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

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

UNITED STATES DEPARTMENT OF THE INTERIOR

Douglas McKay, *Secretary*

GEOLOGICAL SURVEY

Thomas B. Nolan, *Director*

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GEOPHYSICAL ABSTRACTS 164, JANUARY–MARCH 1956

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

INTRODUCTION

EXTENT OF COVERAGE

Geophysical Abstracts includes abstracts of technical papers and books on the physics of the solid earth, the application of physical methods and techniques to geologic problems, and geophysical exploration. A new table of contents, alphabetically arranged, has been adapted to show more clearly the material covered.

Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with limited circulation (such as dissertations, open-file reports, or memoranda) or of papers presented orally at meetings unless summaries of substantial length are published. Abstracts of papers in Japanese and Chinese are based on abstracts or summaries in a western language accompanying the paper.

LIST OF JOURNALS

The following list supplements the List of Journals published in Geophysical Abstracts 160 (January–March 1955, Bulletin 1033–A) and the supplements published in Geophysical Abstracts 161, 162, and 163. Full titles and abbreviations of journals cited for the first time in this issue (with the sponsoring organization and its address where these do not form part of the title) are given.

Akad. Nauk Armyanskoy SSR Izv., Ser. fiz.-mat. yestestven. i tekhn. nauk—Izvestiya Akademii Nauk Armyanskoy S. S. R., Fizikomatematicheskiye yestestvennye i tekhnicheskiye nauki. Erivan.

Akad. Nauk Kazakh SSR Vestnik—Vestnik Akademii Nauk Kazakhskoy S. S. R. Alma-Ata.

Akad. Wiss. Göttingen Nachr. Math.-phys. Kl.—Nachrichten der Akademie der Wissenschaften in Göttingen Mathematisch-physikalische Klasse.

Andhra Univ. Mem. in Oceanography—Andhra University Memoirs in Oceanography. Waltair, India.

Annales Inst. Hydrologie et Climatologie—Annales de l'Institut d'Hydrologie et de Climatologie. Expansion scientifique française, Paris.

Archiwum górnictwa i hutnictwa—Polska Akademia Nauk, Komitet Górnictwa i Komitet Hutnictwa, Warszawa.

Atomics—Leonard Hill Technical Group, London.

Canadian Oil and Gas Industries—National Business Publications, Gardenvale, Quebec.

Československá Akad. Věd. Geotetchnica—Československá Akademie Věd. Geotechnica. Praha, Czechoslovakia.

Current Sci. (India)—Current Science. Current Science Association, Bangalore, India.

Experientia—Verlag Birkhauser, Basel, Switzerland.

Geol. Survey India Mem.—Geological Survey of India Memoirs. Calcutta.

Gidrotekhnika i melioratsiya—Ministerstvo sel'skogo khozyaystvo SSR, Moskva.

Inst. Sci. Madagascar Mem.—Mémoires de l'Institut Scientifique de Madagascar. Tananarive.

Jour. Chem. Physics—Journal of Chemical Physics. American Institute of Physics, New York.

Jour. Glacialogy—Journal of Glacialogy. British Glacialogical Society, London.

Jour. Physics of Earth—Journal of Physics of the Earth. Seismological Society of Japan, Tokyo.

Jour. Sci. Indus. Research (India)—Journal of Scientific and Industrial Research. Council of Scientific and Industrial Research, New Delhi, India.

Meteorologiya i gidrologiya—Gidrometeorologicheskoye izdatel'stvo. Leningrad.

Mississippi Geol. Survey Bull.—Mississippi State Geological Survey Bulletin. University, Miss.

Natl. Geog. Mag —National Geographic Magazine. National Geographic Society, Washington, D. C.

Nat. History—Natural History. American Museum of Natural History, New York.

Natur u. Volk—Natur und Volk. Sekckenbergische naturforschende Gesellschaft, Frankfurt-am-Main, Germany.

Neftyanoye Khozyaystvo—Ministerstvo neftyanoy promyshlennosti (Ministry of Petroleum Industry), Moskva.

Nuovo Cimento—Istituto di fisica dell'Universita, Milano, Italy.

Österreich. Akad. Wiss. Sitzungsber.—Österreichische Akademie der Wissenschaften Sitzungsberichte. Wien, Austria.

Prikladnaya geofiz.—Prikladnaya geofizika. Nauchno-issledovatel'skiy institut geofizicheskikh metodov razvedki, Moskva.

Quaternaria—A. C. Blanc, editor. Roma.

R. Soc. Española Historia Nat. Bol.—Boletin de la Real Sociedad Española de Historia Natural. Consejo Superior de Investigaciones Cientificas, Madrid.

Soc. Geog. Colombia Bol.—Boletin de la Sociedad Geografica de Colombia, Bogota.

South Australia Dept. Mines Min. Rev.—South Australia Department of Mines, Mining Review. Adelaide.

South Australia Geol. Survey Bull.—South Australia Geological Survey Bulletin. Adelaide.

Zeitschr. angew. Geologie—Zeitschrift für angewandte Geologie. Staatliche geologische Kommission und Zentral Vorratskommission der Deutschen Demokratischen Republik, Berlin.

Zeitschr. Elektrochemie—Zeitschrift für Elektrochemie. Bunsengesellschaft für physikalische Chemie, Weinheim Bergstrasse, Germany.

FORM OF CITATION

The abbreviations of journal titles used are those adopted by the U. S. Geological Survey and used in many geological journals. For papers in most languages other than English, the title is given in the original language as well as in translation. Slavic names and titles have been transliterated with the system used by the United States Board on Geographic Names. This system of transliteration for Russian was given in Geophysical Abstracts 148 (January–March 1952, Bulletin 991–A). Titles of papers in Japanese and Chinese are given in translation only.

ABSTRACTORS

Abstracts have been prepared by J. R. Balsley, P. E. Byerly, W. H. Diment, Henry Faul, R. G. Henderson, George V. Keller, Virginia S. Neuschel, L. C. Pakiser, and Isidore Zietz as well as by the principal authors. The notation "Author's abstract" followed by the initials of an abstractor indicates a translation of the author's abstract.

AGE DETERMINATIONS

164-1. Simon, Wilhelm. Die Uhren der Erde [The clocks of the earth]: Natur u. Volk, Band 83, Heft 3, p. 69–80, 1953.

This is a semipopular review of methods of geologic age determinations, including fluorine content of bones, radiocarbon dating, and uranium-lead methods.—*D. B. V.*

164-2. Hahn, Otto. Neuere radioaktive Methoden zu geologischen und biologischen Alterbestimmungen [The newer radioactive methods of geologic and biologic age determinations]: Naturwiss. Rundschau, Jahrg. 8, Heft 9, p. 331–337, 1955.

This is a review of methods of age determination, with particular emphasis on the strontium, potassium-calcium, potassium-argon, radiocarbon, and tritium methods.—*D. B. V.*

164-3. Polański, Antoni. Promienotwórcze metody oznaczania wieku bezwzględnego w geologii [Radioactive methods of determination of absolute age in geology]: Przegald geol., zeszyt 10, p. 453–458, 1955.

A general discussion of the physical foundations of radioactive methods of age determinations including lead-uranium, helium, strontium, and argon methods.—*S. T. V.*

164-4. Linnenborn, Victor J. Radioactivity and the age of the earth: Jour. Chem. Education, v. 32, no. 2, p. 58–68, 1955.

This is a review of radioactive age determination methods and results. The methods described—207/206, 206/238, 207/235, 208/232, helium ratio, and Rb/Sr—first permitted establishment of a maximum (5×10^9 yrs) and minimum (3×10^9 yrs) age for the crust; later refinements of calculations, based on variations in lead ores formed at different times in earth history, placed the actual age of the crust at about 3.5×10^9 yrs. Comparison with meteoritic lead ratios gave an age of 4.5×10^9 yrs.

The potassium-argon ratio has been used to determine the age of rocks, but it is even more important in establishing the age of the atmosphere. Using 3.4×10^9 yrs for the age to the time when the crust solidified to such an extent that mixing of lead isotopes ceased and radiogenic argon no longer escaped to the atmosphere, Linenborn obtains 4.2×10^9 yrs for the age of the atmosphere, which is in closer agreement with the most recent value for the age of the earth than Chackett's calculation based on a lower age of the crust [see Geophys. Abs. 145–12768].—*D. B. V.*

164-5. Kulp, J. Laurence. Carbon-14 measurements on geological samples: Atomics, v. 4, no. 4, p. 96–98, 1953.

A review of carbon-14 dating and other geologic studies based on carbon-14 measurements.—*D. B. V.*

164-6. Kulp, J. Laurence. Dating with carbon-14: Jour. Chem. Education, v. 30, no. 9, p. 432–435, 1953.

Describes the principles, techniques, and results of the radiocarbon dating method. Some of the side problems that have developed in the course of the work concern the effect of upwelling of deep, "old" water along coasts with deep

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offshore troughs, and utilization of carbonate carbon from the water by certain lake plants, giving anomalous C^{14} concentrations. The constancy of cosmic-ray flux throughout the past has been investigated and seems to have been the same within 10 percent for the last 30,000 years.—*D. B. V.*

164–7. Levi, Hilde. Radiocarbon dating conference in Cambridge: Nature, v. 176, no. 4485, p. 727–728, 1955.

A report on the second European conference on radiocarbon dating, held at Cambridge, England, July 25–30. Among the topics discussed were techniques, methods of determining errors, and form of publication. As no method of determining errors was acceptable to all participants, it was agreed that the manner in which the error is calculated should be explicitly stated in each paper. It was agreed that in addition to topical papers, the results of the different laboratories should be collected at regular intervals for publication in Nature or Science, preferably in the form of lists similar to those issued by Libby. A list is given of radiocarbon dating laboratories and their accepted identifying prefix letters for samples.—*M. C. R.*

164–8. Libby, W. F. Datierung mittels radioaktiven Kohlenstoffs und Tritiums. Möglichkeit industrieller Verwendung dieser Isotope [Dating by means of radioactive carbon and tritium. Possibility of industrial application of these isotopes]: Zeitschr. Elektrochemie, Band 58, no. 8, p. 574–585, 1954.

The formation of C^{14} and H^3 by cosmic radiation and the principles and techniques of dating by these isotopes are reviewed. As the tritium content of rainwater depends on the length of time the moisture is exposed to cosmic rays after evaporation, it increases with distance inland. Older rainwater or products containing rainwater, such as wine and agricultural produce, can be dated by their tritium content. In hydrology, it might prove possible to distinguish ground water from rainwater on this basis.

Extensive tables list 49 radiocarbon dates, and the tritium content of Chicago and worldwide rainfall, various rivers, oceanic rains, and four springs. Use of these isotopes in industry and clinical medicine is also discussed.—*D. B. V.*

164–9. Pringle, R. W., Turchinetz, W., and Funt, B. L. Liquid scintillation techniques for radiocarbon dating: Rev. Sci. Instruments, v. 26, no. 9, p. 859–865, 1955.

A study has been made of the merits of liquid scintillation methods for radiocarbon dating. The synthesis of toluene from sample carbon, and the use of this liquid in a 20 cc cell, in combination with the best available photomultiplier tube, gave results which indicate that this method can be of significance for samples of age 45,000 years, for a 48-hour counting period. A background counting rate of 3.34 cpm was obtained with "old" toluene and adequate shielding and pulse height discrimination, but without photomultiplier cooling or the use of coincidence-anticoincidence arrangements. This method suffers, however, from a rather elaborate chemical synthesis, so that a simpler diluent technique was studied, involving the synthsis of methanol from sample carbon. This method is suitable for routine analysis, and gave results indicating a significance to 37,000 years, the decreased accuracy of the method being the result of the somewhat lower fluorescence efficiency of the scintillating mixture. There is evidence that a routine methyl borate diluent method will give an accuracy comparable to that of the toluene method.—*Authors' abstract*

164–10. Burke, W. H., Jr., and Meinschein, W. G. C^{14} dating with a methane proportional counter: Rev. Sci. Instruments, v. 26, no. 12, p. 1137–1140, 1955.

The method of radiocarbon dating at the Magnolia Research Laboratories involves preparation of carbon dioxide from the sample, conversion of the carbon dioxide to methane by quantitative hydrogenation with a ruthenium catalyst, and assaying the methane for C^{14} in a proportional counter. Two sizes of counters are used, the larger containing 0.85 g of carbon, the smaller 0.22 g, at the operating pressure of 2 atmospheres. If the sample and background are both counted for 24 hours, a sample 34,000 years old in the larger counter gives a C^{14} count equal to twice its standard statistical error; a sample 26,000 years old in the smaller counter gives the same effect. The method was developed primarily for the purpose of dating small samples and is used for measuring the ages of samples containing a fraction of a gram of carbon, but can be adapted to larger samples with a consequent increase in the maximum measurable age.—*M. C. R.*

164–11. Broda, E., and Rohringer, G. Die Messung von Radiokohlenstoff mit dem Gas-Geiger-Zählrohr [The measurement of radiocarbon with the gas Geiger counting tube]: Zeitschr. Elektrochemie, Band 58, no. 8, p. 634–636, 1954.

The range of measurement of radiocarbon can be increased almost 100 percent by introducing the C^{14} into the counting tube in the form of CO_2. Using a Neher-Pickering quenching circuit, a regular constancy range of at least 400–500 volts can be maintained, in the absence of water or mercury vapor, if no more than a few seconds elapse between fillings. The method is thus most suitable for series measurements.—*D. B. V.*

164–12. Rafter, T. A. C^{14} variations in nature and the effect on radiocarbon dating: New Zealand Jour. Sci. Technology, Sec. B, v. 37, no. 1, p. 20–38, 1955.

Since the development of the CO_2-gas counter technique, it has become possible to detect the C^{14}/C^{12} variations predicted from C^{12}/C^{12} measurements. It is shown that plants contain less C^{14} than does the CO_2 of the atmosphere; bones of land animals are enriched in C^{14} with respect to their fats and proteins, and the C^{14} activity of these substances differs from that of contemporary wood. Large errors can be made therefore in radiocarbon dating, particularly of more recent carbonaceous specimens other than wood or charcoal, unless the specimen is dated relative to a contemporary standard of similar origin.

Radiocarbon in sea water is not in isotopic equilibrium with that in the atmosphere, unless it takes several hundred years for the equilibrium to be established between atmospheric CO_2 and the bicarbonate ions of the ocean. Marine shells are enriched in C^{14} with respect to wood but not by the predicted 6 percent; the flesh of shellfish is depleted relative to the shell; the enrichment ratio of carbonates to other carbon seems to be relatively constant for land and sea animals. Because of variations in C^{14} content of ocean water, the C^{13}/C^{12} ratio cannot be used to predict C^{14}/C^{12} ratios in marine organisms.—*D. B. V.*

164–13. Hunt, Charles B. Radiocarbon dating in the light of stratigraphy and weathering processes: Sci. Monthly, v. 81, no. 5, p. 240–247, 1955.

Hunt reviews the stratigraphy of the late Pleistocene and Recent deposits to illustrate some of the principles involved in classification and, further, reviews a few conflicts between known stratigraphy and radiocarbon dates and some

aspects of the problems involved in weathering or preservation of specimens for C^{14} analysis. There is no reason to question the reliability of radiocarbon age determinations of samples preserved under conditions precluding contamination by younger organic matter, but samples subject to contamination by organic compounds and bacterial or fungal attack must be suspect until it is determined whether this contamination is a significant factor.—*V. S. N.*

164–14.   Rubin, Meyer, and Suess, Hans E.   U. S. Geological Survey radiocarbon dates III: Science, v. 123, no. 3194, p. 442–448, 1956.

This list includes carbon-14 dates for 69 samples measured at the U. S. Geological Survey laboratory between February 15 and June 20, 1955.   Dates are grouped in four categories: samples with oceanic implications, glacial samples, other geologic samples, and archeology.—*M. C. R.*

164–15.   Harrington, Mark R.   Man's oldest date in America: Nat. History, v. 64, no. 10, p. 513–517, 554–555, 1955.

Charcoal from the Tule Springs site, in southern Nevada, submitted for radiocarbon dating, was found to have lost all its activity and therefore must be more than 23,800 years old.   Present estimates of the antiquity of man in the Western Hemisphere are three times those of 20 years ago.—*D. B. V.*

164–16.   Straka, H., and de Vries, Hl.   Eine Radiokarbon-Datierung zum Alter der Eifelmaare [A radiocarbon date for the age of the Eifel crater lakes]: Naturw., Jahrg. 43, Heft 1, p. 13, 1956.

Radiocarbon dating of mud from a depth of 420–430 cm in the east crater of the Schalkenmehren Doppelmaar gives an age of 10,770±250 years, which agrees completely with pollen-analysis dating of the eruption of the Eifel crater lakes as 10,500 years ago, in the Alleröd period.—*D. B. V.*

164–17.   Cherdyntsev, V. V., and Abdulgafarov, K. K.   Soderzhaniye geliya v nekotorykh kamennykh meteoritakh [The helium content of some stony meteorites]: Akad. Nauk SSSR Doklady, tom 106, no. 2, p. 311–312, 1956.

The ages of four stony meteorites from the collection of the Akademii Nauk were determined by the helium method.   The helium content of three was found to be very low, but in two samples from the fourth meteorite, a chondrite, the helium content was very high and the age was more than 6×10^9 years.—*S. T. V.*

164–18.   Paneth, F. A.   Die Heliummethode zur geologischen Alterbestimmung und das Alter der Eisenmeteorite [The helium method of geologic age determination and the age of iron meteorites]: Zeitschr. Elektrochemie, Band 58, no. 8, p. 567–573, 1954.

After reviewing the historical development of the helium method, Paneth discusses its application to iron meteorites.   The presence of He^3 indicates that their helium content is not entirely the result of uranium and thorium decay, but partly of cosmic-ray activity.   When this is taken into account, the age of most iron meteorites is found to fall between 100 and 200 million years.   A very few are less than 1 million years old.   One possible explanation for the unusually low helium content shown by 5 out of 72 samples is that these particular meteorites came so near the sun that they melted and lost all previously formed helium; another is that meteorites in general were not all formed at the same time, but rather by the shattering of a number of planetoids in different collisions at different times [see Geophys. Abs. 163–151].—*D. B. V.*

164–19. Kulp, J. Laurence, Bate, George L., and Giletti, Bruno J.   New age determinations by the lead method: Geol. Assoc. Canada Proc., v. 7, pt. 2, p. 15–24, 1955.

Ages of a number of radioactive minerals have been determined from Pb^{207}/Pb^{206}, Pb^{206}/U^{238}, Pb^{207}/U^{235}, and Pb^{206}/Pb^{210} ratios. Values obtained for minerals from classic localities agree well with those reported by other investigators. Major attention has been given to the anomalies of the ages of a given mineral computed from the various possible isotope ratios. The development of the Pb^{210} method adds greatly to the fund of data required to obtain accurate ages. The 206/210 age is essentially independent of uranium leaching or radon leakage. The latter is a significant factor in 206/238 and 207/206 ratios and must be measured experimentally to evaluate ages from these ratios. It appears that throughout most of the span of geologic time the 207/235 and 206/210 ages are the most reliable if lead loss has not occurred. The 206/238 supersedes the 207/235 age in accuracy for very young minerals. For young minerals the 207/206 age does not merit the reliability ascribed to it by earlier investigators.—*Authors' abstract*

164–20. Ahrens, L. H.   Analytical error as a possible cause of the $t(206/238) > t(207/235) > t(207/206)$ age distribution: Geochim. et Cosmochim. Acta, v. 8, no. 5/6, p. 299, 1955.

The minority distribution $t(206/238) > t(207/235) > t(207/206)$ is common in minerals where gravimetric procedures have been used to determine uranium when present in low concentration. It is suggested that the apparent uranium deficiency is the result of inaccuracy of the gravimetric determination, presumably owing in part to incomplete precipitation.—*D. B. V.*

164–21. Eckelmann, Walter R., and Kulp, J. Laurence.   Uranium-lead method of age determination. Part I: Lake Athabasca problem: Geol. Soc. America Bull., v. 67, no. 1, p. 35–54, 1956.

The apparent isotopic ages of a suite of samples of pitchblende, clausthalite, and galena from the Lake Athabasca uranium province range from 220 to 1,860 million years. Uranium leaching and radon leakage are inadequate to explain these anomalies. It is suggested that there was a single period of pitchblende deposition 1.90±0.04 billion years ago which was followed by at least two periods of exsolution of lead (about 1.2 and 0.15 billion years ago) probably resulting from mild regional metamorphism.

This process is a general one and explains most anomalous uranium-lead ages. Early Precambrian uranium minerals cannot be dated with confidence from a 207/206 measurement, which is a minimum and in extreme cases may be low by a factor of one-half. Complete isotopic analyses on a number of specimens from a locality are desirable if the true age is to be closely approximated.—*D. B. V.*

164–22. Gottfried, David, Senftle, F. E., and Waring, C[laude] L.   Age determination of zircon crystals from Ceylon: Am. Mineralogist, v. 41, no. 1–2, p. 157–161, 1956.

