direction recorder. D. W. Epstein, Princeton, N. J., assignor to Radio Corporation of America, a corporation of Delaware: U. S. patent 2,430,283, issued Nov. 4, 1947.

A radio locator system comprising means for radiating a radio signal and means for receiving the signal after reflection from a reflecting surface or target in the path of said radiated signal, at least one of said means comprising an antenna having a directive radiation pattern, means for changing the direction of the radiation pattern of said antenna, successively through a predetermined angle, a cathode-ray storage tube having a storage screen, means for storing reflected target signals on said screen in rectangular co-ordinates representative of target range and target azimuth, means for scanning said storage screen in rectangular co-ordinates by a cathode ray which is deflected at a certain rate along the co-ordinate representative of azimuth and at a different rate along the co-ordinate representative of range, a recorder comprising means for rotating a recording paper disc element in synchronism with said deflection along the azimuth co-ordinate, means for moving a recording contact point radially with respect to said disc element in synchronism with said deflection along said range co-ordinate, means including said cathode ray scanning means for taking off said storage screen, an output signal representative of the target signals stored thereon, and means for applying said output signal to said recorder for marking said recording paper at the recording contact point in response to said output signal reaching a value representative of a target signal. Claims allowed, 6.

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