The average age of 21 gem-quality zircon crystals from Ceylon has been determined, by a modification of the lead-alpha activity method, as 561±26 million years. When the presence of thorium was taken into account by means of uranium analyses, the average corrected age for 12 of those samples was 574±32 million years.—*D. B. V.*

164–23. Begemann, F., Geiss, J[ohannes], Houtermans, F[riedrich] G[eorge], and Buser, W. Isotopenzusammensetzung und Radioaktivität von rezentem Vesuvblei [Isotopic composition and radioactivity of recent Vesuvius lead]: Nuovo Cimento, v. 11, no. 6, p. 663–673, 1954.

In three samples of cotunnite from Vesuvius, the radioactive constituent in the lead was identified as RaD [Pb^{210}] and its decomposition products; 21.2±0.5 disintegrations per second per mg of lead were counted. The lead is of a hitherto unknown intermediate type, of which about 0.7 percent is radiogenic. This radiogenic lead was derived from a "uranium concentrate" in the magma, whose maximum age according to the Pb^{210} method is 17×10^6 yrs. The isotope ratios, averaged for the three samples, are: 206/204, 19.14; 207/204, 15.75; 208/204, 39.41; these are similar to the ratios noted in the lead ores of Joplin, Sudbury, and other districts.—*D. B. V.*

164–24. Hayase, Ichikazu. Relative geologic age measurements on granites by pleochroic halos and the radioactivity of the minerals in their nuclei: Am. Mineralogist, v. 39, no. 9–10, p. 761–772, 1954.

The radioactivity of inclusions surrounded by pleochroic halos in various Japanese granites was measured by an autoradiographic method. It was found that even in the same specimen the minute grains vary in radioactivity, and that the blackness of the halo is proportional to the product of the radioactivity and the age of the nucleus mineral. Thus the relative geologic age of rocks bearing pleochroic halos can be determined by comparing the stages of development of the halos in each, and by contrasting the respective radioactivities of their nucleus minerals. This method is potentially a more exact method of dating, for igneous and metamorphic rocks, than fossils are for sedimentary rocks.—*D. B. V.*

164–25. Deutsch, Sarah, Hirschberg, D., and Picciotto, E. [E.] Mesure des âges géologiques par les halos pléochroiques [Measurement of geologic ages by means of pleochroic halos]: Experientia, v. 11, no. 5, p. 172–174, 1955.

This is a preliminary paper on the possibility of dating crystalline rocks by means of pleochroic halos. Standard thin section of well-dated granites have been used for purposes of calibration. The α-activity of the inclusions is measured by photographic nuclear emulsion techniques; the absorption of light by the halo is measured on the thin section by a microphotometer. The method is relative rather than absolute, and best applied to Paleozoic and younger rocks. The resolving power depends on the age ratio. So far, Tertiary and Paleozoic rocks can easily be distinguished.—*D. B. V.*

164–26. Noddack, W., and Zeitler, G. Alterbestimmungen am Graniten des Fichtelgebirges nach der Argonmethode [Age determinations on granites of the Fichtelgebirge by the argon method]: Zeitschr. Elektrochemie, Band 58, no. 8, p. 643–646, 1954.

This describes a simple apparatus for driving off argon in minerals by heating. The non-noble gases are taken up chemically by heated calcium, the noble gases separated by absorption on charcoal (Kohle) at lower temperature. The argon is measured in the mass spectrometer and the potash content determined analytically.

Samples of sylvinite from Stassfurt and several granites from the Fichtelgebirge were investigated by this method, and their ages calculated. Two sylvinites are 1.09 and 1.13 $\times 10^8$ years old, which is in good agreement with the geologic

evidence. The average age of five granites is 2.3×10^8 years (maximum), indicating that they were emplaced as late as Carboniferous rather than Archean.—*D. B. V.*

164–27.   Gentner, W., Goebel, K., and Präg, R.   Argonbestimmung an Kalium-Mineralien. III.   Vergleichende Messungen nach der Kalium-Argon-und Uran-Helium-Methode [Argon determination on potassium minerals. III.   Comparative measurements by the potassium-argon and uranium-helium methods] : Geochim. et Cosmochim. Acta, v. 5, no. 3, p. 124–133, 1954.

The uranium-helium content was determined on the same samples of potassium chloride from Buggingen, Germany previously measured for argon content [see Geophys. Abs. 158–176; 160–154]. The helium content showed the same dependence on crystal size as the argon content. It is concluded on theoretical grounds that the salt layers were formed at a higher temperature than the present ; under this assumption the diffusion coefficients for A and He in KCl were evaluated by combining all results. The new age is $25^{+5}_{-3} \times 10^6$ years ; as this is only slightly higher than the age previously obtained, varying temperature seems to have little effect on the results of argon age determinations.—*D. B. V.*

164–28.   Gentner, W., and Kley, W.   Zur geologischen Alterbestimmung nach der Kalium-Argon-Methode [On geologic age determination by the potassium-argon method] : Zeitschr. Naturforschung, Band 10a, Heft 11, p. 832–833, 1955.

This describes an improved method of obtaining the argon, in which the specimen is melted at 1,700°C in a high-frequency furnace. The advantage lies in the fact that the potassium can be determined directly on the same material rather than on an adjacent portion of the sample as in the previous method involving treatment with Na$_2$O$_2$. In analyses of seven samples of microcline feldspar (from pegmatite from Varuträsk in northern Sweden), ages range from 1.16–1.42×10^9 by the old method and from 1.22–1.47×10^9 yrs by the improved method. With the maximum argon content obtained, and a Rb/Sr age for the pegmatite of $1.59 \pm 0.08 \times 10^9$ yrs, the branching ratio of K^{40} is calculated as $\lambda_K : \lambda\beta = 0.104$; this is a lower limit, because of argon loss due to kaolinitization of the microcline. Wasserburg and Hayden's lower branching ratio of 0.085 [see Geophys. Abs. 161–132] is probably the result of analytical error. The branching ratio value obtained here is in closer agreement with the average (0.119 ± 0.006) of direct measurements by several different investigators.—*D. B. V.*

164–29.   Anirkhanov, Kh. I., Gurvich, I. G., and Sardarov, S. S.   Mass-spektrometricheskiy uskorennyy metod opredelniya absolutnogo vozrasta geologicheskikh obrazovaniy po radioaktivnomu raspadu K^{40} b Ar^{40} [The mass-spectrometric rapid method of determination of the absolute age of geologic formations using the radioactive disintegration of K^{40} into A^{40}] : Akad. Nauk SSSR Izv. Ser. geol., no. 4, p. 80–87, 1955.

One of the most promising methods of age determination of geologic formations is the potassium-argon method, based on the natural radioactivity of K^{40}. The indispensable feature of any radioactive method is the preservation of the products of disintegration, and the preservation of the radiogenic argon within the crystalline lattice has been proved by many experiments. The method is also less time consuming than others.

The ages of 10 specimens of different Precambrian minerals have been determined by the authors; the results agree with Gerling's determinations by the lead-isotope method with a maximum discrepancy of 6 percent.

Age determinations on minerals and rocks from the northern Caucasus showed the applicability of the argon method to quite young geologic formations, ranging in age from 10 to 15 million years.—*S. T. V.*

164–30. Afanas'yev, G. D. Problema vozrasta magmaticheskikh porod Severnogo Kavkaza [The problem of the age of magmatic formations of the northern Caucasus] : Akad. Nauk SSSR Izv. Ser. geol., no. 4, p. 57–59, 1955.

On the basis of numerous age determinations by Polkanov, Gerling, Komlev, Rik, and recently by Kh. I. Anirkhanov, I. G. Gurvich, and S. S. Sardarov (see the preceding abstract) on many minerals from the northern Caucasus, Afanas'yev presents an interpretation of the structure around the Induke Mountain, the northwestern extremity of the main Caucasian ridge, and of some other parts of the northern Caucasus.—*S. T. V.*

164–31. Herr, Wilfrid, and Merz, Erich. Eine neue Methode zur Alterbestimmung von Rhenium-haltigen Mineralien mittels Neutronaktivierung [A new method of age determination of rhenium-bearing minerals by means of neutron activation] : Zeitschr. Naturforschung, Band 10a, Heft 8, p. 613–615, 1955.

This describes a method of absolute age determination based on the decomposition of Re^{187} into Os^{187}. The rhenium content, osmium abundance, and Os^{187} content are ascertained by a combination of neutron activation, chemical analysis, and spectrophotometric techniques. With sufficient content of rhenium, accurate age determinations can be made on as little as 1 g of material. The results of determinations on five molybdenite samples are as follows: Lofoten, Norway—2.7×10^9 years; Stavanger, Norway—1.1×10^9 years; Nummedalen, Norway—1.2×10^9 years; San Antonio, Chile—$<2.5 \times 10^7$ years; and Kingsgate, New South Wales—$<3 \times 10^8$ years—*D. B. V.*

164–32. Zeller, Edward J., Wray, John L., and Daniels, Farrington. Thermoluminescence induced by pressure and by crystallization : Jour. Chem. Physics, v. 23, no. 11, p. 2187, 1955.

The observation that younger coral limestones gave abnormally bright thermoluminescence led to the discovery that $CaCO_3$ freshly precipitated in the laboratory is also thermoluminescent, without exposure to radiation. High pressure (50 tons per square inch) increases this thermoluminescence. In limestones older than 100 million years, pressure decreases radiation-induced thermoluminescence; this effect is useful because it distinguishes between the radiation-induced thermoluminescence on which age determination is based, and the complicating crystallization- or pressure-induced effect. New possibilities for age determination, based on the different types of thermoluminescence and influence of pressure, are the subject of experiments now in progress.—*D. B. V.*

164–33. Mahadevan, C., and Aswathanarayana, U. Age levels of Archaean structural provinces : Current Sci. (India), v. 24, no. 3, p. 73–74, 1955.

This is a preliminary report on detailed investigations of radioactive minerals from various localities, undertaken in order to date the pegmatitic, hence the orogenic, cycles of the structural provinces of peninsular India. Three new lead-uranium-thorium determinations (on samarskite from Nellore and allanities

from Purulia and Anakapalle) are included in a table with other recent alpha-helium and Rb-Sr ages (see also the following abstract).—*D. B. V.*

164–34. Aswathanarayana, U. Absolute ages of the Archaean orogenic cycles of India: Am. Jour. Sci., v. 254, no. 1, p. 19–31, 1956.

Correlation within the Archaean rocks of India has been difficult and, without the aid of radioactive age data, not very satisfactory. The available age data pertaining to the Archaean obtained by the Pb-U-Th, alpha-helium, and Rb-Sr methods are presented cycle-wise, and the degree of dependability of each determination is given. The Eastern Ghats orogenic cycle (1,625±75 million years) is older than the Satpura (955±40 million years) and Delhi cycles (735±5 million years), and younger than the Dharwar cycle (2,300±100 million years)— a succession which is fully consistent with the structural evidence. Recent advances in the field of measurement of geologic time have thus facilitated the bringing together of two distinct, but nevertheless mutually related, approaches; namely, the correlation of rock formation and the dating of orogenic cycles.— *Author's abstract*

164–35. Besairie, Henri, Eberhardt, Peter, Houtermans, Friedrich Georg, and Signer, Peter. Mesures d'âges de quelques galènes de Madagascar [Age determinations on some galenas from Madagascar]: Acad. Sci. Paris Comptes Rendus, tome 242, no. 3, p. 317–319, 1956.

The ages (model or conventional) of specimens of galena from Besakay, Ampandrana, and Ambatogangehana have been determined as 1,750±70, 1,160±60, and 1,140±70 million years, respectively. The latter two undoubtedly belong to the same period of mineralization, at the upper limit of the Cipolins series. The galena from Besakay indicates that the Maevatanana belongs to the Vohibory system.—*M. C. R.*

EARTHQUAKES AND EARTHQUAKE WAVES

164–36. Due Rojo, Antonio. Notas sismologicas de 1953 [Seismological notes of the year 1953]: Rev. Geofísica, año 13, no. 50, p. 185–188, 1954.

From the statistical point of view, 1953 is not much different seismically from the previous years, either in the magnitude or number of earthquakes. A slight increase in the number of recorded shocks is to be explained by better observation and recording. A world map of the epicenters is included.—*S. T. V.*

164–37. Lotze, Franz. Aktuo-geologische Charakteristik des Jahres 1953 [Current geological characteristics of the year 1953]: Neues Jahrb. Geologie u. Paläontologie Monatsh., Jahrg. 1954, Heft 12, p. 529–538.

This is a summary of disasters due to exogene and endogene geological forces which occurred over the world in 1953. Exogene, or external, agencies caused floods, storms, blizzards, droughts, landslides, avalanches, and the like; endogene, or internal, forces caused earthquakes and volcanic eruptions. Casualties and property damage are tabulated.—*D. B. V.*

164–38. Toperczer, M[ax]. Ein Beitrag zur Seismotektonik der Ostalpen [A contribution to the seismotectonics of the eastern Alps]: p. 72–80 *in* Skizzen zum Antlitz der Erde, Geologische Arbeiten herausgegeben aus Anlass des 70 Geburtstages von Prof. Dr. L. Kober, Wien, Verlag Brüder Hollinek, 1953.

Earthquakes in Austria have occurred chiefly in four regions: the Vienna basin, the Semmering-Mürztal region, Aichfeldes (around Judenburg, above Murtal),

and the Inntale and Mieminer plateaus. In the eastern Alps all earthquakes seem to be 20 to 30 km deep, but the foci are at more shallow depths in the western part. It is suggested that the deeper shocks are related to thermochemical changes.—*M. C. R.*

164–39. Svyatlovskiy, A. E. Seysmotektonika Kamchatsko-Kuril'skoy oblasti [Seismotectonic characteristic of the Kamchatka-Kurile region] : Akad. Nauk SSSR Doklady, tom 103, no. 1, p. 125–128, 1955.

The Kamchatka-Kurile region is one of great seismic activity, with several earthquakes during the last 10 years of intensity greater than 9.

The principal seismotectonic features of the area are a northeastward-striking fracture along the Kurile Islands, a northwestward-striking fracture along the Aleutians; the depth of the western fracture is 7 to 10 km deep and there is an abrupt change in the depth of about 1 km across the fault. Another factor, of secondary importance, is the volcanic ridge across the Kamchatka peninsula.

A map showing the areas of observed earthquakes of different intensities is included.—*S. T. V.*

164–40. Ramirez, Jesus Emilio. Progreso de la sismologia en Centro America, Mexico y las islas del Caribe durante los años de 1950 y 1951 [Progress in seismology in Central America, Mexico, and the Caribbean islands during 1950 and 1951] : Soc. Geog. Colombia Bol., v. 11, no. 1, p. 3–20, 1953.

A brief history of seismological investigations in Central America, Mexico, and the Caribbean. Data on seismological stations in the area are tabulated, and a list of shocks in 1950 and 1951 is included [see also Geophys. Abs. 156–106].—*M. C. R.*

164–41. Due Rojo, Antonio. Movimientos sismicos en España durante el año 1951 [Seismic activity in Spain during 1951] : R. Soc. Española Historia Nat. Bol., tomo 51, sec. geol., p. 59–71, 1953.

The year 1951 was unusual both for the number of shocks recorded (650) and for a decrease in intensity except for the great shocks of March 10 and May 19. Earthquakes felt and recorded in Spain and their chronological and geographic distribution are given in three tables.—*M. C. R.*

164–42. Due Rojo, Antonio. Movimientos sismicos en España durante el año 1952 [Seismic activity in Spain during 1952] : R. Soc. Española Historia Nat. Bol., tomo 51, sec. geol., p. 73–84, 1953.

The total of 460 shocks during 1952 was higher than the average although less than in 1951. None exceeded intensity 5. Data are tabulated on earthquakes felt and recorded, and their distribution.—*M. C. R.*

164–43. Milne, W. G. Canadian west coast earthquakes, 1953: Dominion Observatory Ottawa Pubs., v. 16, no. 13, p. 393–401, 1955.

During 1953, 150 earthquakes in southwestern British Columbia were recorded, bringing to 443 the number of shocks recorded since the start of the Dominion Observatory program in August 1951. The epicenters are tabulated and plotted on a map. Several shocks were recorded from the vicinity of Jervis Inlet, continuing a trend first noted in 1952. Several moderately heavy shocks occurred off

the west coast of Vancouver Island. The majority of the earthquakes located seem to occur toward the southern end of Vancouver Island.—*M. C. R.*

164–44.   Milne, W. G. Canadian west coast earthquakes 1954; Dominion Observatory Ottawa Pubs., v. 18, no. 3, p. 47–58, 1955.

During 1954 there were 178 earthquakes recorded on the network of stations in southwestern British Columbia. Epicenters were determined for 67, and they seem to fall within the regions where activity has been reported for the previous 3 years. The strongest earthquakes were those some distance off the west coast. Small shocks were recorded from several areas, including the Gulf Islands, the Olympic Mountains, and off the west coast of Vancouver Island.—*M. C. R.*

164–45.   Murphy, Leonard M., and Cloud, William K. United States earthquakes 1953: U. S. Coast and Geod. Survey Serial 785, 51 p., 1955.

This is a summary of earthquake activity in the United States, Alaska, the Hawaiian Islands, Panama Canal Zone, and Puerto Rico. Noninstrumental results are tabulated chronologically and by area. Information is also tabulated on fluctuations in well-water levels, principal earthquakes in the world, and strong-motion results.—*M. C. R.*

164–46.   Janczewski, E. W. Trzęsienia ziemi na Górnym Śląsku [Earthquakes in Upper Silesia (summaries in Russian and French)]: Archiwum górnictwa i hutnictwa, tom 3, zeszyt 2, p. 205–225, 1955.

Although local earthquakes of moderate magnitude have occurred frequently in Upper Silesia, they could be scientifically studied only in very recent years, after several seismic observatories were established in Poland. The earthquakes of February 2, May 4, and May 28, 1950, have been studied on the records obtained at four observatories in Poland, five in Czechoslovakia, and several others in central Europe, and the epicenter, depth of focus, and time of origin have been determined. The most important result indicates that the foci are at very shallow depths of 5 to 10 km. This shallow depth explains the very restricted area in which the earthquakes are observed.—*S. T. V.*

164–47.   Janczewski, E. W. Wyznaczenie położenia ognisk kilku górnośląskich wstrząsów sejsmicznykh z 1950 [The location of the foci of some earthquakes in Upper Silesia during 1950 (in Polish with French summary)]: Acta Geophys. Polonica, v. 3, no. 1, p. 3–26, 1955.

Using a method which is a combination of those of P. Caloi and G. Schmerwitz, Janczewski investigated three earthquakes that occurred in Upper Silesia during 1950.

Depths of the foci of three earthquakes were 7.17 km, 8.50 km, and 10.36 km. Previously the frequent local earthquakes of Upper Silesia had been explained as resulting from rock bursts, but this suggests they result from shallow tectonic breaks, and may produce rock bursts in the mines as an aftereffect.—*S. T. V.*

164–48.   Budryk, Witold. Skutki trzesień Ziemi w kopalniach górnośląskich [The effects of earthquakes in the mines of Upper Silesia (in Polish with Russian and French summaries)]: Archiwum górnictwa i hutnictwa, tom 3, zeszyt 2, p. 227–240, 1955.

Frequent seismic shocks in Upper Silesia, usually felt in very restricted areas, have been attributed to rock bursts in mines, but Janczewski has shown that they

are tectonic earthquakes with very shallow foci. Such shocks produce very small amplitudes at the earth's surface, but have much greater intensity in deep mines and cause damage that seem to have been produced by rock bursts.—*S. T. V.*

164-49. Girlanda, Antonino. Studio di un movimento sismico del basso Tirreno, originante alla profondità di 265 km [Study of a seismic movement of the Tyrrhenian basin, originating at a depth of 265 km]: Accad. Naz. Lincei Atti Cl. sci. fis. mat. et nat. Rend., v. 18, fasc. 3, p. 288–297, 1955.

Girlanda analyses observations, from about 30 stations, of the P and S waves from the deep earthquake of December 26, 1952 off the Lipari Islands. Discrepancies in arrival times of previous deep earthquakes (April 13, 1938 and March 16, 1941) had suggested that the Tyrrhenian basin was an area of anomalous velocity, perhaps because of its volcanic nature, or perhaps because of thinness of the "granite" layer. The coordinates of the epicenter have been determined as $15°32.778' \pm 4.072'$ E. long.; $39°46.279' \pm 1.957'$ N. lat. (geocentric); the focal depth as 264.6 km± 10.1; and origin time, $23^h55^m55.6^s \pm 06^s$. The time-distance curve of the P wave approximates a third-order parabola, from which the velocity at the deepest part of the path is calculated to be 8.55 kmps; the S-wave velocity for the same point is similarly calculated to be 4.71 kmps. These velocities agree fairly well with those deduced from the Jeffreys-Bullen tables.—*D. B. V.*

164-50. Girlanda, Antonino. Sul terremoto profondo delle Isole Eolie del 23 novembre 1954 [The deep-focus earthquake in the Lipari Islands, November 23, 1954]: Annali Geofisica, v. 8, no. 4, p. 439–455, 1955.

When the characteristic deep-focus phases such as pP, sP, sS are not recorded, the initial arrivals of P can be used to determine depth of focus, epicentral coordinates, and time of origin by fitting observations of traveltime curves by statistical methods. By such a method, the epicenter of the earthquake of November 23, 1954 has been located at $15°01'23.6''$ E. long., $38°33'09.1''$ N. lat., depth, 239.2 km, and time at origin, $13^h 00^m 05.5^s$.—*M. C. R.*

164.51. Reznov, I. A. O Kazandzhikskom zemletryasenii 1946 g. [The Kazandzhik earthquake of the year 1946]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 475–482, 1955.

Rezanov disagrees with Gubin in the latter's estimation of the seismic effects and in his interpretation of tectonic phenomena associated with the violent earthquake of November 5, 1946 in Turkmen SSR [see Geophys. Abs. 158–147]. From an analysis of geologic conditions in the western part of the Turkmen SSR, Rezanov concludes that the focus of the earthquake was much deeper than thought by Gubin, who considered the earthquake to be the result of two separate fractures.—*S. T. V.*

164-52. Nazarov, A. G. Uravneniya teorii seysmostoykosti s uchetom rasseyaniya energii [The equations of the theory of earthquake resistance with the dissipation of the energy taken into account]: Akad. Nauk Armyanskoy SSR Doklady, tom 18, no. 3, p. 69–74, 1954.

This is an analysis of vibrations and stresses produced in a structure by earthquakes. The vibrations are assumed to be of small amplitude around the position of stable equilibrium. The important feature of this study is the consideration of frictional energy losses, which affect the reactions of the structure to the

deformations produced. This is equivalent to assuming that the stress vector and the deformation vector do not coincide in direction but that the stress vector leads by a constant small angle. The stresses are first determined as functions of deformation in the idealized case with no frictional losses. The solution is obtained by using Lagrange equations. The solutions are then modified to include the frictional resistance. The effect of the friction on deformation is determined by direct measurement, using a special instrument called a "maximal multipendular seismometer," which consists of a system of six special pendulums—three for horizontal, three for vertical vibrations—and which gives the greatest amplitudes of the components of vibrations with an accuracy of about $\pm 10\mu$. By substitution of these measurements in the formulas it is possible to determine stresses in the structure for any seismic shock characterized by a given amplitude and frequency.—*S. T. V.*

164–53.   Karapetyan, B. K. Metod opredeleniya privedennykh seysmicheskikh uskoreniy [A method of determining reduced seismic accelerations] : Akad. Nauk Armyanskoy SSR Izv., Ser. fiz.-mat. yestestven i tekhn. nauk, tom 8, no. 1, p. 41–47, 1955.

The determination of stresses to which a structure is exposed during an earthquake is possible only when the waveform of the oscillations of the ground on which the structure is erected is known. Taking as an example the earthquake of September 21, 1931 with epicenter near Tokyo, Karapetyan constructed from the oscillograms of the accelerations the envelope of these curves and matched it by an equation of the form $U=Ate^{-pt}$, where U is the ordinate, A and p are coefficients that are specific for this earthquake. It was found that $U=23.5te^{-0.0855}t$, where t is time. From this equation the maximums of accelerations can be computed and the period of the vibrations of the earthquake was found to be 0.5 second. The accelerations produced by this seismic vibration in buildings of different natural frequencies T_n were computed and were found to be: 102 cm per second^2 for $T_n=0.05$ second, 120 cm per second^2 for $T_n=0.20$ second, 276 cm per second^2 for $T_n=0.40$ second, 1,246 for the case of interference when $T_n=0.5$ and .226 cm per second^2 for $T_n=0.60$ second.—*S. T. V.*

164–54.   Mügge, R. Änderungen des Grundwasser-Spiegels bei Erdbeben and durch Luftdruck-Schwankungen [Fluctuations of ground-water level due to earthquakes and atmospheric pressure variations] : Natur u. Volk, Band 83, Heft 7, p. 209–215, 1953.

This discussion of ground-water fluctuations includes a comparison of the well-level fluctuations at the Inheiden waterworks with the seismograph records at the Taunus Observatory for the Turkish earthquake of March 18, 1953 ; the surface waves are clearly indicated in the former [see also Geophys. Abs. 163–112].—*D. B. V.*

164–55.   Geographical Survey Institute. Resurvey of the southwestern part of Japan after the great Nankaido earthquake of 1946 : Geog. Survey Inst. Japan Bull., v. 4, pt. 1, p.1–48, 1954.

A resurvey of first-order leveling lines in southwestern Japan was begun in 1947 and completed in 1951. Comparison of this series with earlier surveys shows that considerable vertical displacements have been associated with earthquakes in the Mikawa, Nankaido, Fukui, and Imaichi regions, but there is little noticeable crustal disturbance in the region of the Tottori earthquake. The elevations of several hundred benchmarks are tabulated.—*M. C. R.*

164–56. Kōmura, Saburō. On relations between the Ishimoto-Iida's statistical formula and some crack-phenomena [in Japanese with English abstract] : Zisin, v. 8, no. 2, p. 80–83, 1955.

In Ishimoto-Iida's statistical formula, $na^m = k$, a is the maximum trace amplitude, n is an annual average frequency of small shocks with that amplitude, and m or k is a constant at that place. The same statistical formula holds for the distribution of the maximum amplitude of cracks occurring naturally in an earthen wall or artifically produced by heat in a glass sheet.—*V. S. N.*

164–57. Asada, Toshi. On lower limit of the magnitude of earthquakes accompanied by aftershocks [in Japanese with English abstract] : Zisin, v. 8, no. 1, p 1–7, 1955.

Using data from earthquakes in the Kanto District, Japan, Asada finds that 2 to 3 percent of earthquakes between magnitude 5.85 and 5.35 are accompanied by aftershocks; 5 to 6 percent of those between magnitude 6.35 and 5.35 have aftershocks; 30 percent of those between magnitude 6.85 and 6.35 have aftershocks; and 50 percent of those between magnitude 7.35 and 6.85 have aftershocks.—*V. S. N.*

164–58. Hayatu, Akio. On the decay factor of maximum amplitude of earthquake motions [in Japanese with English abstract] : Zisin, v. 8, no. 2, p. 75–79, 1955.

Tsuboi has found the formula $M = \alpha \log \Delta + \log A + \gamma$ useful for calculating from seismological data the Gutenberg-Richter magnitude of an earthquake occurring in and near Japan. The term α can be regarded as the decay factor for each station of the maximum amplitude of earthquake waves with distance.

Hayatu determined the constants α and γ for seismological stations in Japan by making seismological data fit the corresponding Gutenberg-Richter magnitude as closely as possible. The value of α ranges from 0.49 to 2.47, and its distribution seems to have close relation to that of Bouguer anomalies.—*V. S. N.*

164–59. Malinovskaya, L. N. Metodika opredeleniya mekhanizma zemletryaseniy [Methods of determining the mechanism of earthquakes] : Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 22 (149), p. 143–165, 1954.

In this discussion of methods of determining the mechanism of earthquakes the dimensions of the focus are assumed to be negligible in comparison with the length of the dominant seismic waves and the epicentral distance. Six cases of mechanical forces acting in the focus are discussed: a simple force, a dipole without a rotating moment, a dipole with a moment, a double dipole with a moment, two rotating moments, and a simple rotation. The seismograms of one or more stations are first assumed, and in the development of the solution the epicentral distance, the depth of the focus, the azimuth of the epicenter, the angle of the arrival of the seismic wave, the displacement of the ground in the direction of the ray, and other parameters from which the geometric and dynamic description of the effect occurring in the focus can be determined are taken into account. Most of the determinations are made by graphical constructions of which some 30 are given. Several charts and 24 geometrical maps used for the determination of the stereographic projection of the terrestrial hemisphere on the diametric plane (Wolf's grid) are included.—*S. T. V.*

164–60. Hodgson, John H. Direction of faulting in Pacific earthquakes: Geofisica Pura e Appl., v. 32, p. 31–42, 1955.

Determination of the direction of faulting in 36 Pacific earthquakes by Byerly's method indicates that transcurrent faulting is more important than was expected. In the Pacific coast area from Alaska to Seattle only 2 of 6 earthquakes were predominantly transcurrent, but 10 earthquakes from the southwest Pacific, 1 from Japan, 6 form the Kurile Islands, 2 of 3 earthquakes in the Aleutians, and 4 of 5 in South America all resulted from transcurrent faults. Both shallow- and deep-focus earthquakes are included.—*M. C. R.*

164–61. Caloi, Pietro, and Spadea, Maria Cecilia. Relazioni fra lente variazioni d'inclinazione e moti sismici in zona ad elevata sismicità [Relations between slow variations in inclination and seismic movements in zones of high seismicity]: Accad. Naz. Lincei Atti Cl. sci. fis. nat, e nat. Rend., v. 18, fasc. 3, p. 250–256, 1955.

This presents further observations of slow deformation in the vicinity of Tolmezzo which unquestionably presage sharp earthquake shocks [see Geophys. Abs. 162–141].—*D. B. V.*

164–62. Aki, Keiiti. Quantitative prediction of earthquake occurrence as stochastic phenomena: Jour. Physics of Earth, v. 2, no. 2, p. 63–69, 1954.

This is an investigation of the possibility of predicting earthquakes by use of information theory by regarding the occurrence of earthquakes as a stochastic process. The most appropriate quantity to be taken as the stochastic variable is $[n(t)-E(n(t))]$ where $n(t)$ is the number of earthquakes within in a specified range of magnitude in a specified area from time $t=0$ to $t=t$, and $E(n(t))$ is the average of $n(t)$ at $t=t$. The theory is applied to 210 earthquakes that occurred in an area of about 30,000 km² near Shiriyasaki between 1900 and 1945. The projection of the data to 1947 was not completely accurate; the discrepancy may be the effect of the relatively large variance in the long period variation, and ambiguities in the short period variation.—*M. C. R.*

164–63. Gayskiy, V. N. O tochnosti opredeleniya polozheniya ochaga i elementov struktury semnoy kory [The accuracy of the determination of the focus and structural elements of the crust of the earth]; Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 22(149), p. 131–142, 1954.

From the records of at least six stations, the epicenter can be determined with an error ranging from 5 to 15 km, the seismic velocity with an error of 0.1 to 0.3 kmps, the thickness of the granite and basalt layers with an error of ±10 km; but the depth of the focus, if the epicentral distance is more than 50 km, cannot be determined for shallow earthquakes with any reasonable accuracy. An increase in the number of seismic stations increases the accuracy of seismic determinations very little. A decrease in the error in the position of the epicenter to 2–5 km and of seismic velocities to 0.01–0.05 kmps is possible only if the accuracy of the instrumental records is increased at least five times.—*S. T. V.*

164–64. Willmore, P. L., and Hodgson, J[ohn] H. Charts for measuring azimuth and distance and for tracing seismic rays through the earth: Dominion Observatory Ottawa Pubs. v. 16, no. 14, p. 405–414, 1955.

Two charts that have been found useful in the seismological work of the Dominion Observatory are given and their use discussed: one, a stereographic net

for the determination of distances and azimuths between any two points on the earth; the second, a diagram, based on the structure of the earth as determined by Jeffreys and Bullen, for tracing ray paths penetrating to various depths. The latter is useful in studies involving the relation between depth of penetration and point of emergence.—*M. C. R.*

164–65.   Lehman, I.   The times of *P* and *S* in northeastern America : Annali
          Geofisica, v. 8, no. 4, p. 351–370, 1955.

P and *S* traveltimes for the earthquakes of March 1, 1925, November 1, 1935, March 9, 1937, October 19, 1939, and December 30 and 24, in northeastern America can be fitted to straight lines of slope 13.6 seconds per degree and 24.0 seconds per degree (8.2 kmps and 4.6 kmps) to an epicentral distance of 14°.   Beyond that distance the *P* times lie on the Jeffreys-Bullen curve for a surface focus lowered to join the straight line, and the *S* times fit the Jeffreys-Bullen curve for a surface focus with a discontinuous break of about 13 seconds at 14°.   Macroseismic data indicate the foci are not at the surface, but the data do not permit determination of depth.   The fit with the Jeffreys-Bullen curves suggests the earthquakes are not deep.—*M. C. R.*

164–66.   Caloi, Pietro. $C_{j,i}$ [in Italian with English summary] : Annali Geo-
          fisica, v. 8, no. 3, p. 293–313, 1955.

Surface waves associated with *S*, *SS*, *PS*, and similar waves have been explained as resulting from *SV* waves incident at the base of crustal layers at angles greater than the critical angle.   Periods of waves so formed at the base of the granitic layer are about 24 seconds, those formed at the base of the intermediate layer, 35 seconds, and those formed at the base of the crust, 50 seconds. The epicentral distances at which the three waves begin to appear are about 3,000 km for $C_{2,1}$, 4,000 km for $C_{1,1}$, and 6,500 for $C_{0,1}$.   Waves of this type can also originate at multiples of these distances, corresponding to *SS* waves ($C_{2,2}$, $C_{1,2}$, and $C_{0,2}$) or *SSS* waves ($C_{2,3}$ and similar waves).   These $C_{i,j}$ waves have the characteristics of the evanescent waves of wave theory in the case of reflection at the critical angle.   Stationary wave trains, resulting from the interference of evanescent waves from different directions, may also be formed.   The waves are of particular interest as a possible source of information on the crust. Other conditions being equal, the greater the thickness of continental layers, the greater the amplitudes and periods of these waves.—*M. C. R.*

164–67.   Pannocchia, G.   La registrazione dei terremoti a Pavia [The registration
          of earthquakes at Pavia] : Annali Geofisica, v. 8, no. 4, p. 417–423,
          1955.

An appreciable delay in the time of arrival of *P* and *S* waves at Pavia has been observed.   It is attributed to the low velocity of propagation in the near-surface layers in the vicinity of the station.   Information on station equipment is included.—*M. C. R.*

164–68.   Kanai, Kiyoshi, and Suzuki, Masazi.   Analytical results of the accelera-
          tion seismograms obtained at Tokyo and Yokohama : Tokyo Univ.
          Earthquake Research Inst. Bull., v. 32, pt. 2, p. 189–197, 1954.

Analysis of acceleration seismograms obtained at several places in Tokyo and Yokohama indicates that the maximum acceleration is smaller on soft ground than on firm ground, and that on firm ground high-acceleration vibrations are confined

to a narrow period range, though a wide range of periods is found on soft ground. In firm ground there are several successive waves of the same period only near the period of maximum acceleration, but in soft ground there may be successive waves of the same period over a wide range of periods. The relation between earthquake damage and the nature of the ground is also discussed with reference to Japanese construction.—*M. C. R.*

164–69.   Savarenskiy, Ye F.   Zamechaniya o znachenii gruntovykh usloviy dlya seysmicheskikh i naklonomernykh nablyudeniy [Remarks on the importance of ground conditions for seismic and clinometric observations] : Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 22 (149), p. 102–110, 1954.

In selecting a site for a seismic station or choosing a spot for temporary installation of seismometers or inclinometers, it is necessary to take into account the foundation characteristics. These are determined in most places by the properties of the sedimentary layer, especially thickness of the layer with respect to the length of the incoming seismic wave. If the layer is thin, its effect will be negligible, but if it is thicker than a wavelength, the vibrations on the upper surface will be increased in crossing the boundary between the granite and the sediments. The kinetic energy of the wave motion is determined by the product dc^2, where d is the density of the formation and c is the velocity of the oscillatory displacement proportional to the amplitude. The density of the sediments being lower than that of granite, the amplitude of seismic waves reaching the surface of the earth increases.

Examples are given of the sometimes unexpected effects of different factors on the highly sensitive instruments of modern seismology, such as the effect of rain on the indications of inclinometers and on the foundation of the buildings—*S. T. V.*

164–70.   Kanai, Kiyoshi.   A short note on the relation of amplitude-period of earthquake motion : Tokyo Univ. Earthquake Reserach Inst. Bull., v. 32, pt. 2, p. 211–213, 1954.

The relation between the maximum wave amplitude at bedrock and the maximum amplitude at the surface of the ground has been observed to be almost independent of the nature of the ground [see Geophys. Abs. 162–135]. Apparently factors tending to increase the amplitude at the surface (decrease of vibrational impedance and decrease of damping) are balanced by those tending to decrease the amplitude at the surface (an increase in the number of layers of different vibrational impedance in thicker surface layers and the coherency of the waves). Consequently the relation between D, the amplitude at the bedrock, and T, the period of the waves, may be represented by $D \propto T^{1.7}$ $^{0.2}$.—*M. C. R.*

164–71.   Adams, W[illia]m Mansfield.   The Reeff horizontal seismograph and its calibration : Am. Geophys. Union Trans., v. 37, no. 1, p. 70–74, 1956.

A new horizontal seismograph, having high magnification and excellent initiation of phases, has recently been invented by Nicholas Reeff. The instrument consists of an inverted pendulum seismometer, an electrodynamical generating system, and galvanometric registration. Since the pendulum mass is less than seven kilograms, galvanometric reaction on the seismometer motion must be considered in the calibration procedure. For calibration, the first adjustment suggested by Eaton was applied. For the periods of the seismometer and galvanometer both

equal to 1.92 sec, the damping of the galvanometer equal to 1.00, and the damping of the seismometer equal to 1.70, the peak magnification was determined to be 5050 at a period of 1.9 sec.—*Author's abstract*

164–72. Bernard, Pierre. Sur l'amplification des séismographes dont la période est allongée par condensateurs [On the amplification of seismographs whose period is increased with condensers]: Annales Géophysique, tome 11, no. 3, p. 374–375, 1955.

Experiments are described concerning the effect of a shunt condenser across the coil of a vertical seismometer pendulum. A resistance of more than 10^5 ohms separates the condenser from the galvanometer. It is found that the increase in period of the pendulum, due to the introduction of the condenser, is accompanied by a reduction in magnification of the system in the same proportion, provided that no other characteristic of the apparatus be modified.

An analogous result can be formulated when the period of the galvanometer is increased by placing a condenser across its input terminals.—*P. E. B.*

164–73. Molard, P[ierre]. Séismographes à amplification électrostatique [Seismographs with electrostatic amplification]: Annales Géophysique, tome 11, no. 3, p. 369–373, 1955.

If one plate of a variable condenser is fixed to the arm of a seismometer pendulum and the fixed plate is connected to the control grid of an "electrometer tube," satisfactory transmission characteristics are obtainable for periods sufficiently shorter than the time constant of the grid circuit. Wiring diagrams and descriptions are presented of seismometers with such electrostatic coupling planned for the Guadeloupe and Martinique stations. A horizontal component instrument of relatively short period is to be used for registering near earthquakes at Guadeloupe. Type 954 tubes are employed for this instrument, and the time constant of the circuit is greater than 1 second. At Martinique it is desired to record distant earthquakes and microseisms. A Mazda 6196 tube is employed in conjunction with a grid-isolating resistor of 4×10^{11} ohms, and the time constant of the circuit is about 40 seconds.—*P. E. B.*

164–74. Olsson, B. H. Note on the automatic recording of time signals on seismograph records: New Zealand Jour. Sci. Technology, sec. B., v. 37, no. 2, p. 115–118, 1955.

This describes an instrument which selects time signals (originating in the Seismological Observatory at Wellington and superimposed on radio broadcasts) from the radio program and records them automatically on the seismograms at an unattended seismograph station. The signals are recorded with a fixed delay of 1/20 second and an accuracy of 1/50 of a second.—*D. B. V.*

EARTH TIDES AND RELATED PHENOMENA

164–75. Lopez Arroyo, Alfonso. Mareas terrestres [Tides in the solid earth body]: Rev. Geofísica, año 13, no. 49, p. 37–76, 1954.

This is a review of the deformation in the solid earth body and related phenomena such as tidal phenomena in the ocean, the periodic deviations of the plumb line, displacement of the pole and the Chandlerian motion of the axis, the variation of latitude, and the variation of the gravitational potential due to the luni-solar effect combined with the elasticity of the globe.—*S. T. V.*

164–76. Melchior, Paul J. Les marées terrestres [Earth tides] : Ciel et Terre,
70ᵉ année, fasc. 1–2, p. 22; fasc. 3–4, p. 103–131; fasc. 5–6; p. 191–217 ;
fasc. 7–8, p. 266–288; and fasc. 11–12, p. 435–454, 1954.

This is a very comprehensive mathematical treatment of the question of earth
tides. There are five aspects of the phenomenon: reduction of the amplitude of
oceanic tides; deflections of the vertical with respect to the crust; deflections
of the vertical with respect to the axis of the globe; variations in the intensity
of gravity ; and deformations of the crust (tides in mines and wells). Detailed
discussion of the theory and methods of observation and calculation of these vari-
ous coordinates of earth tides shows the difficulty of precise determination. The
source of this difficulty is a lack of an adequate method of correcting for the in-
direct effect the Boussinesq and Corkan methods are discussed and evaluated.

In order to apply data on earth tides to solution of the problem of the internal
constitution of the earth, two phenomena related to elasticity of the crust must
be considered—wandering of the poles and seismic wave velocities. Six dif-
ferent earth models are postulated, with different combinations of rigidity of
crust and core, and the various coefficients are calculated for each. Tabulation
of the results shows that present observations of earth tides are not precise
enough to permit deductions on the nature of the interior; any discrepancy be-
tween actual and theoretical phenomena is smaller than the observational error
due to the indirect effect and also to polar wandering.

Calculations of polar movement from earth tide observations do not agree with
direct observations of such movement; viscosity must be taken into account.
The very high viscosity (probably about 3×10^{23} cgs) implies practically no phase
displacement of tides, but it can cause appreciable variation in the inclination of
the ecliptic at least in the geologic crust of the earth; it can affect nutation ; and
it seems to show a damping effect on seismic waves.

An 11-page bibliography accompanies the final installment of this paper.—
D. B. V.

164–77. Jung, K[arl]. Über die Darstellung der Gezeitenkräfte [The represen-
tation of tidal forces] : Gerlands Beitr. Geophysik, Band 64, Heft 4,
p. 278–283, 1955.

A derivation of tidal forces, suitable for lectures.—*H. F.*

164–78. Castro, Honorato de. Variaciones de la latitud de los puntos de la
superficie terrestre producidas por acciones de la luna y el sol
[Variations in the latitude of points on the surface of the earth pro-
duced by the action of the moon and the sun] : Petroleos Mexicanos,
2ª época, tomo 2, no. 7, p. 508–510, 1955.

A discussion of the effect of the sun and the moon on the deviation of the plumb
line at a point of the earth's surface, and hence on the latitude of the point of
observation.—*S. T. V.*

164–79. Argentieri, D. Influssi gravitazionali di Giove su taluni fenomeni
geofisici [Gravitational effect of Jupiter on some geophysical phe-
nomena] : Annali Geofisica, v. 8, no. 4, p. 457–473, 1955.

Data on ancient eclipses and other astronomical observations indicate a sec-
ular variation of astronomical time, and modern quartz clocks have given clear
evidence of a seasonal variation. Measurements of the velocity of light in
vacuum have shown a periodic variation which must be attributed to corre-

sponding variations in astronomic time. There should be analogous variations in all physical measurements based on measurements of time; the difference of 14 milligals in measurements of gravity at Potsdam in 1901 and 1937 may be one. The 83-year period of this variation of astronomical time can be associated with the 83-year period by which the Babylonians made predictions on future positions of Jupiter, and the Sun, Earth, and Jupiter are in the same relative positions every 83 years. It is suggested that the combined gravitational effect of the Sun and Jupiter produce earth tides and oscillations of the earth's crust. The velocity of the displacement would cause the variations in astronomical time. Displacement of the meridian should cause a displacement of magnetic isogones with a period of 83 years and out of phase with variations of astronomical time by a quarter period. This prediction is fairly well represented by the formula for magnetic declination at Oslo. According to this theory, rather than variations in the earth's rotation, there are displacements of the surface of the earth.—*M. C. R.*

164-80. Fleckenstein, J. O. Erdkreisel der Geophysik und Fundamentalsystem der Astronomie [Spinning motion of the earth of geophysics and fundamental system of astronomy (with English summary)]: Experientia, v. 9, no. 12, p. 437–457, 1953.

This is a detailed mathematical review of polar wandering and variations in the earth's rotation, and their geophysical and astronomical consequences. Because the Laplace system of astronomy is based on the concept of an invariable axis of the earth, the discovery that it is variable has led to the establishment of the international catalogs of star coordinates, corrected for variations in latitude (0.6″ in 1.2 years), speed of rotation (0.1 second decrease per year), and spinning of the earth. The last are so delicate that they can be measured only electronically; it is to these that the problems of polar wandering and continental drift are related. The concept of a rigid earth has had to be rejected in favor of a fluid body model.—*D. B. V.*

ELASTICITY

164-81. Matumoto, Tosimatu, and Satō, Yasuo. On the vibration of an elastic globe with one layer. The vibration of the first class: Tokyo Univ. Earthquake Research Inst. Bull., v. 32, pt. 3, p. 247–258, 1954.

To determine if it is possible to infer the state of the earth's deep interior from the dispersion of long surface waves (for example, those with a wavelength equal to the radius of the earth), Matumoto and Satō have calculated the vibration of the first class (Lamb's notation, corresponding to transversal vibration) in an earth composed of two parts, the core and mantle, with density and rigidity assumed uniform in each part. Two cases are considered, first, a rigid core, and second, a liquid core. The periods of the vibrations will be 33.7 minutes with a rigid core and 42.5 minutes with a liquid core (the S-wave velocity in the mantle is assumed to be 6.5 kmps). The period will be intermediate with an intermediate state of the core.—*M. C. R.*

164-82. Knopoff, L. The interaction between elastic wave motions and a magnetic field in electrical conductors: Jour. Geophys. Research, v. 60, no. 4, p. 441–456, 1955.

The propagation of elastic waves in an electrically conducting solid permeated by a uniform, static magnetic field is discussed. In the case of plane wave mo-

tions, two systems of waves arise: simple uncoupled systems, and a trimodal coupled system of waves. In the uncoupled case, in which polarizations are unaltered, two dispersive, complex phase velocities exist. For a weak impressed magnetic field, one of these velocities is close to the elastic wave velocity of the polarized wave in the absence of the field. The other wave, called an eddy current wave, although strongly attenuated, cannot be neglected in the solution of boundary value problems.

When the theory of magnet elastic interactions is applied to seismic motions in the conducting core of the earth, it is found that compressional waves are virtually unattenuated in the core for the pertinent values of frequency, conductivity, and magnetic intensity. It is concluded that magnetoelastic interactions are not a significant mechanism in the earth's core.—*Author's abstract*

164–83.   Pekeris, C. L.   The seismic buried pulse: Natl. Acad. Sci. Proc., v. 41, no. 9, p. 629–639, 1955.

A exact solution is given for the motion of the surface of a uniform elastic half-space produced by a point pressure pulse situated at a depth H below the surface and varying with time like the Heaviside unit function $H(t)$. This source excites both P and SV waves. When the epicentral distance is greater than $H/\sqrt{2}$ for a medium in which the elastic constants λ and μ are assumed equal, the P wave is followed by a diffracted P wave, derived from the SV wave, which arrives before the direct SV wave.—*M. C. R.*

164–84.   Matuzawa, Takeo.   S-Wellen an der fest-flussigen Schichtgrenze II. [S-waves at a solid-liquid interface. Part 2]: Tokyo Univ. Earthquake Research Inst. Bull., v. 32, pt 2, p. 155–160, 1954.

In Part 1 [see Geophys. Abs. 161–70], the behavior of SH waves at a solid-liquid interface was developed mathematically. This is a similar discussion of SV waves.—*M. C. R.*

164–85.   Spencer, T. W.   Reflection of an acoustical pressure pulse from a liquid-solid plane boundary: Geophysics, v. 21, no. 1, p. 71–87, 1956.

The problem treated is concerned with predicting the transient response of a system composed of a liquid layer, bounded above by a vacuum and below by a perfectly elastic solid, when excited by an arbitrary pressure applied uniformly over the surface of a spherical cavity located in the fluid. The Laplace transform of the displacement response is expressed in terms of an integral which is expanded in such a way that each term describes the contribution from one of the image sources. Each term may be evaluated exactly at points located on a vertical axis passing through the source. The final expression for the vertical displacement at axial points is composed of the acoustic, afterflow, and correction terms. In solids for which Poisson's ratio is greater than one third, the initial variation of the correction is toward positive values (corresponding to motion directed toward the interface). For Poisson's ratio less than one third the initial variation may be either positive or negative depending on the magnitude of the compressional velocity ratio. A surface wave is shown to exist regardless of the choice of parameters. The surface wave velocity is always less than it would be in the absence of the liquid.—*Author's abstract*

164–86. Satō, Yasuo. Study on surface waves XI. Definition and classification of surface waves: Tokyo Univ. Earthquake Research Inst. Bull., v. 32, pt 2, p. 161–168, 1954.

Surface waves are defined as waves propagated in a medium with a single or several parallel plane boundaries with the wave front perpendicular to the boundary surface(s). The amplitude distribution may be classified in two groups, one expressed by an exponential function (as in Rayleigh waves) and the other sinusoidal. A classification of possible surface waves is prepared from the permutations and combinations of these types in media with both free surfaces and rigid boundaries.—*M. C. R.*

164–87. Suzuki, Ziro. On Love waves in heterogenous media: Tōhoku Univ. Sci. Repts., 5th ser., v. 7, no. 2, p. 82–93, 1955.

Effects of the state of heterogeneous media at infinite depth on the propagation of Love waves are studied. If rigidity or S-wave velocity is assumed to increase infinitely with depth, a curious kind of Love waves can be propagated in the medium. These waves have no definite phase velocity for a given period and, in some cases, have infinite number of nodal planes even at infinite depth. If the medium is taken to be in the form that rigidity and density is kept finite throughout the medium, ordinary waves which have some definite phase velocities for a given period and no nodal plane at infinite depth are exclusively propagated. The range of existence of Love waves in such medium is shown to be $b_\infty > c > b_s$, where the phase velocity is written by c and b_∞ and b_s denote the S-wave velocity at infinite depth and the smallest value of the velocity in the medium respectively.—*Author's abstract*

164–88. Solov'yev, S. L., and Dzhibladze, E. A. Ob izmenenii potoka seysmicheskoy energii s epitsentral'nym rasstoyaniyem [The changing of the flux of seismic energy with epicentral distance]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 462–463, 1955.

In an infinite homogeneous space the energy E of the elastic waves decreases inversely with the square of the distance r from the source of the disturbance, $(E=1/r^2)$. In a semispace in the vicinity of the boundary, the energy decreases more rapidly because a certain amount of the energy in the incoming spherical waves is transformed into surface waves that propagate along the boundary. The energy of transverse waves produced by numerous earthquakes in the Caucasus with the focal depths ranging from 5 to 20 km has been found to be related to distance by the formula $E=a/r^{3.8}\pm0.3$. This is close to Lamb's formula of $E=a/r^4$.—*S. T. V.*

164–89. Keylis-Borok, V. I. K voprosu o rezonansnykh svoystvakh interferentsionnykh voln v sloye [On the resonant properties of interference waves in a layer]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 22 (149), p. 50–59, 1954

This is the continuation of the previous study [see Geophys. Abs. 160–71] of the propagation of steady waves in a plane-parallel layer between two semispaces. The media are assumed to be homogeneous, isotropic, and perfectly elastic; the waves are produced by a concentrated force within the layer varying sinusoidally with time. The interference waves become dominant as soon as the distance from the force becomes large compared with the thickness of the

layer. The case of a force acting on the boundary plane of the layer is also studied. Results are presented in formulas and graphs. The results correspond to observations in seismic prospecting.—*S. T. V.*

164–90. Zvolinskiy, N. V. Mnogokratnyye otrazheniya uprugikh voln v sloye; [Multiple reflections of elastic waves in a layer] : Akad. Nauk SSSR. Geofiz. Inst. Trudy, no. 22 (149), p. 26–49, 1954.

In the interpretation of seismic records from areas of stratified rocks, it is important to be able to distinguish waves reflected from deep horizons from multiple reflections in the upper layer. Zvolinskiy uses a criterion based on the variation of the amplitudes of waves reflected at the upper or lower boundary of the layer over elastic semispace. The boundaries are assumed to be parallel and horizontal. The variation of the potential of the elastic wave reflected from a boundary plane is determined and the expression applied to repeated reflections to establish formulas for the "coefficient of reflection." These are applicable to an indefinite number of reflections, but the analysis here is limited to three consecutive reflections of *P* or *S* waves and waves derived from them.— *S. T. V.*

164–91. Honda, Hirokichi, and Nakamura, Kohei. On the motion of the surface of the sea due to a submarine earthquake : Tōhoku Univ. Sci. Repts., 5th ser., v. 7, no. 1, p. 17–34, 1955.

Vessels on the surface of the ocean are sometimes shaken violently when a shallow-focus submarine earthquake occurs nearby. In this paper, Honda and Nakamura report a mathematical investigation of the motion of surface of a sea, of uniform depth overlying a solid bottom, due to *P* and *S* pulses emitted from a point source within the solid bottom. Solutions are obtained from which the motion due to sound waves refracted into the sea and reflected at the surface or the bottom can be obtained. These motions predominate near the epicenter, and motions due to normal-mode propagation predominate at large distances.—*M. C. R.*

164–92. Kato, Yoshio, and Takagi, Akio. Model seismology (Part 1) : Tōhoku Univ. Sci. Repts., 5th ser., v. 7, no. 1, p. 35–44, 1955.

Propagation of elastic waves produced in a thin plate by an ultrasonic pulse and in a medium of two homogeneous plates divided by a step-shaped boundary was studied experimentally. Both horizontal and vertical motions were measured. In the first, two predominant phases were found in every seismogram, the first consisting of large motion with a horizontal component and small vertical component (3 : 1 to 4 : 1) which are identified as primary body waves. The second phase exhibits the character of Rayleigh waves. In the complex structure, the waves are not so simple, but the traveltimes are well explained by x-ray theory.—*M. C. R.*

164–93. Collins, Francis, and Lee, C. C. Seismic wave attenuation characteristics from pulse experiments : Geophysics, v. 21, no. 1, p. 16–40, 1956.

Laboratory data on the transmission of stress waves in rocks indicate that the attenuation exponent (db/ft) for steady state sine waves is roughly proportional to frequency in dry cores at atmospheric pressure. Measurements of the effects of pressure and water saturation, however, show that much more work

is required before laboratory results can be extrapolated to conditions in the earth. Field experiments avoid these problems, but not, of course, without introducing others. The field tests and theoretical studies of Ricker indicate that the attenuation exponent is proportional to the square of the frequency at low frequencies; these results have not, however, been accepted unreservedly. We propose further experiments of the type conducted by Ricker, but with emphasis on recording the wave at several distances so that the changes in shape can be observed as the wave travels through the medium.

To use such data to determine the attenuation exponent and the wave propagation equation, we propose that the pulses be converted to equivalent steady state sine wave data by Fourier integral analysis. Geometric effects in the particular experiment can be eliminated by mathematical analysis and the attenuation exponent calculated from the steady state magnitudes and phases at different distances. The basis of the analysis method is the fact that the manner in which the attenuation exponent appears in the harmonic solution of the most general linear wave equation is independent of the manner in which it varies with frequency. Hence at each frequency the attenuation exponent can be calculated from the steady state data for that frequency. The method is applied to data obtained in a quarry sandstone. Although the results are not consistent for different transmission distances, it is believed that data from additional experiments of this kind can be used to determine the attenuation exponent and the wave propagation equation.

In formulating the method, the Boltzmann superposition principle is used in which the general three-dimensional stress-strain relations for an isotropic material require two elastic constants and two memory functions. A preliminary study of the memory function for dilatational waves yields some interesting limitations on possible functions when we impose the restriction of elastic behavior with static stresses and strains. If the Laplace transform of this function is analytic at the origin, then the attenuation exponent increases with the square or some higher even power of the frequency at low frequencies. To obtain any other variation, the memory function transform must have a branch point at the origin (poles and essential singularities are ruled out). No memory function will yield an attenuation exponent precisely proportional to frequency over any frequency range, but a class of memory functions may exist yielding an attenuation exponent proportional to frequency raised to a power arbitrarily close to unity at low frequencies. This analysis is based on the assumption of linearity, which we do not wish to abandon until forced to by experimental data.—*Authors' abstract*

164-94. Koefoed, O. On the effect of Poisson's ratios of rock strata on the reflection coefficients of plane waves: Geophys. Prosp., v. 3, no. 4, p. 381–387, 1955.

Reflection coefficients were computed for longitudinal waves incident at oblique angles on boundary planes between elastic media. The variation of the reflection coefficients with the angle of incidence is strongly affected by the values of Poisson's ratio of the two media. Contrary to the conclusions of Muskat and Meres, the reflection coefficient may vary appreciably with the angle of incidence in the range from 0° to 30°. The possibility of practical application of this phenomenon is discussed.—*W. H. D.*

164-95.   Malecki, Ignacy, and Kołtoński, Wacław. Zastosowanie ultradźwieku do badania struktury jednorodnych złóż geologicznych [The use of ultrasonic waves in the investigation of the structure of homogeneous geologic formations (in Polish with French and Russian summaries)] : Archiwum górnictwa i hutnictwa, tom 3, zeszyt 2, p. 157–204, 1955.

The laws of propagation of ultrasonic waves in different media are discussed, and experiments are described which were made in the laboratory and in the field for the determination of the velocity of the elastic waves in various media, their damping properties at different frequencies, and the reflecting properties at the boundaries of different layers. The results of the measurements on anhydrite, rock salt, limestone, coal, and sandstone are presented on graphs and in tables.

An ultrasonic method was successfully applied in exploration for coal and rock salt. The capacity of the generator producing ultrasonic waves was only 200 watts; the frequency used ranged from 30 to 150 kc.—*S. T. V.*

164-96.   Barducci, Italo. Sul modulo elastico apparente di solidi porosi [On the apparent modulus of elasticity of porous solids] : La Ricerca Sci., anno 24, no. 3, p. 528–533, 1954.

Gatto's method of studying the influence of isolated holes on the velocity of sound in metals has been extended to a theoretical examination of the effect of a great number of statistically distributed small cavities on the Young's modulus of a solid. It is demonstrated that, in contrast to Gatto's case, the effect of porosity is the same for both static and dynamic measurements; it consists of a decrease of apparent modulus in proportion to a decrease in density. These results agree very well with recent experiments on fritted materials by Barducci and Cabarat.—*D. B. V.*

164-97.   Ozerskaya, M. L. Opyt laboratornogo izmereniya uprugikh svoystv gornykh porod [The results of laboratory determinations of the elastic properties of rocks] : Prikladnaya geofiz., vypusk 12, p. 93–106, 1955.

Seismic velocities, usually determined by seismic well logging, may be measured in the laboratory on core samples from drill holes, either by seismoacoustic measurements or by observing the height of elastic rebound from the surface of the core specimens with a scleroscope, an instrument currently used in technology for the determination of hardness. The procedure is very simple and gives results not less reliable than those obtained by the ultrasonic impulse method. Discrepancies between the results obtained by these two methods and those of seismic well logging are not attributable to the new method. Comparison of data on porosity, density, seismic velocity, and the height of rebound indicates a simple linear correlation among them.—*S. T. V.*

164-98.   Shimozuru, Daisuke. Study on the elasticity near the melting point. Part 1. Nature of dilatational wave : Tokyo Univ. Earthquake Research Inst. Bull., v. 32, pt. 3, p. 271–279, 1954.

The variation with temperature of the velocity of ultrasonic compressional waves in Wood's metal was experimentally determined in the range from 10°C to 90°C. The apparatus used was similar to that described by Hughes [Phys. Rev., 1949], with the sample enclosed in a brass pipe 5 cm long by 2.5 cm wide. The

velocity of the dilatational wave decreased continuously as the temperature was raised to the melting point where there was a discontinuous decrease from 2,510 meters per second to 2,345 meters per second and a more rapid decrease from the melting point to 90°. The amplitude decreased continuously with increasing temperature without any sudden change near the fusion point.—*M. C. R.*

164–99. Sakuma, Shūzō. Effect of thermal history on viscosity of Oosima lavas (Elastic and viscous properties of volcanic rocks. Part 4) : Tokyo Univ. Earthquake Research Inst. Bull., v. 32, pt. 2, p. 215–230, 1954.

New experiments on Oosima lavas show that the more rapidly the specimens are heated to high temperatures, the more fluidal they become, and the more glassy the specimens, the more fluidal the behavior. This means that the lavas are affected by their thermal histories, and that the viscosity is a function of the history of the lava, that is, of the degree of development of crystallization. Differences in viscosity of lavas among volcanoes may be caused primarily by differences in the chemical composition of the magma, but also by the difference in the stage of development of crystallization at the time they move toward the surface.— *M. C. R.*

164–100. Wyllie, M. R. J., Gregory, A. R., and Gardner, L. W. Elastic wave velocities in heterogeneous and porous media : Geophysics, v. 21, no. 1, p. 41–70, 1956.

Longitudinal wave velocities have been measured in several synthetic and natural porous media with an ultrasonic velocity meter that measures the velocity of propagation of high-frequency pulses (200 to 1,000 kc) through hand samples. Velocities were determined on aggregates of spheres, both dry and saturated with various liquids, and in natural sandstones in the dry state and as a function of water and oil-and-water saturation under different pressure conditions. Results are presented graphically to show the relations among wave velocity, porosity, pore content, and nature of matrix. There is a sufficiently close relation between velocity and porosity to suggest that interval velocity measurements can be used to indicate porosities of sandstone and perhaps limestones. The relation between velocity and the sixth power of the depth of burial found by Faust for shale and sand-shale sections may be due primarily to variations in the porosity of the shales.—*M. C. R.*

ELECTRICAL EXPLORATION

164–101. Kisłow, Afrikan. Elektryezne metody poszukiwawcze [Electric methods of prospecting] : Przeglad geol., zeszyt 5, p. 169–177, 1954.

A brief review of the electric resistivity method.—*S. T. V.*

164–102. Tarkhov, A. G. Geofizicheskaya razvedka metodom induktsii [Geophysical exploration by the induction method] : 96 p., Moscow, Gosgeoltekhizdat, 1954.

This is a treatise on the electromagnetic induction method in mineral exploration. Four chapters deal with the physical foundation of the method, field methods and instruments, disturbing effects, and the application of the method and examples of its successful use.—*S. T. V.*

164–103. Porstendorfer, G[ottfried]. Die tellurischem Ströme als geophy-
sikalisches Aufschlussverfahren und ihre praktischen Anwendung-
smöglichkeiten in der Deutschen Demokratischen Republik [Telluric
currents as a geophysical investigation method and the possibilities
of their practical application in the German Democratic Republic] :
Geologie, Jahrg. 4, Heft 3, p. 347–348, 1955.

After a brief explanation of the origin of earth currents and their relation to
subsurface formations and structures, Porstendorfer suggests that the chief use
of the telluric current method is in reconnaissance for oil structures, serving to
indicate promising areas which then can be surveyed seismically.   Limestone anti-
clines and salt domes are easily distinguished.   In some places, telluric current
surveys succeed where seismic reflections fail at greater depths owing to
inhomogeneities in the cover.

In East Germany, the Brandenburg and Mecklenburg areas are suitable for
earth current prospecting, but the industrial and mining regions of central Ger-
many are not because stray currents would interfere.   Regional earth current sur-
veys would supplement previous gravity and magnetic surveys.   The cost of such
surveys is about $1\frac{1}{2}$ times that of gravimetric and about $\frac{1}{3}$ to $\frac{1}{4}$ that of seismic
methods.—*D. B. V.*

164–104. Shalayev, S. V. Opredeleniye polozheniya provodyashchego tela v
elektrorazvedke [The determination of a conductive body by electri-
cal prospecting methods] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 5,
p. 468–474, 1955.

Many ore bodies are good conductors of electricity, much better than the sur-
rounding formations, so that their boundary surface can be considered as an
equipotential surface.   To locate such bodies, Shalayev uses potential theory and
determines the values of the potential function in the lower semispace as the
analytical continuation of the potential function which is determined from values
on the earth's surface.   Thus the assumption is made that the potential function
is harmonic inside the sphere S of radius r; and if harmonic, this function can be
uniquely determined from its values and the values of its normal derivatives on
the circle cut by the sphere S on the earth's surface.   It can be proved that on the
earth's surface the normal derivatives are all zero, which makes the solution
possible.   By applying the theory of the complex variable, a method is derived
for determining the upper surface of the ore body, but its lower boundary
surface remains unknown.—*S. T. V.*

164–105. Yudkevich, R. V. Ob otsenke neftenosnosti plastov s malym udel
'nym soprotivleniem [The valuation of the oil-bearing potential of
reservoirs characterised by low specific resistivity]: Prikladnaya
geofiz., vypusk 11, p. 63–71, 1954.

Oil-bearing rocks as a rule have high electric resistivity, as much as 40–50
times greater than the resistivity of a similar water-bearing layer.   To evaluate
the oil-bearing properties of a layer, the ratio of its resistivity when filled with
oil to that when saturated with water is recommended.   This ratio is called the
coefficient of the resistivity increase; the greater this coefficient, the more proba-
bility that the layer is petroliferous.   However, in certain conditions even with
a very low coefficient the layer can prove to be oil bearing, as when the layer con-

sists of several alternating oil-bearing sands separated by water-saturated clays. In such conditions it is recommended that spontaneous potential curve be determined as variation of the potential can be considered as the indication of such stratification. When it is possible to obtain side-wall samples, illuminating them with luminescent light, differences in the color of such layers can be clearly seen.—*S. T. V.*

164–106. Tikhonov, A. N., and Enenshteyn, B. G. Fizicheskiye prichiny oshibok, poluchayushchikhsya pri vypolnenii VEZ kompensatsionnym metodom [Physical causes of errors in vertical electrical sounding using the compensating method] : Prikladnaya geofiz., vypusk 10, p. 74–83, 1953.

Theoretical and experimental studies on the physical causes of errors in d-c electric profiling with a potentiometer as the measuring instrument are discussed. By using an oscillograph the building up of the current and the voltage have been observed, and it is concluded that when a potentiometer and dry batteries are used the errors of measurements are very often high, as when the electrode spacing exceeds 10,000 meters the final value of the voltage is reached in about 20 seconds, and to take readings after such a lapse of time is usually impossible because of disturbances created by stray currents. Therefore, the elimination of errors due to the slow building up of voltage is possible only when oscillographic recording and an electric generator of sufficient capacity are used.— *S. T. V.*

164–107. Carpenter, E. W. Some notes concerning the Wenner configuration : Geophys. Prosp., v. 3, no. 4, p. 388–402, 1955.

This paper deals with the four electrode method of electrical resistivity prospecting using direct current. It is shown that three resistances can be measured for any four electrode configurations, and a simple relation between them is derived. The particular case of the Wenner electrode configuration is discussed and a further relation derived between the three apparent resistivities corresponding to the three resistances. The practical value of the resistance relation as a means of avoiding experimental errors is indicated.

In general the three apparent resistivities are different in magnitude although there are certain particular cases where they are equal to one another. Their actual values are determined for a number of simple problems and the possibility of having a negative apparent resistivity is illustrated.

Finally, examples of field tests are given in which the three resistances were measured, and it is concluded that the method can often provide a simple way of distinguishing between the effects of lateral and vertical resistivity variations.— *Author's abstract*

164–108. Szabadváry, László. Kutató fúrásokra tamaszkodó geoelektromos feltalajkutatás [Geoelectric soil investigations based on several borings (with English and Russian summaries)] : Magyar Állami Eötvös Loránd Geofiz. Intézet. Geofiz. Közlemények, kötet 3, szám 9, p. 121–141, 1954.

This discusses a new method of interpreting electrical depth profile where several boreholes are available in the area under investigation. The method concerns surface soil problems involving shallow depths and very precise determination of layer boundaries.—*D. B. V.*

164–109.   Samoylov, V. G., and Konshin, G. G.   O primenenii metodov elektro-
razvedki pri geologicheskikh issledovaniyakh dlya proyektirovaniya
i stroitel'stva vodokhranilishch, prudov i vodoyemov v rayonakh s
karstuyushchimisya gruntami [The application of the electric
method of exploration to geologic investigations when designing
and building reservoirs, ponds, and basins in areas of possible
karst] : Gidrotekhnika i melioratsiya, no. 1, p. 14–27, 1956.

Examples are cited of reservoirs built on highly permeable ground or in karst
areas that were drained of accumulated water. It is necessary to make a careful
and detailed investigation of the ground before building dams, especially in
regions abounding in limestone, chalk, marl, and dolomite. The best method
for this is the electric resistivity method, with in many places, the electrode
spacing reduced to about 1 meter. Several practical examples are described,
and the electric profiles are shown.—*S. T. V.*

164–110.   Sebestyén, Károly.   Filtraciós potenciálok Velem környékén [Filtra-
tion potential in the vicinity of Velem (with English and Russian
summaries)] : Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz.
Közlemények, kötet 4, szám 1, p. 39–43, 1955.

Self-potential measurements reveal an extensive anomaly in the Köszeg hills,
which is attributed to filtration of fluids.—*D. B. V.*

164–111.   Běhounek, Rudolf.   Geoelektrické sondováni základové půdy přehrad-
niho mista no Vltavě u Zlakovic [Geoelectric exploration for the
dam over the Vltava River near Zlakovice] : p. 89–90 *in* Zoubek,
Vladimir, The geological basis for the project of the Orlik dam
on the Vltava near Zlakovice : Československá Akad. Věd. Geo-
technica, svazek 15, 126 p., 1953.

As part of the geologic investigation of the foundation around the projected
dam across the Vltava River near Zlakovice, the electric resistivity method was
used to determine the depth of the alluvium over the rock. Lee's arrangement
with a Megger Earth Tester was used with a Lee configuration of electrodes,
and depths were determined at 31 places. Four of these were verified by drilling,
and the depths were found to be in good agreement with those predicted.—
S. T. V.

164–112.   McCullough, Edgar J.   Resistivity measurements in cyclothemic sedi-
ments : Compass, v. 33, no. 2, p. 115–119, 1956.

A report of resistivity work in thin members of the Conemaugh series of the
Pennsylvanian system. The resistivity work delineated sandstone, shale, and
limestone members of the series and should prove useful in developing sand
deposits. It might be possible to estimate the quality of material to be used for
road fill from the resistivity readings.—*V. S. N.*

164–113.   Shibatō, Kihei.   Geophysical prospecting at Kuga Mine, Yamaguchi
Prefecture [in Japanese with English abstract] : Geol. Survey
Japan Bull., v. 6, no. 3, p. 19–26, 1955.

Electrical and magnetic prospecting in the Umenoki and Iwaya regions, Kuga
mine, an area of contact metamorphic mineralization containing pyrrhotite,
chalcopyrite, scheelite, and skarn minerals, resulted in a better understanding of

the relationships between known deposits and in the discovery of one or two promising new areas.—*V. S. N.*

164–114. Antsyferov, M. S., and Gol'dfarb, M. L. Opyt issledovaniya strunnogo gal'vanometra [Experimental investigation of a string galvanometer] : Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 22(149), p. 19–25, 1954.

In repairing a galvanometer a platinum wire was inserted in place of a broken string and the sensitivity of the instrument measured. A wire 87 mm long with a diameter of 5μ was first used, and later one with a diameter of 1.5μ. With the latter the sensitivity of the instrument was very high $(10^{-12}\ a/(mm/m))$. Because of the high electric resistivity of the wire, the galvanometer can measure a voltage of hundredths of a volt; the sensitivity can be increased by using a quartz wire of suitable diameter. Such high sensitivity is very desirable in measurements of telluric currents, in electric well logging, and in some other geophysical applications.—*S. T. V.*

ELECTRICAL LOGGING

164–115. Heidecke, Otto. Grundsatzliches zu elektrischen Bohrlochmessungen [Basic principles of electrical logging] : Zeitschr. angew. Geologie, Band 1, Heft 2, p. 77–83, 1955.

A review of the principles, field techniques, and interpretations of electric logging.—*M. C. R.*

164–116. Kisłow, Afrikan. Rdzeniowanie elektryczne otworów wiertniczych [Electrical logging of drill holes] : Przeglad geol., zeszyt 8, p. 341–342, 1954.

Electrical well logging is of great value in providing information on the geology of an area. The usual practice in exploring an oilfield should be reversed. Usually the first two drill holes are logged lithologically and only the later ones electrically; Kisłow says the electrical logging gives more information and information of a more regional character, and therefore, the first drill holes in a new oilfield ought to be logged electrically.—*S. T. V.*

164–117. Rivkin, I. Ya. O prirode pomekh pri elektricheskom karottazhe skvazhin [The nature of disturbances in electric well logging] : Prikladnaya geofiz., vypusk 11, p. 50–62, 1954.

Disturbances, changing the ordinates of the curve of apparent resistivity, are caused by electromagnetic induction between the adjacent turns of the cable wound on the drum of the hoist. The best way to eliminate them is to use armored cable. Leakage and inflow of alternating current in the measuring circuit provoke oscillations of the recording instruments owing to commutation of the current by the pulsator. The amplitude and frequency of these oscillations are determined by the ratio of the frequency of the alternating current to the frequency of the pulsator. To decrease the interference it is necessary to find the optimum frequency of the pulsator; use of a pulsator with a frictional device is recommended. When the recording of apparent resistivity and self potential are fed in parallel, stabilizing resistances must be inserted.—*S. T. V.*

164–118. Martin, J[ohn] L., and Campbell, W. M. Displacement logging—a new exploratory tool: Am. Inst. Min. Metall. Engineers Trans., v. 204, Jour. Petroleum Technology, v. 7, no. 12, p. 233–239, 1955.

When fresh water or drilling mud of low salinity is injected into a sandstone containing both oil and saline connate water, the injected fluid will displace both the oil and the connate water, with the connate water forming a buffer between the oil and the displacing fluid. The oil-saturated and fresh-water-saturated zones will have a high electrical resistivity while the connate water buffer zone will have a low resistivity. On the other hand, if the sandstone contains only connate water originally, there will be only two zones after flooding—a flooded zone of high resistivity and an unflooded zone of low resistivity. These two conditions may be distinguished by taking a group of electric logs with a variety of spacings and determining the manner in which resistivity varies with distance from the well bore following flooding. Electrode spacings of from 6 inches to 52 inches were used. The electrode carrier was equipped with flexible rubber gaskets to minimize current flow through the mud column. It was possible to detect the low-resistivity buffer zone in 19 of 25 oil-bearing sections, while only 4 out of 88 water-bearing sections exhibited the same characteristic.—*G. V. K.*

164–119. Temkina, B. S., and Yezupov, F. I. Materialy po teorii karottazha soprotivleniy, poluchennykh v resul'tate setochnogo modelirovaniya [Data on the theory of resistivity well logging obtained from measurements on models]: Prikladnaya goefiz., vypusk 11, p. 72–91, 1954.

Many curves of apparent electric restivity were obtained in the laboratory from measurements on models simulating different combinations of layers, and from these data graphs have been constructed, showing the effect of parameters such as the diameter of the hole, the thickness of the surrounding formations, their electric resistivity as well as that of the mud, and the distance between the measuring electrodes. These curves can be useful in special cases in well logging, but no attempt has been made to generalize the results.—*S. T. V.*

164–120. de Witte, Leendert. A study of electric log interpretation methods in shaley formations: Am. Inst. Min. Metall. Engineers Trans., v. 204, Jour. Petroleum Technology, v. 7, no. 7, p. 103–110, 1955.

In a clay-bearing sandstone, in addition to the free ions in solution in the connate water, there is an additional number of ions equal to the exchange capacity of the clay particles that are available for electrical conduction and that contribute to the natural potential. In the vicinity of clay particles, the charge density may be so great that the activity of the ions is reduced. Taking this effect into consideration, de Witte derives a pair of equations for the interpretation of self-potential and resistivity logs in shaley sands.—*G. V. K.*

164–121. Daknov, V. N. O nizkikh kazhushchikhsya soprotivleniyakh produktivnykh gorizontov, slozhennykh tonkimi sloyami glin i neftenosnykh peskov [On the low apparent resistivity of producing horizons, formed by thin layers of clay and oil-bearing sand] : Prikladnaya geofiz., vypusk 10, p. 29–35, 1953.

When the drill hole taps a formation composed of several thin layers of clay alternating with oil-saturated sands an increase of apparent resistivity, indicative of the existence of the oil, is not always shown because of the high conductivity of the clay layers that contain much water.

Several measuring arrangements are suggested to obtain evidence of even thin oil-bearing strata, the best being a triple electrode mounted vertically. The middle electrode serves as the usual measuring electrode, the other two are kept at the same potential and produce deeper penetration of the currnt into the wall of the drill hole. Measurement of the SP curve and its gradient are also recommended.—*S. T. V.*

164–122. Blum, Harold A., and Martin, John L. Log interpretation problem in low resistivity sands: Jour. Petroleum Technology, v. 7, no. 8, p. 10–14, 1955.

The Frio sand in the Mustang Island field of Nueces County, Tex., is characterized by low electrical resistivity even when it is oil saturated. This effect is generally attributed to a "dirty" sand where saline water absorbed by clay in the sandstone causes the resistivity to be low even when oil is present. Blum and Martin carried out electriclog interpretations using the techniques suggested by Poupon and others [Geophys. Abs. 158–101], Wyllie and Southwick [Geophys. Abs. 156–61], de Witte [Geophys. Abs. 164–120], and White [Geophys. Abs. 159–76] for dirty sands and also by Archie's method [Geophys. Abs. 130–9411] for clean sands. The results showed that in most cases, clay conductivity effects were negligible and Archie's equation provided accurate results. Of the interpretation procedures for dirty sands, those of Poupon and de Witte provided the most accurate results. The low resistivity of oil-bearing Frio sands may result from connate water being held in impermeable sand stringers rather than from clay conduction effects.—*G. V. K.*

164–123. Varjão de Andrade, Paulo. A result of SP log interpretation: Jour. Petroleum Technology, v. 7, no. 11, p. 59–60, 1955.

The self-potential logs from a group of water wells in the Brotas formation in the Bahia area of Brazil were interpreted in terms of connate water salinity using the equation $SP = -K \log (R_m/R_w)$. Samples of formation water were taken for comparison. The calculated salinities were consistently lower than the salinities measured directly on the samples. It is suggested that the SP equation must be modified to take into account the salinity of the water in contact with clay minerals in the shale.—*G. V. K.*

164–124. Sebestyén, Károly. Vizsgálatok néhány hazai kőszén kimutatására fúrólyukban gerjesztett potenciál módszerrel [Investigations concerning the detection of some of our Transdanubian lignite deposits in boreholes by means of the induced potential method] : Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 4, szám 1, p. 45–61, 1955.

This is a discussion of the induced potential method of electric logging developed by Dakhnov and his colleagues [see Geophys. Abs. 161–58]. Laboratory and field measurements indicate that the method should be suitable, with some exceptions, for the detection of the Transdanubian lignite beds in boreholes.—*D. B. V.*

164–125.   Alger, R. P.   Electrical logging problems in the Eocene Wilcox: Gulf Coast Assoc. Geol. Soc. Trans., v. 4, p. 47–65, 1954.

The Wilcox formation of the Gulf Coastal embayment exhibits a wide range of special conditions that affect the evaluation of electrical surveys.   In the shallow Wilcox, exemplified by the Natchez trend, one of the major problems is that of determining the true resistivity.   Accuracy at low resistivities and sharp discrimination for thin beds are required.   Use of the induction log and MicroLog has solved most of the problems.   In the deep Wilcox the response of the logging devices depends to a large extent on the type of drilling mud and the invasion effects.   If mud control, both in regard to water loss and resistivity, is accomplished, a combination of auxiliary logs should provide information for reliable interpretations.—*M. C. R.*

164–126.   Priddy, Richard Randall.   Fresh water strata of Mississippi as revealed by electrical log studies: Mississippi Geol. Survey Bull., no. 83, 71 p., 1955.

The lateral and vertical distribution of the subsurface fresh-water-bearing sands of Mississippi were determined by a study of nearly 500 electric logs of oil tests selected from 3,500 logs to provide aid in drilling for water wells.   Aquifers are listed by county and graded as poor, fair, good, or excellent.   Rating is based on porosity-permeability as shown by the electrical log and not on thickness of bed.—*V. S. N.*

ELECTRICAL PROPERTIES

164–127.   Mukherjee, B.   Electrical conductivity of coal, coke, and lignite: Jour. Sci. Indus. Research (India), Sec. B., v. 13, no. 1, p. 53–55, 1954.

Bituminous coals are found to be nonconducting when dry (moisture content<1.5 percent), moderately conducting with moisture content of 3 to 10 percent.   The conductivity of lignite likewise varies with moisture content.   After coking, the more completely carbonized cokes are more highly conducting.   This suggests the absence of the graphitic layer arrangement in bituminous coal and lignite, its incipience in coke.—*D. B. V.*

164–128.   Noritomi, Kazuo.   Investigations of thermoelectricity for metallic and silicate materials: Tôhoku Univ. Sci. Repts., 5th ser., v. 7 no. 2, p. 94–101, 1955.

The thermoelectricity of galena, pyrite, magnetite, quartz, and perthite was measured in the temperature range from room temperature to about 600°C.   For all samples except quartz, the variation of electromotive force with temperature was negative.   For pyrite and galena, the variation was discontinuous at about 300°C.   Below 300° the change is reversible, but in cooling from above 300° differences indicate evaporation of sulfur, and thus changes in chemical composition and crystal structure of the mineral.   Magnetite shows a reversible change through all temperature ranges in this experiment, with a discontinuous change at about 575°.   In these three minerals, conduction is predominantly electronic.   In perthite, the sign of the variation is negative, but there are anomalous changes in heating and none in cooling.   The variation in quartz is positive except at the lower temperatures in heating, and there is an abrupt change in the vicinity of the inversion temperature.   The negative emf in perthite and quartz is attributed to an impurity with electronic conduction.   The positive emf of quartz indicates that "positive hole" conduction predominates.—*M. C. R.*

164–129.   Deeg, Emil, and Huber, Oskar.   Das dielektrische Verhaltung verschiedener Tone in Abhängigkeit von ihrem Wassergehalt bei der Messung mit Dezimeterwellen [The dielectric behavior of various clays in relation to their water content by measurement with decimeter waves] : Naturw., Jahrg. 42, Heft 18, p. 507, 1955.

Believing that the reason why direct determination of water content of clays from their dielectric properties has not proved feasible lies in the fact that the water is present in more than one type of chemical combination.   Deeg and Huber investigated the specific polarizability of three ceramic clays (fire clay, kaolinite, and bentonite) at frequencies of a few hundred million cycles per second.   A linear relationship between water content and specific polarizability was noted when "free" water is present in excess of bound water.—*D. B. V.*

164–130.   Cambefort, H.   Mesure de la porosité des roches par des méthodes électriques [Measurement of the porosity of rocks by electrical methods] : Rev. Inst. Français du Pétrole, v. 10, no. 10, p. 1205–1208, 1955.

The measurement of porosity of rocks composed of material of very high electrical resistivity has until now been made by introducing a "formation factor."   On the basis of measurements carried out by Cambefort and by Albert and Chaumet, a general formula is established which is valid for porosities ranging between 0.057 and 0.85; $\epsilon = 1.56/(\rho/\rho_0)^{0.9}$, where ϵ=index of porosity, ρ=resistivity of the saturated rock, and ρ_0=resistivity of imbibed water.— *D. B. V.*

EXPLORATION SUMMARIES AND STATISTICS

164–131.   Flandrin, J.   Le développement des idées directrices et des techniques en géologie petrolière [The development of guiding principles and techniques in petroleum geology] : Rev. Inst. Français du Pétrole, v. 10, no. 9, p. 1039–1052, 1955.

As a result of the evolution of concepts relating to the significance of oil showings, the formation of source rocks and to the origin of the migration of hydrocarbons, exploration for petroleum moved gradually from mountainous regions toward sedimentary basins, at the same time that the geologists previously preoccupied with structural traps, realized the importance of stratigraphic traps. At the same time, petroleum exploration was facilitated by the perfecting of new techniques: geophysical methods, rotary drilling (following which subsurface geology and borehole surveying were developed), and photogeology.—*Author's abstract, M. C. R.*

164–132.   Dobrin, Milton B., and Van Nostrand, Robert G.   Review of current developments in exploration geophysics: Geophysics, v. 21, no. 1, p. 142–155, 1956.

The greatest progress in exploration geophysics in the past year has been in the application to prospecting of newly developed instruments and techniques such as, for example, magnetic recording and velocity logging.   Other noteworthy developments in seismic exploration during 1955 include new methods of generating seismic energy, new approaches to the problem of signal-to-noise ratio, and the use of high-frequency techniques.   Important developments, in methods other than seismic, include the gamma-gamma logger which now gives density data which are sufficiently reliable for gravity interpretation; air-

borne electromagnetic methods, widely used in the search for base metals in Canada ; an induced polarization method that has been successful in finding ground water ; and a new airborne magnetometer based on nuclear magnetic resonance.—*M. C. R.*

164–133.   Closs, Hans, and Schott, Wolfgang.   Stand der Erdölgeologie und Geophysik [State of petroleum geology and geophysics] : Erdöl u. Kohle, Jahrg. 8, Heft 6, p. 367–372, 1955.

This reviews, separately, the development of applied geophysics and of petroleum geology in Germany.   From its difficult resumption after the war until the Third World Petroleum Congress (The Hague, 1951), geophysics expanded turbulently with respect to methods, apparatus, personnel, and scope of application ; the ensuing period has been one of consolidation.   In the three oil- and gas-producing areas (Northwest German Basin, Upper Rhine Graben, and Molasse Trough), the first phase of development (exploratory drilling) ended about 1930; the last 25 years have seen astonishing development of the oilfields with increasing exploration, particularly by geophysical methods.—*D. B. V.*

164–134.   Migaux, Léon.   La géophysique et les recherches de pétrole [Geophysics and petroleum exploration] : Rev. Inst. Français du Pétrole, v. 10, no. 10, p. 1191–1204, 1955.

This is a review of the principles of the various geophysical methods used in petroleum exploration (gravity, magnetic, electrical, and seismic refraction and reflection methods), their scope of application, and the results expected of each.—*D. B. V.*

164–135.   Martin, Rodolfo.   A geofísica e suas aplicações [Geophysics and its applications] : Brasil Univ., Escola de minas Rev., ano 19, no. 2–6, p. 3–9, 1954.

This is a brief presentation of the content and methods of geophysics, chiefly applied geophysics, in investigation of geologic problems and in prospecting for minerals.—*S. T. V.*

164–136.   Polak, Edward Jan.   Geophysics as an aid in coalmining : Colliery Eng., v. 32, no. 378, p. 330–334, 1955.

A brief description of magnetic, gravity, electrical, and seismic methods and their application in coal-mining problems.   Examples from the Cannock Chase area of the West Midlands are cited.—*M. C. R.*

164–137.   Hammer, Sigmund.   Geophysical activity in 1955—interim report to midyear : Mines Mag., v. 45, no. 12, p. 34–38, 1955 ; and Geophysics, v. 21, no. 1, p. 179–191, 1956.

Geophysical exploration for oil on a global scale increased 5 percent during the first 6 months of 1955 compared to the average for 6 months of 1954.   In the eastern hemisphere, geophysical activity increased by 22 percent, compared to only 2 percent for the western hemisphere.   The use of the gravity method increased on a global scale by 16 percent, seismic activities increased by only 4 percent, and worldwide magnetic exploration decreased by 8 percent.   North America accounted for 81.9 percent of the world seismic activity.

Mining geophysics expanded significantly in the first half of 1955, with Canada making the greatest capital investment in geophysics.   Aeromagnetic operations

decreased 50 percent, and electromagnetic work increased significantly. Contract operators accounted for about one-fourth of all private mining geophysics. A significant amount of mining geophysics in all countries is done by governmental agencies.—*L. C. P.*

164-138. Dupuy de Lome, E., and Lozano, Sanchez. Labor de la Compañía de Investigación y Explotaciones Petroliferas, S. A. [Work of the Petroliferous Investigation and Exploitations Company, S. A.] : Inst. geol. min. España notas y comunicaciones, no. 38, p. 17–95, 1955.

In the course of this summary of all the work of the Compañía de Investigación y Explotaciones Petroliferas, S. A. ("Ciepsa"), it is mentioned that during the first stages of their work, world conditions made it impossible to import geophysical equipment into Spain with which to supplement geological studies. In 1942 the Oliana structure alone had been surveyed seismically. Since 1953, seismic work has been carried on steadily by the Ciepsa in collaboration with the firm of Dielmann. The Ebro basin and several petroleum concessions in northern Spain have been completed, including the Gastiain anticline and neighboring structures, and much of the Vitoria region. A new geophysical company is engaged in investigating the distribution of the Mesozoic rocks underlying the Tertiary rocks of Miranda de Ebro and Condado de Trevino.—*D. B. V.*

GEODESY

164-139. Niskanen, E. Some remarks on the geoidal undulations and the theory of plasticity : Isostatic Inst. Pub. no. 29, 18 p., 1953. Reprinted from Acad. Sci. Fenn. Annales, Ser. A III, Geol.-Geog. 32.

Undulations of the geoid, if small in area, could be understood because the elastic resistance of the crust is sufficient to support small additional loads, but very wide undulations require the assumption of a plastic magma with some strength. If the magma is assumed to behave like an ideal plastic substance as defined by Lévy and von Mises, the undulations may be explained in two ways : the disturbing masses causing the undulations are so small that the supplementary stresses in the magma do not exceed the yield value of the shearing stress ; or the yield limit has been reached and masses are flowing toward equilibrium positions, a very slow plastic convection current.—*M. C. R.*

164-140. Castro, Honorato de. Determinacion gravimetrica del elipsoide que mas se ajuste a la realidad Mexicana [Gravimetric determination of the best-fitting ellipsoid for Mexico] : Ciencia (Mexico), v. 14, no. 7–8, p. 169–171, 1954.

Using gravity values measured at 20 stations in Mexico, Castro calculated that the best-fitting ellipsoid for that country is one in which $g=977.261$ gals at the equator and 985.321 gals at the poles. The values for the earth as a whole are $g_e=978.049$ and $g_p=983.221$.—*D. B. V.*

164-141. Hirvonen, R. A. On the precision of the gravimetric determination of the geoid : Am. Geophys. Union Trans., v. 37, no. 1, p. 1–8, 1956.

On the basis of the gravity material available, the author studies two statistical functions : $G_s=$the rms (root mean square) anomaly in a square with side s, and $E_s=$the rms deviation of one actual point anomaly from the actual mean anomaly in a square with side s.

The function E_s is called the error of representation, for if inside a square there is only one observed anomaly and this anomaly is accepted to represent the mean anomaly of the entire square, a standard mean error E can be used for the estimation of accuracy. On the other hand, if there are no observations inside the square and the mean anomaly of the square is assumed to be zero, G can be used as the standard mean error.

For points or for very small squares, E is zero and G has a maximum value G_o. For a hemisphere, G is zero and E has a maximum value G_o. There is a critical size at about $s=3°$, where $E=G$. When s is greater, it is not advisable to use the observed anomaly at a single station, as the representative of the mean anomaly of the square, because for zero the error to be expected is smaller. The weighted mean of zero and the observed anomaly is recommended.

Because the regions without any observations are still large, it is necessary to estimate the size of the smallest squares, where the mean anomaly can be assumed to be independent of the mean anomalies of the adjacent squares. On the basis of the present gravity data, an estimated value of $s=30°$ seems to be acceptable.

Using the functions E and G and the accepted values $s=3°$ and $s=30°$, the precision obtainable for the gravimetric determination of the elevations N of the geoid (Stokes' formula) and of the deflections δ of the vertical (Vening Meinesz' formula) has been estimated. In the most favorable cases (Central Europe and the central parts of the United States) the standard mean error of N is ±10 meters and that of $\delta\pm0.''85$. The former figure is almost entirely due to the great unexplored areas of the Earth; the latter depends half on these unexplored areas and half on the small gaps within a distance of $50°$ from the point where δ is computed.—*Author's abstract*

164–142.   Bonchkovskiy, V. F., and Namsaray, S. O tochnosti pokazaniy naklonomerov [On the precision of the inclinometers] : Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 22(149), p. 3–18, 1954.

Extensive investigations of inclinometers built on the principle of a horizontal pendulum to determine their reliability under different conditions of operation and their accuracy indicate the instruments are capable of a very high sensitivity, making it possible to measure inclinations of only 0.7'' with an error not more than $\pm0.01''$, or even 0.005'' by increasing the optical arm and keeping the same natural period. These instruments can be used for measurements of slow deformation of dams, mountain slopes, drill holes, or mining shafts. The instruments are sturdy and insensitive to temperature variations.—*S. T. V.*

GEOTECTONICS

164–143.   Gaertner, Hans Rudolf von. Gedanke zu den Gebirgsbildungstheorien von Ernst Kraus [Thoughts on the mountain-building theories of Ernst Kraus] : Erdöl u. Kohle, Jahrg. 8, Heft 1, p. 3–5, 1955.

This is a condensation and critical review of Kraus' "Unterströmung" theory of orogenesis, as presented in his "Baugeschichte der Alpen" and "Vergleichende Baugeschichte der Gebirge," both published in 1951 ; these works represent the first application of a convection current theory to any particular great mountain system.

Folding is considered to be due mainly to currents in the hyporheon which drag the surface down into the geoplasma. Deeper bathyrheal currents flow con-

stantly under continents as well as orogenic zones. During orogenesis, these currents are counteracted under the orogenic zones, but as hyporheal forces weaken, isostasy reasserts itself and the period of high uplift begins. Thus the final deformation of mountains is controlled by isostasy and the bathyrheon, the only movements being epirokinetic.

The theory leaves open the question of the origin of the masses which are swept downward by the currents, and the origin of the currents themselves. Von Gaertner also doubts that the removal of a few kilometers of sediment is adequate to provoke continual movement.—*D. B. V.*

164-144. Kraus, Ernst. Neue Gedanken zur Entstehung der Alpen [New ideas on the origin of the Alps]: Eclogae geol. Helvetiae, v. 47, no. 1, p. 61–75, 1954.

This outlines the structural development of the Alps in the light of the "Unterströmung" hypothesis. The undercurrents arise in plastic layers deep in the earth; orogenic structures are the near-surface expression of their displacement—uplift, subsidence, and horizontal movements. Analogous structures can be observed in glass.

The cause of the undercurrents can be determined only theoretically. Thermally caused hyporheal convection currents, together with slower bathyrheal horizontal drift due to tidal retardation of the earth's rotation, could produce results fitting the observed facts.—*D. B. V.*

164–145. Krishnan, M. S. The structural and tectonic history of India: Geol. Survey India Mem., v. 81, 109 p. and 4 pls., 1953.

India (including India and Pakistan) excluding the mountain belts surrounding it in the north, is an ancient stable mass or shield that has had little folding since the Precambrian. The ancient grain is along four major regional trends: the Aravalli trend in Rajputana, the Dharwarian trend in Mysore and Hyderabad, probably the southerly continuation of the Aravalli trend; the eastern Ghats, cutting across and superposed on the Dharwarian trend, and the Satpura trend characteristic of the rocks of the Narbada-Son drainage area. Both structural evidence and radioactive age determinations indicate that the Aravalli and Dhawat orogenies are identical, the Eastern Ghats is younger, and the Satpura may be younger than the Eastern Ghats.

The great latitudinal geosyncline (the Tethys) was formed in the Carboniferous. A rift that later developed into the Indian Ocean was formed between Africa and India-Madagascar in the Permian and gradually widened. India began to drift from Africa and Madagascar perhaps in the Cretaceous. The Red Sea rift seems to have developed in the Upper Triassic, and Arabia also drifted northeast, with probably a counterclockwise twist in the Cretaceous. Orogeny in the Cretaceous was followed by a period of tension during which the Deccan traps were erupted at the end of the Cretaceous and in Lower Eocene. The Himalayas were formed during a series of great orogenic movements separated by periods of comparative quiescence. A tremendous shortening of the crust in a direction at right angles to the Himalayan arc is indicated. A depression or foredeep was formed in front of the convex side of the Himalayan arc, consisting of three strips of the same alinement, separated from each other by transverse ridges. This corresponds more or less to a strip of negative anomalies. Another negative strip along the Indus-Brahmaputra valleys is parallel to Burrard's "Hidden Range" and "Hidden Trough." These have been attributed to the depression or elevation of subcrustal layers which suggest the crest and trough

of a subcrustal wave generated during the northward drift of India and that
have not yet had time to be smoothed out. The bottom of the foredeep is likely to
contain fractures that may have formed when it was bent down, and such a frac-
ture zone, being a zone of weakness, is thought to be an adequate locus for earth-
quake shocks. Seismic and gravity maps of India are shown in plates 2 and 3.—
M. C. R.

164–146. Havemann, Hans. Zur Frage eines Systems von Konvektionsströmun-
          gen in der Erde [On the question of a system of convection currents
          in the earth] : Geologie, Jahrg. 4, Heft 1, p. 27–54, 1955.

The existence of convection currents within the earth can no longer be dis-
puted. It is likely that these currents are distributed in a regular system of
levels in the mantle, rather than haphazardly. The dynamic consequences of
such systematic distribution, based on a twelve-celled distribution of current
systems [see Geophys. Abs. 151–14079] ; can explain the distribution of the moun-
tain systems over the earth. Corollaries of the hypothesis involve an eastward
drift due to rotation of the earth ; poleward and equatorward forces with lati-
tudinal components ; wandering of the poles ; alternate rising and sinking of
continents relative to the Pacific Ocean floor ; and control of the currents by sub-
magmatic obstacles. Some of these dynamic possibilities contradict certain
geologic postulates, but may yet be proved correct by future investigations. This
paper offers the theory in hopes of stimulating discussion.—*D. B. V.*

164–147. Brock, B. B. Some observations on vertical tectonics in Africa : Am.
          Geophys. Union Trans., v. 36, no. 6, p. 1044–1054, 1955.

A review of the fundamental structure of Africa puts the emphasis on vertical
tectonics, which has resulted in an "embossed" shield. Basins and swells,
troughs and rims, pans and domes, all are manifestations of epeirogenesis or
tafrogenesis. All types of depressional features are compared and unified : the
Rhodesian type of basement remnant, basins, troughs, gently folded mountains,
and geosynclines. All these depressions are thought to result from the same type
of fundamental forces in varying degree. The process in the early stages in-
volves only vertical tectonics. Compression where present is induced, it is postu-
lated by these tafrogenetic processes when carried to excess. Such an hypothe-
sis explains epsilon shaped ranges, and the spidery basement remnants with di-
verging isoclinal trends. It can account also for the occurrence of folding and
thrusting in some rift valleys, and its absence in others. Here, it is thought,
is the link between orogenesis and tafrogenesis.—*Author's abstract*

164–148. Nettleton, L. L. History of concepts of Gulf Coast salt-dome forma-
          tion : Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2373–
          2383, 1955.

Early salt-dome model experiments were based on the assumption that the
salt was squeezed up through the surrounding sediments under the influence of
tectonic forces. In these experiments an external pressure was applied which
forced a material simulating salt up through a material representing the sedi-
ments. These models have no true geologic counterparts in nature. Later models,
using fluid materials, were based on the assumption that salt domes were formed
by gravitational forces caused by differences in density between the lighter salt
and the more dense sediments. Models using a combination of fluids (representing
salt) and soft materials with small but definite shear strength (representing the
sediments), and with the mechanical properties roughly to scale, seem to simulate

actual salt-dome formation fairly well, including the formation of model rim synclines.—*L. C. P.*

164–149. Travis, J. P., and McDowell, A. N. Model studies of salt-dome tectonics: Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2384–2470, 1955.

In a great many models constructed of various materials and analyzed in accordance with the theory of scale models, asphalt was the most nearly satisfactory material found to represent the salt, and weak muds of greater density than the asphalt were found to be best suited to represent the sedimentary overburden above the salt. The motivating force causing the upward growth of the model domes was produced by the contrast in the densities of the materials.

Single domes were initiated in the laboratory by irregularities on the original asphalt surface, variations in overburden thickness, lateral variations in overburden density, deformation which produced normal faulting of the overburden, and by folding resulting from externally applied forces. The flowage of material into a dome produced a peripheral sink in the asphalt, which in turn caused the initiation of a group of secondary domes in a nearly circular arrangement about the margins of the sink. It appears, therefore, that it is not necessary to call upon a separate geologic event to account for the initiation of each known salt dome. Furthermore, no linear arrangement of salt domes should be expected if many domes are of secondary origin.

The diameters of the model domes were approximately equal to the thickness of the source layers from which they developed. Attempts to form domes with large diameters from thin source beds were entirely unsuccessful. If a similar relationship between dome diameter and source-bed thickness exists in sedimentary basins, the source layer of salt in the salt-dome provinces of the Gulf Coastal Plain must be several thousands of feet thick.

When the thickness of overburden above the top of a model dome exceeded a certain value, no further movement of the dome occurred provided that the overburden had a finite shear strength. The actual thickness required to prevent the growth of a dome depended on the height of the dome above its source layer, the density contrast between the overburden and the salt equivalent, and the strength of the overburden. In the models that were considered to be most nearly dimensionally correct, this critical thickness was approximately the same as the height of the dome above its source layer.

Although the model domes displayed a variety of shapes in the early stages of their development, depending on the method of initiation employed, they became circular in horizontal cross section as they grew upward through successive layers of overburden. When the top of an asphalt dome entered overburden layers of low strength and low density near the surface of a model, the upper part of the dome commonly increased in diameter.

The overburden was arched and fractured by the growth of the model domes. Beds penetrated by the asphalt core were broken by radial fractures, and the nearly triangular segments between these fractures were upturned by the rising asphalt. Layers above the core were arched and broken by normal faults. Grabens over the centers of many of the domes occurred as a result of the greater uplift of marginal fault segments; radial faults were numerous. The fault patterns in the models were controlled by the size and shape of the core, the depth of the core beneath the faulted layer, the amount of uplift of that layer, the configuration of the peripheral sink, and the physical properties of the overburden.—*Authors' abstract*

164-150.   Gates, Olcott, and Gibson, William.   Interpretation of the configuration of the Aleutian Ridge: Geol. Soc. America Bull., v. 67, no. 2, p. 127-146, 1956.

In this structural interpretation of the submarine contour maps of the western Aleutian area, four principal topographic provinces are recognized: the crest of the Aleutian Ridge including the islands; the North and South Insular Slopes, the former probably marking a major fracture in the earth's crust; the Aleutian Bench, whose inside edge may be a thrust-fault trace; and the arcuate Aleutian Trench, perhaps marking a major thrust zone dipping beneath the Aleutian Ridge.

The topography suggests that the western part of the Aleutian Ridge is an arched and faulted asymmetrical wedge bounded by a northward-dipping normal fault on the north and by a northward-dipping zone of reverse faults on the south. Formation of this wedge probably began with major uplift and faulting of the western Aleutian area during the middle Tertiary, and the many earthquakes and active volcanoes in the Aleutian arc today indicate that deformation is still continuing.—*D. B. V.*

GLACIERS

164-151.   Victor, Paul-Emile.   Wringing secrets from Greenland's icecap: Natl. Geog. Mag., v. 109, no. 1, p. 121-147, 1956.

This is a popular, illustrated account of the French Polar Expeditions in Greenland from 1947 to 1953, which included geodetic, seismic, gravity, thermal, atmospheric electrical and optical, meteorologic, and geologic studies. Seismic soundings in the southern half of the icecap indicate that Greenland resembles an ice-filled bowl rimmed by coastal ranges. Much of the depressed bedrock lies below sea level. The greatest known thickness of ice is about 11,000 feet; the total volume of the ice is estimated to be 647,800 cubic miles.—*L. C. P.*

164-152.   Röthlisberger H[ans].   Studies in glacier physics on the Penny Ice Cap, Baffin Island, 1953, Part III: Seismic sounding: Jour. Glacialogy, v. 2, no. 18, p. 539-552, 1955.

Firn and ice thickness measurements were carried out by seismic refraction and reflection methods on a flat col of the highland snowfields of the Penny Ice Cap and on a medium-sized valley glacier (Highway Glacier). The longitudinal wave velocities were found to vary from some 1,000 meters per second (3,280 fps) in firn to 3,810 meters per second (12,500 fps) in ice and approximately 6,000 meters per second (20,000 fps) in the bedrock (gneiss). The thickness of the firn and ice at the firn col was found to be 254 meters (834 ft). On Highway Glacier some 80 reflections were evaluated, giving position, dip and strike of the bedrock surface. A longitudinal profile of Highway Glacier from the junction of three main tributary glaciers to the tongue is given; the ice thickness slowly decreases. At the junction, the bedrock is 400 meters (1,310 ft) deep, and there is no deep basin as might be expected from the surface features. The mean slope of the glacier surface is about 3° of arc and of the bed about 1°.—*Author's abstract*

164-153.   Förtsch, O[tto], Schneider, H. J., and Vidal, H.   Seismische Messungen auf den Gepatsch- und Kesselwandferner in den Ötztaler Alpen [Seismic studies of the Gepatsch and Kesselwand firns in the Ötztal Alps]: Gerlands Beitr. Geophysik, Band 64, Heft 4, p. 233-261, 1955.

Refraction seismic studies were made of the topography of the bed of the glacier along profiles perpendicular to its course. Results show that the glaciers are not

more than 100 to 150 meters thick and lie in flat basins. A profile across the tongue of the Kesselwand glacier shows a more troughlike character with a thickness of more than 200 meters of ice. The longitudinal velocity was 3,600 meters per second in the ice and 4,350 meters per second in the basement. One of the profiles gave the value of 5,000 meters per second for the basement, which should correspond to the unweathered rock. The velocity of 4,350 meters per second indicates frozen moraine material. Crevasses had no apparent effect on the wave propagation.—*H. F.*

GRAVITY

164–154. Zatopek, Alois. Possible applications of electronic chronographs in geophysics: Czechoslovak Jour. Physics, v. 4, no. 3, p. 380–381, 1954.

In geophysics many measurements involve the precise determination of time. Electronic chronographs with crystal frequency standards may be used in such problems as the absolute measurement of gravity with a reversing pendulum. To obtain a precision of the order of 1 milligal presupposes the measurement of the reduced pendulum length to within 1 micron and the period of oscillation to within less than 2.5×10^{-7} second. Electronic chronographs make it possible to reduce the time of measurement to only 100 oscillations of a second pendulum. Electronic chronographs may also bring improvements in the techniques of relative gravity measurements where to attain a precision of 0.1 milligal it is necessary to measure the time interval of 50 seconds with an error of less than 2×10^{-6} second.

Another use of electronic chronographs is in measuring the tension in rock in mines or important engineering structures where precise measurements of time intervals of the order of 10^{-4} second are required to determine the seismic velocity of about 5,000 meters per second and its variation with time with sufficient accuracy as well.—*S. T. V.*

164–155. Lukavchenko, P. I. Neotlozhnyye zadachi neftyanoy gravimetrii [The urgent problems of petroleum gravimetry] : Neftyanoye Khozyaystvo, tom 33, no. 1, p. 57–63, 1955.

This is a review of the problems and of the regions where the gravimetric method has made important contributions to the success of geological surveys, especially in the investigations of potential oil or gas areas. Russian geophysicists now have many types of gravimeters specially adapted for specific purposes, and there are also available gravimeters that function simultaneously as altimeters. Further developments needed include a small, light gravimeter to be transported on horseback or carried for use in northern Siberia, on the mountains of the Caucasus and in the deserts of central Asia, and of a gravimeter adapted for use in a helicopter. The reliability and the accuracy of such instruments must be within only ±0.1 milligal. Special instruments must also be constructed for use on boats and in well logging, and it is desirable also to construct a compound instrument to be used as gravimeter and magnetometer.

It is necessary to simplify and make more accessible to the rank and file of geophysicists, mathematical methods of interpretation of gravimetric surveys.—*S. T. V.*

164–156. Castro, Honorato de. Determinaciones de la pesantex por las oscila-
ciones de un pendulo libre [The determination of gravity by the oscil-
lations of a free pendulum] : Petroleos Mexicanos, tomo 2, no. 6, p.
428–432, 1955.

A brief review of the use of the pendulum in the determination of the force of
gravity.—*S. T. V.*

164–157. Veselov, K. E. Elementarnaya teoriya gravimetrov, postroyennykh po
printsipu prushinnykh vesov [Elementary theory of gravimeters built
as spring balances] : Prikladnaya geofiz., vypusk 12, p. 127–156, 1955.

This is a discussion of the operation of about 20 gravimeters of different design.
Accuracy, reliability, and convenience in field operation are analyzed.—*S. T. V.*

164–158. Borrego González, Joaquin. El gravimetro Atlas, modelo F. Descrip-
ción, corrección y manejo del instrumento [The Atlas gravimeter,
model F. Description, calibration, and maintenance of the instru-
ment] : Rev. Geofísica, año 13, no. 51–52, p. 233–257, 1954.

A detailed description is given of the Atlas gravimeter.—*S. T. V.*

164–159. Shokin, P. F. K voprosu ucheta spolzaniya nul' unkta gravimetrov
[Concerning the evaluation of the drift of zero point in gravimeters] :
Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 29 (156), p. 98–106, 1955.

The drift of the zero point in gravimeters with a quartz elastic element is pro-
nounced and unavoidable. It is usually assumed that the drift is linear between
two calibrations. Shokin investigated the behavior of seven different gravime-
ters during 50 trips and concludes that the amount of drift is not linear with time,
but is influenced by several factors. This can be seen from the fact that the
coefficient of correlation between the amount of drift and time ranged from only
0.38 to 0.67. Conditions of the transportation are certainly important and cannot
be neglected.—*S. T. V.*

164–160. Smolitskiy, Kh. L. Obobshcheniye odnogo kriteriya dlya proverki
interpretatsii gravitatsionnykh nablyudeniy [The generalization of
a criterion for the verification of the interpretation of gravita-
tional observations] : Akad. Nauk SSSR Doklady, tom 106, no. 2, p.
237–238, 1956.

Lyapunov's criterion for the vertification of the interpretation of gravitational
observations in the case of an infinite cylindrical mass of arbitrary cross section
buried under ground [see Geophys. Abs. 164–164] is derived in a more general
way, making it applicable to bodies of finite dimensions of any form. The
mathematical treatment is based on potential theory and is very general, but is
also applied to specific geometric shapes resulting in simpler formulas.—*S. T. V.*

164–161. Brown, William Fuller, Jr. Minimum variance in gravity analysis,
Part II : Two-dimensional: Geophysics, v. 21, no. 1, p. 107–141,
1956.

The principles developed in Part 1 [Geophys. Abs. 163–2] apply whether the
data points are located on a line or distributed over a plane. The practical cal-
culation problem, however, is more complicated in two dimensions than in one

There are two steps: (1) deciding what terms to keep in the polynomial approximation; (2) estimating second vertical derivatives and the like on the basis of the chosen approximation. For (1) we can use two-dimensional orthogonal polynomials; but complete tables of them would be bulky, and therefore several alternative procedures are outlined. For (2) we can easily derive "best" estimation formulas by the minimum-variance method; but these usually involve many-digit multipliers, and therefore "near-best" coefficients, with fewer digits, are also derived. The specific problems solved here start with uncorrelated data at points of a square grid. In practice, data are taken at irregularly distributed stations: then the minimum-variance principle and orthogonalization still apply, but the calculations are more complex, and grid values computed from the station values are correlated.—*Author's abstract*

164–162. Veselov, K. E. Primeneniye vtoroy vertikal 'noy proizvodnoy potentsiala sily tyazhesti pri geologicheskom istolkovanii gravimetrovoy s'emki [Use of the second vertical derivative of the potential of gravity in the geologic interpretation of gravimetric survey]: Prikladnaya geofiz., vypusk 11, p. 152–162, 1954.

In gravimetric exploration it is important to be able to separate local from regional anomalies. Usually the local anomalies are small and are superimposed on much larger regional anomalies. Conditions can be improved by recalculating the observed gravity data to another, preferably a lower, level nearer the disturbing bodies. Even better is the use of the second vertical derivative of the potential function. These calculations are simple, though time consuming. Examples of the use of this procedure are given.—*S. T. V.*

164–163. Pudovkin, I. M. Prostranstvennyye raschety vertikal 'nykh gradientov gorizontal 'noy i vertikal 'noy sostavlyayushhikh magnitnogo polya pri interpretatsii anomaliy [Three-dimensional computations of the vertical gradients of the horizontal and vertical components of the magnetic field in the interpretations of anomalies]: Prikladnaya geofiz., vypusk 13, p. 99–109, 1955.

Formulas are derived for the vertical gradients of the horizontal and vertical components of the geomagnetic vector at a given height over the earth's surface from measured values of the horizontal and vertical components at a lower level.

Calculations were made for the depth of the magnetic mass producing the Kursk anomalies. Assuming a dikelike mass, the depth and width of the source was calculated using the calculated vertical derivatives at several levels. The results compared favorably with the average depth as determined by drilling.—*S. T. V., I. Z.*

164–164. Lyapunov, A. A. Ob obnom kriterii dlya proverki interpretatsii gravitatsionnykh nablyudeniy [On a criterion for the verification of the interpretation of gravimetric observations]: Akad. Nauk SSSR Doklady, tom 102, no. 2, p. 265–266, 1955.

The integrated gravitational intensity of a horizontal infinite cylindrical mass for a profile on the earth's surface is derived. The formula is used as an aid in the interpretation of gravitational anomalies.—*S. T. V., I. Z.*

164–165. Tyapkin, K. F. Uskorennoye vychisleniye gradientov potentsiala na razlichnykh vysotakh [Rapid evaluation of the gradients of the potential on different levels]: Prikladnaya geofiz., vypusk 12, p. 177–181, 1955.

An approximate method is given by which it is possible to compute one component of the gradient of the potential function at any level if another component is known on a given level. The problem is limited to plane potential fields. Tyapkin begins with the known formula of the potential theory

$$x(p) = \frac{1}{\pi} \int_{-\infty}^{\infty} z(l) \frac{l\,dl}{l^2 + h^2}$$

where $z(l)$ is the vertical component of the field intensity on the line l, p is any point outside of the line l, h the distance from point p to the line l, and $x(p)$ is the horizontal component. Usually this computation is performed by mechanical integration, which is time consuming. By transforming the relation given, Tyapkin obtains an expression more convenient for calculations. Tables and two alinement charts facilitating the procedure are given.—*S. T. V.*

164–166. Colley, G. C. Gravity variations in surveys across geological boundaries: Geophys. Prosp., v. 3, no. 4, p. 403–424, 1955.

Variations of the elevation correction factor across various geologic boundaries are discussed with particular reference to the dipping beds, faults, and horsts. Graphs are presented giving the variation of the elevation correction factor for different angles of dip. The dip, position of outcrop, and thickness of a dipping bed can be determined from a gravity map. Anticlines can give rise to negative anomalies, and great care must be exercised in the interpretation of such gravity inversions.—*W. H. D.*

164–167. Morrison, Lawrence S. Gravity surveys to determine possible fault trends: Mines Mag., v. 45, no. 10, p. 112–114, 1955.

This is a discussion of the appearance of the gravity expression of a typical fault superimposed on a typical regional gravity anomaly with various orientations and with comparable examples from field gravity surveys.—*L. C. P.*

164–168. Lukavchenko, P. I. Ob izmerenii sily tyazhesti v burovykh skvazhinakh [The measurement of gravity in drill holes]: Prikladnaya geofiz., vypusk 12, p. 157–176, 1955.

The basic relations of gravitational logging are derived, and problems involved are discussed, such as the effect of a disturbing mass on the force of gravity in the drill hole as a function of the position of the mass in relaton to the hole, and the effect of the deviation of the hole from the vertical. Gravity measurements have been made in mines in different parts of the U. S. S. R. since 1941 at depths as great as 750 meters. Their results confirmed the data previously obtained from gravity measurements in drill holes.—*S. T. V.*

164–169. Seedsman, K. R. Regional gravity survey of the Moorlands Military sheet area: South Australia Dept. Mines Min. Rev., no. 98, p. 158–161, 1953 [1955].

A gravity survey indicated that shallow basins likely to provide economic coal deposits are not present in the area but suggests that favorable areas may exist to the north and east of known coalfields.—*M. C. R.*

164–170. Whetton, J[ohn] T., Myers, J. O., and Watson, I. J. The geological results of measurements of gravity in East Carmarthenshire: Geofisica Pura e Appl., v. 32, p. 43–53, 1955.

Observations of gravity in the East Carmarthenshire anthracite coalfield show this to be an area of positive Bouguer anomalies. The trend of the gravity contours is approximately northeast-southwest or Caledonoid, and there is no deviation from the coalfield to Devonian older strata. The regional gradient can be explained in terms of known structure, and local anomalies are attributed to facies changes and volcanic activity rather than fortuitous lithologic variations in the basement.—*M. C. R.*

164–171.—Whetton, J[ohn] T., Myers, J. O., and Watson, I. J. Gravity surveying in the East Carmarthenshire anthracite coal field: Colliery Eng., v. 32, no. 374, p. 140–144; no. 375, p. 191–195; no. 376, p. 233–238; no. 377, p. 279–284, 1955.

Gravity surveys were made near Cynheidre in southwest Wales where a new colliery is being sunk to aid in working out the geologic structure. In addition to 365 stations in a 9-square-mile area near Cynheidre, an additional 112 stations were occupied in a 4-square-mile area to the northwest where the geologic structure is known. The surveys showed the existence of density variations in the Coal Measures that produce recognizable anomalies from which complex structure in the Coal Measures can be interpreted.—*M. C. R.*

164–172. Powell, David Williamson, Griffiths, Donald Harrison, and King, Roy Favell. Gravity and magnetic anomalies in North Wales; with an appendix on the magnetic anomalies over the Lleyn peninsula: Geol. Soc. London Quart. Jour., v. 111, pt. 4, p. 375–397, 1955 [1956].

Bouguer anomalies in North Wales have been calculated from a network of gravity stations in which the standard deviation of a gravity difference is about 0.2 milligals. Vertical magnetic anomalies have been surveyed in part of the area, and densities measured in the laboratory and field. The magnetic anomalies are thought to be controlled by depth to the Precambrian basement, the regional gravity gradients by deeper density contrasts, possibly those involved in crustal warping. In the appendix by Griffiths and King, the magnetic anomalies over the Lleyn peninsula are attributed to a single large igneous body fairly near the surface rather than to several separate bodies. The last 4 pages are devoted to discussion.—*D. B. V.*

164–173. Morelli, Carlo. Gravità e tettonica nelle Marche e negli Abruzzi settentrionali [Gravity and tectonics in the Marche and in eastern Abruzzi]: Annali Geofisica, v. 8, no. 4, p. 475–513, 1955.

A gravimetric survey of 315 stations (about 1 in 10 km^2) was made in the region between Rimini, Pescara, Avezzano, and Lago Trasimeno. Results are tabulated and also given as a Bouguer anomaly map. The map shows a series of negative anomalies from north to south with a positive anomaly to the west and the beginning of a positive anomaly to the east. The anomalies are discussed in detail with reference to geologic structure and particularly the tectonic development of the eastern Appennines as proposed by Merla. Some areas, especially near the coast, may offer promising possibilities for petroleum exploration.—*M. C. R.*

164–174. Scarsella, Francesco. Di alcune corrispondenze tra rilievo geologico e rilievo gravimetrico nelle Marche, nell 'Umbria e negli Abruzzi [On some correlations between the geologic and gravimetric surveys in the Marche, Umbria, and Abruzzi] : Annali Geofisica, v. 8, no. 4, p. 515–519, 1955.

Although there is correspondence between some anomalies on Morelli's map (see preceding abstract) and structure, there are equally remarkable structures with which no anomalies are associated. Because of the wide station spacing, no detailed geologic interpretation should be attempted.—*M. C. R.*

164–175. Norinelli, Armando. Raffittimento gravimetrico della zona centro orientale dell'arco alpino [Increase in the density of gravimetric observations in the east-central zone of the Alpine arc] : Annali Geofisica, v. 8, no. 4, p. 401–416, 1955.

Observations of gravity have been made at 181 stations in northeastern Italy and in the region south of the Lago di Garda to supplement earlier work and to increase the station density to 1 in 100 km² as required for the gravimetric map of Italy. Data are tabulated, and a Bouguer anomaly map based on available data and contoured at 10-milligal intervals is included.—*M. C. R.*

164–176. Geographical Survey Institute. Gravity survey in Japan I. Gravity survey in Hokkaido district: Geog. Survey Inst. Japan Bull., v. 4, pt. 2, p. 23–99, 1955.

As part of a systematic gravity survey of Japan by the Geographical Survey Institute, gravimeter observations are being made along level lines at benchmarks and at triangulation points and pendulum stations established at intervals of 100 to 200 km. More than 2,000 observations have been made in Hokkaido, and the results have been compiled as Bouguer and free-air anomaly maps. A positive anomaly crosses the middle part of the district in a north-south direction, and a low anomaly zone lies parallel to it on both sides, more distinct on the west side than on the east. Large positive anomalies (230 milligals) in the south side of the eastern part of Hokkaido, perpendicular to these anomalies, increase in intensity toward the Pacific side. The anomaly pattern is closely related to the geologic structure.—*M. C. R.*

164–177. Cattala, Louis. Étude de la gravité à Madagascar [Study of gravity in Madagascar] : Inst. Sci. Madagascar Mem., Sér. D, tome 6, p. 1–33, 1954.

The Bouguer anomaly map of Madagascar shows positive anomalies on the southwest coast, the most important being those at Morondava and Ambovombe, because of the gradient, and at Sakva, for its relation to the coal basin. The strongest positive anomalies are on the east coast at Nosy-Varika. The only closed positive anomaly, near Morafenobe, is attributed to an elevation of the substratum. The most important negative closed anomaly is near Antsirabe and parallels the axis of the mountain chains. Data are tabulated for several hundred stations at which observations of gravity have been made.—*M. C. R.*

164–178. Shvank, O. A. O prirode gravitatsionnykh anomaliy v Saratovskom Povolsh'e [The nature of the gravity anomalies in the Saratov region of the Volga basin] : Prikladnaya geofiz., vypusk 12, p. 66–92, 1955.

The gravitational field of the shield formed by the Saratov region of the Volga basin is conditioned by the topography of the Carboniferous rocks, the topography of the crystalline basement, and the distribution of dense masses in the basement. The transition from the shield to the Caspian depression is characterized by a sharp gravity gradient, caused obviously by a depression of the dense rocks of the Paleozoic of probably more than 1.4 km. Along the northern boundary of the Caspian depression, gravity minimums indicate salt domes. All known high areas on the surface of the Paleozoic are reflected in the gravity pattern ; the magnetic field is primarily determined by structural details in the crystalline basement. In many places in the area the gravity and magnetic anomalies are of opposite signs.—*S. T. V.*

164–179. Cook, Kenneth L. Regional gravity survey in northeastern Oklahoma and southeastern Kansas: Geophysics, v. 21, no. 1, p. 88–106, 1956.

In 1948 the U. S. Geological Survey, in cooperation with the U. S. Coast and Geodetic Survey, made a regional gravity survey in northeastern Oklahoma and southeastern Kansas in connection with the studies of the deflection of the vertical. About 550 gravity stations were occupied with spacings of 5 to 10 miles in parts of 54 counties, and a Bouguer anomaly map, contoured at intervals of 5 milligals, was drawn.

In southeastern Kansas there is a lack of correlation of regional gravity with known regional structural geology. The observed gravity anomalies are apparently caused principally by variations of density in the Precambrian basement and indicate a basement of complex nature, made up of rocks of contrasting properties, with a regional grain striking predominantly west or west-northwest.

In northeastern Oklahoma the several observed regional gravity anomalies indicate different degrees of correlation of regional gravity with regional structural geology. In the Precambrian highland area in Osage, Pawnee, and Creek Counties, there is a lack of correlation, as the gravity anomaly is probably caused chiefly by density contrasts within the basement complex. The anomaly associated with the Hunton arch is probably caused partly by structural relief of the rocks of pre-Pennsylvanian age and partly by density contracts within the basement, and thus indicates some correlation. The steep gravity gradients along the outer flanks of the Ozark uplift indicate good correlation with the subsurface geology. The great anomaly over the Arkansas basin, which indicates a close correlation, is probably caused largely—but perhaps not entirely—by downwarping of the basement and pre-Pennsylvanian rocks.—*Author's abstract*

HEAT AND HEAT FLOW

164–180. Lyubimova, Ye. A. O nagrevanii zemnykh nedr v protsesse obrazovaniya zemli [The heating of the earth's depths in the process of the formation of the earth] : Akad. Nauk SSSR Izv, Ser. geofiz., no. 5, p. 416–424, 1955.

If the earth originated by condensation of cold interstellar dust particles, the rise of the temperature caused by compression of matter from the pressure of the

external layers is computed as 800° to 2,400°K ; the maximum of the temperature occurs at 0.6 R from the center of the earth.—*S. T. V.*

164–181. Buddington, A. F., Fahey, Joseph, and Vlisidis, Angelina. Thermometric and petrogenetic significance of titaniferous magnetite : Am. Jour. Sci., v. 253, no. 9, p. 497–532, 1955.

Study of the variation of titanium content of magnetite relative to its host rock shows that in the Fe_3O_4–$FeO \cdot TiO_2$ system, where ilmenite is present in excess as independent grains, the percent of TiO_2 in magnetite is largely a function of temperature. The variation in composition of titaniferous magnetite thus is a potential geological thermometer for the range 550°–1000°C.—*D. B. V.*

164–182. Kullerud, G[unnar], Padget, P., and Vokes, F. M. The temperature of deposition of sphalerite-bearing ores in the Caledonides of northern Norway : Norsk Geol. Tidsskr., bind 35, p. 120–127, 1955.

Using the FeS-ZnS system as a geologic thermometer [see Geophys. Abs. 156–144], the temperature of formation was determined for six zinc-ore deposits in northern Norway. All but one lie within a narrow range (550°±40°C.).—*D. B. V.*

164–183. Fabian, H. J. Carbon-Ratio-Thorie, geothermische Tiefenstufe und Erdgas-Lagerstätten in Nordwestdeutschland [Carbon-ratio theory, geothermal gradient, and natural gas deposits in northwest Germany] : Erdöl u. Kohle, Jahrg. 8, Heft 3, p. 141–146, 1955.

This explains the relationships between geothermal gradient and oil and gas content of various formations in northwest Germany in the light of the carbon-ratio theory of the origin of petroleum. If the theory is valid, oil should be found in the carbonate rocks of the Zechstein at Fallstein or near Volkenroda in Thuringia, whereas the dolomites between the Netherlands border and the Weser should contain only gas deposits related to the periphery of the highly coalified central portion of the Lower Saxonian Wealden Basin. Rather high temperatures within rather low geothermal gradients seem to be particularly favorable to the formation of petroleum bitumens.

Current drilling programs in the vicinity of Diepholz may soon provide confirmation, or at least throw new light on the subject.—*D. B. V.*

164–184. Misener, A. D. Heat flow and depth of permafrost at Resolute Bay, Cornwallis Island, N. W. T., Canada : Am. Geophys. Union Trans., v. 36, no. 6, p. 1055–1060, 1955.

The program of diamond drilling carried out by the Dominion Observatory and the Meteorological Division, Department of Transport at Resolute Bay during the summers of 1950 to 1953 permitted the placing of thermistors at various intervals to a maximum depth of 650 ft. The thermal conductivity of core samples was determined by the divided-bar method. The average conductivity combined with the high reciprocal gradient (25.4 m per °C) give a value of the heat flow toward the surface of $2.9 \pm 0.4 \times 10^{-6}$ calories cm^{-2} sec^{-1}. Extrapolation of the temperature versus depth graph indicates that the permanently frozen region extends to a depth of 1,280±10 ft.—*Author's abstract*

164–185. Bordet, Claude. Sur la géologie de la galerie Isère-Arc (Savoie) [On the geology of the Isère-Arc tunnel (Savoie)] : Soc. géol. France Bull., tome 5, fasc. 4–6, p. 349–353, 1955 [1956].

This description of the section exposed along a 13.666-km tunnel connecting the Isère and Arc valleys, as part of a hydroelectric project, includes rock temperature measurements taken along most of the length. The maximum observed was 34.2°C, corresponding to the maximum (>1,800 meters) overlying thickness.—*D. B. V.*

164–186. Vasil'yev Yu. F. Termometr soprotivleniya na odnozhil'nom kabele [The resistance thermometer with the single-core cable] : Prikladnaya geofiz., vypusk 13, p. 116–130, 1955.

Two circuits can be used for measurement of temperature with an electric resistance thermometer in a single-core cable. In one, the potential drop, produced by changing the resistance of the heat-sensitive element, is measured by a potentiometer with a shunt placed in series with the element. In the second, a Wheatstone bridge is used with the heat-sensitive element inserted in one side. Formulas are derived for the variation of temperature, for the relative value of the error of the measurement, and for the effect of spontaneous potential. This spontaneous potential arises and can be important when the cable sheath used as the grounding conductor is exposed to electrochemical action of the mud.—*S. T. V.*

164–187. Kunz, K. S., and Tixier, M. P. Temperature surveys in gas producing wells: Am. Inst. Min. Metall. Engineers Trans., v. 204, Jour. Petroleum Technology, v. 7, no. 7, p. 111–119, 1955.

In some instances a gas well may be drilled without using water as a drilling fluid, precluding the use of electric logs. In such instances, temperature logs may be obtained with a sensitive thermometer of short time constant and used for quantitative interpretation. Induction logs and neutron logs may also be run in such dry holes, but their utility is limited. Temperature logs are run while the well is producing gas so that the cooling of the gas as it expands on leaving the formation may be detected. As the gas rises in the well, it regains heat from the rock, and gradually the thermal log will return to the geothermal gradient. A graphical method to compute the rate of gas production from such temperature logs is derived.—*G. V. K.*

INTERNAL CONSTITUTION OF THE EARTH

164–188. Shmidt, O. Yu. Proiskhozhdeniye i rannyaya evolutsiya zemli [The origin and early evolution of the earth] : Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 26(153), p. 5–10, 1955.

The present physical state of the earth is affected by its previous history, and therefore, the theory of the origin of the earth does not belong exclusively to cosmogony but ought to be considered as part of geology. Shmidt considers the Laplace theory of the formation of the earth erroneous and subscribes to the theory of the formation of the earth by condensation of cold interstellar dust

particles. In this process a certain amount of heat was produced by the destruction of part of the kinetic energy of condensing particles, but the main sources of the earth's heat are the radioactive processes, concentrated chiefly near the crust of the earth. The condensate forming the earth was initially homogeneous and later separated into different substances. As the earth grew in mass it began to attract cosmic dust particles and meterorites which now amount to about 100 tons daily.—*S. T. V.*

164–189.   Gialanella, Lucio. L'origine e l'evoluzione del Mondo cosmico [The origin and evolution of the cosmic world] : La Ricerca Sci., anno 23, no. 4, p. 573–592, 1953.

The primeval universe may have consisted of a gigantic, hydrogenous, cold, and extremely rarified nebula filling entire space. Hydrogen is the origin of everything, but details of the chain of events leading to formation of all the other elements and to the present universe are still not clear.

Major difficulties arise in the question of the origin of the planets, which are third-order features in the cosmic system. No adequate hypothesis has yet been put forward. It is certain that the problem cannot be solved by means of rational mechanics alone, but only with the help of the entire field of physics, from turbulence to electromagnetism and other aspects.—*D. B. V.*

164–190.   Levin, B. Yu. Sostav zemli [The constitution of the earth] : Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 26(153), p. 11–38, 1955.

A review is presented of different hypotheses of the origin of the earth and of the solar system, beginning with the Kant-Laplace theory. The fundamental theory of present-day cosmogony is that attributed to O. Yu. Shmidt, according to which the earth was created by the condensation of the cold interstellar dust particles. A bibliography of about 75 papers is included.—*S. T. V.*

164–191.   Belousov, V. V. Vnutrenneye stroyeniye i razvitiye zemli v svete geotektonicheskikh dannykh [Internal structure and the evolution of the earth from geotectonic evidence] : Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 26(153) p. 51–160, 1955.

It is possible to form an approximate judgment about processes taking place in great depths of the earth from their manifestations on the earth's surface at present time as well as during the geologic past. Among processes of fundamental importance are the vertical pulsations of different periodicities. The most interesting are the pulsations with a period of about 40 million years, the average duration of a geologic period. The amplitudes of these pulsations are measured in hundreds, or in a few places, thousands of meters. Positive pulsations affecting very great areas in certain regions took place at the same time as negative pulsations in others. Another type of movement of the crust is the undulatory movement slowly shifting along the surface of the earth. In many places the total amplitudes of such vertical displacements have been as much as 12–15 km.

The cause of these displacements lies in the physicochemical processes in the earth's interior that result in changes in density indifferent with the ensuing differentiation of the material.

The general contraction of the globe may also cause vertical movement of the crust which would produce the expansion of existing oceans and the formation of new ones.—*S. T. V.*

164-192.   Jung, Karl. Was wissen wir vom tiefen Erdinnern? [What do we know about the depths of the earth?] Natur u. Volk, Band 84, Heft 12, p. 405-413, 1954.

This is a semipopular discussion of the present state of knowledge of the methods and results of investigation of the structure, physical properties, and composition of the earth's interior.—*D. B. V.*

164-193.   Wiese, Horst. Tiefentellurik—Erforschung der Erdkruste durch geomagnetische Variationen [Deep tellurics—investigation of the earth's crust by means of geomagnetic variations] : Geologie, Jahrg. 4, Heft 5, p. 520-525, 1955.

Electric currents induced in the earth's interior by variable ionospheric current systems suggest the possibility of determining the conductivity, and therefore the large-scale structure of the crust and mantle, from anomalies observed during magnetic bay disturbances. The name "Tiefentellurik" ("deep tellurics") is proposed for this method of investigation. Giving several examples, Wiese shows that all known anomalies in conductivity occur outside the shield areas, in strongly orogenic regions.—*D. B. V.*

164-194.   Bartels, Julius. Erdmagnetisch erschliespbare lokale Inhomogenitäten der elektrischen Leitfähigkeit im Untergrund [Geomagnetically indicated local heterogeneities of electric conductivity of the underground] : Akad. Wiss. Göttingen Nachr. Math.-phys. Kl., Abt. IIa, no. 5, p. 95-100, 1954.

Temporal variations of the geomagnetic field are ordinarily attributed to changes in the intensity and field pattern of electric currents surrounding the earth and flowing partly in the upper atmosphere, partly penetrating to an indefinite depth into the earth. The two components of geomagnetic field can be separated under certain assumptions and so the causes of differences in the systems of telluric currents during a bay disturbance around different observatories can be analyzed. Bay disturbances recorded at Sitka, Alaska, Cheltenham, Md., Tucson, Ariz., and Watheroo, West Australia have been analyzed. For at least a 200-km radius around Tucson no important heterogeneities of the ground are probable, especially in electric conductivity, whereas, near Huancayo Observatory differences in electrical conductivity near the earth's surface are indicated. Details of geologic differences can not be determined.—*S. T. V.*

164-195.   Shimazu, Yasuo. Chemical structure and physical property of the Earth's mantle inferred from chemical equilibrium condition [in Japanese with English abstract]: Zisin, v. 8, no. 2, p. 67-74, 1955.

If it is assumed that chemical and hydrostatic equilibrium are attained in the mantle and that the mantle is isothermal and incompressible, the distribution of chemical elements would be controlled by differences in their chemical affinities as well as by gravitational separation due to density differences. From calculation of the equilibrium distribution of the $FeO-MgO-Fe-SiO_2$ system, it is concluded that FeO would increase with depth, reach a maximum at the depth of several hundred kilometers, and then would decrease toward the earth's center. This suggests the origin and the nature of Jeffry's $20°$ discontinuity.—*V. S. N.*

164–196.   Lopez Arroyo, Alfonso. Acerca de la anisotropia elastica de la corteza terrestre [On the elastic anisotropy of the earth's crust] : Rev. Geofísica, año 13, no. 50, p. 169–173, 1954.

From analysis of deviations of the plumb line at different points on the earth's surface Hecker and Meissner concluded that the elastic constants are about 20–30 percent lower in the north-south direction than in the east-west direction. Love attributed this anisotropy to the gyroscopic effect produced by the rotatiton of the earth. Analysis of the velocities of earthquake waves in different directions, from 20 earthquakes selected at random from those listed in "Seismicity of the earth" by Gutenberg and Richter, shows that no anisotropy in the elasticity of the crust can be found. If it exists, it is smaller than the errors in the observations.—*S. T. V.*

164–197.   Reinhardt, Hans Günter, Steinbruchsprengungen zur Enforschung des tieferen Untergrundes [Quarry explosions in the investigation of deeper crustal structure] : Geologie, Jahrg. 4, Heft 3, p. 349–350, 1955.

Quarry explosions and other large industrial blasts yield valuable seismic data on crustal structure because the time and focus are accurately known. Data from such explosions have been compiled in recent years in East Germany in the hope that they will lead to better understanding of the structure of the deeper parts of the crust in that country. Information on the relationship of the Paleozoic to the crystalline subbasement under the North German basin would have economic as well as scientific value. For this purpose, profiles about 50 km long would suffice. It is proposed that large explosions be set off in deep boreholes; the main technical problem would be that of finding explosives and fuses which would be reliable under relatively great hydrostatic pressure [see also Geophys. Abs. 162–147].—*D. B. V.*

164–198.   Lagrula, Jean. Sur l'épaisseur de l'écorce terrestre [On the thickness of the crust of the earth] : Acad. Sci. Paris Comptes Rendus, tome 241, no. 22, p. 1609–1611, 1955.

The discontinuity between the solid crust and the substratum in gravimetric interpretation is usually taken as corresponding to the discontinuity at the base of the intermediate layer determined from seismologic data. Heiskanen, for example, gives 30 km as the "best value" of the thickness T of the crust for altitude zero using as a criterion the independence of anomalies a with respect to altitude z ($\Delta a/\Delta z=0$). This would be correct if there had been a "geologic correction" applied. In general in the zones at higher elevations, there is higher density material exposed than in the zones at lower elevations where there is an accumulation of relatively light sedimentary material. Vecchia's density map [see Geophys. Abs. 154–14613] shows that for $z\geqq1,000$ meters, the average density above the geoid is 3.00 and for z about 0 the average density is 2.00. By considering a mountain chain as an infinite horizontal prism of triangular cross section, and taking into account the difference between 3.00 and the 2.67 usually assumed, Largrula calculates an error of the order of 10 milligals per kilometer of altitude would result. Therefore the best value of T is not 30 km but somewhat less than 20. The base of the gravimetric crust is therefore equivalent to the base of the granite layer.—*M. C. R.*

164–199.   Gamburtsev, G. A., Veitsman, P. S., and Tulina, Yu. V.   Stroyeniye
zemnoy kory v rayone Severnogo Tyan'-Shanyo po dannym glubin-
nogo seysmicheskogo zondirovaniya [The constitution of the earth's
crust around the northern Tien Shan as revealed by the deep seismic
sounding] : Akad. Nauk SSSR Doklady, tom 105, no. 1, p. 83–86, 1955.

Seismic profiles with careful tracing of individual waves to a distance of about
400 km from the shot point were made from 1949 to 1953 in the northern part
of the Tien Shan in the Kirghiz S. S. R.   By placing the explosives in water, in
local lakes at depths of 20 to 30 meters, and using high-sensitivity seismometers,
seismograms were obtained at distances of 400 km from shots of 50 to 300
kilograms.   The length of geophone lines varied according to geologic conditions
from 1 to 48 km ; the best results were obtained with geophones from 150 to 400
km from the shot point.

Three groups of waves were clearly recorded, $\overline{P}$, $P*$ and P.   The apparent
velocity of $\overline{P}$ was 5.0–6.0 kmps, of $P*$, 6.0–7.0 kmps, and of P, 8.0–8.5 kmps.   The
velocity in the granitic layer was 5.5 kmps.

The depth to the Mohorovičić discontinuity varied from 40 to 50 km, and to
the basalt from 8 to 20 km.   The thickness of the basalt layer ranged from 24 to
42 km.   Comparison of seismic and gravity data indicated that the negative
gravity anomaly observed between the Ili River and the Transilian Ala Tau-
ridge is produced by a lowering of the Mohorovičić surface in this region.—*S. T. V.*

164–200.   Bentley, Charles R., and Worzel, J. Lamar.   Geophysical investigations
in the emerged and submerged Atlantic coastal plain.   Part X :
Continental slope and continental rise south of the Grand Banks :
Geol. Soc. America Bull., v. 67, no. 1, p. 1–18, 1956.

Seismic refraction profiles shot on the continental rise and slope south of the
Grand Banks show great sediment thickness which reaches a maximum of nearly
10 km about 90 km south of the 100-fathom curve and thins rapidly under the
banks.   These sediment layers are present, with average velocities of 1.83, 2.47,
and 3.97 kmps, the highest velocity layer constituting the major portion of
the column.   The basement is thickest under the south edge of the continental
shelf, thinning to 2 or 3 km to the north and to the south.   Its velocity averages
5.77 kmps except on the southernmost profile where it is 6.70 kmps.   Subbasement
is reached on the three southernmost profiles at an average depth of about 13
km, the velocity decreasing from south to north from 7.76 kmps to 7.24 kmps.—
Authors' abstract

164–201.   Schulz-Weidner, W.   Schuf ein Riesen-Meteorit die Kleinen Antillen?
[Did a giant meteorite create the Lesser Antilles?] :   Umschau,
Jahrg. 55, Heft 23, p. 713, 1955.

This outlines Kelso de Montigny's theory that the Lesser Antilles were created
by the impact of a gigantic meteorite, an asteroid, about 5,000–6,000 years ago.
The theory is based on the rimlike shape of the island chain with a craterlike
depression within, deepest in the center ; the distribution of certain snakes indicat-
ing land connections between the islands and South America less than 10,000
years ago ; and on Indian folklore.   The finding of meteorite remains on the west
coats of the Lesser Antilles or in the sea floor in the center would support the
theory.—*D. B. V.*

164–202.   Butterlin, Jacques. A'propos de la nature du fond de la mer des Antilles [On the nature of the sea bottom in the Antilles] : Soc. géol. France Comptes Rendus, no. 13, p. 251–252, 1955.

Butterlin disagrees with Worzel and Ewing [see Geophys. Abs. 156–16, 17] when they conclude that the sial layer is relatively thin in the Antilles region; one of their own refraction soundings, about 130 km south of Puerto Rico, indicates a thickness of as much as 9 km. In a forthcoming work on the structure of the Antilles, Butterlin plans to discuss their interpretation in the light of the orogenic history of the region.—*D. B. V.*

164–203.   Pettersson, Hans. Magnetische Kügelchen und Meteore [Magnetic pellets and meteors] : Naturw., Jahrg. 42, Heft 13, p. 387–388, 1955.

The *Albatross* deep sea expedition of 1947–48 found numerous magnetic globules (on the order of 1,000 per kilogram of sediment) distributed unevenly throughout core samples of Pacific Ocean sediments deposited 1.5 to 3 million years ago. This definitely disproves Schwinner's theory that meteorites originated from a cosmic cloud which traversed our solar system only about 20,000 years ago. Further study of the distribution of meteorite particles in deep sea sediments is expected to throw light on their frequency throughout the past few million years—*D. B. V.*

164–204.   Öpik, E. J. Cosmic sources of deep sea deposits : Nature, v. 176, no. 4489, p. 926–927, 1955.

Black magnetic spherules found in deposits collected by the *Challenger* expedition have been recognized as being probably of cosmic origin. The relatively high nickel content of deep sea deposits in the Pacific Ocean led Pettersson and Rotschi to suggest a cosmic origin for the excess nickel. This has been questioned because the relative abundances of nickel and other metals are more like those in terrestrial sources than in meteoritic. However, meteorites and meteoric dust have a different origin—meteorites being fragments of larger bodies destroyed in collisions and meteoric dust the product of condensation from a gaseous medium. The fact that terrestrial abundances agree best with those of deep sea deposits may not mean the latter has a terrestrial origin but that the outer crust being the last addition to the earth from cosmic sources is built of material the remnants of which are still falling on the earth from the zodiacal-light cloud.—*M. C. R.*

ISOSTASY

164–205.   Pugh, John Charles. Isostatic readjustment in the theory of pediplanation: Geol. Soc. London Quart. Jour., v. 111, pt. 4, p. 361–374, 1955 [1956].

The principle of isostatic recovery is applied to the theory of landscape reduction by back-wearing scarps. Calculations show that major post-Cretaceous erosion surfaces can be predicted within definite altitude ranges; in West Africa there is marked correspondence between calculated and observed heights. The theory explains the intermittent uplift during the Tertiary, without resorting to unknown forces.

Pages 369–374 are devoted to discussion of this and the foregoing paper (see following abstract).—*D. B. V.*

164–206. King, Lester C. Pediplanation and isostasy: an example from South
Africa: Geol. Soc. London Quart. Jour., v. 111, pt. 4, p. 353–359, 1955
[1956].

Observed elevations of late Mesozoic and Tertiary erosional surfaces in South
Africa are in noteworthy agreement with calculated heights which allow for
isostatic recovery between cycles. Isostatic readjustment thus seems to occur as
a simple function of erosion and deposition under the pediplanation principle.—
D. B. V.

164–207. Arambourg, C. Les "plages soulevées" du Quaternaire [The "raised
beaches" of the Quaternary]: Quaternaria, v. 1, p. 55–60, 1954.

Eustatic changes of sea level alone cannot explain the arrangement in tiers of
ancient shorelines; the return to the same position with respect to the center of
the geoid implies uplift of the continents. Unloading by erosion, with resulting
isostatic readjustment, satisfactorily explains the generality of the phenomenon.
Local influences cause local modifications of the general movement.—*D. B. V.*

164–208. Cailleux, André. Ampleur des regressions glacioeustatiques [Ampli-
tude of glacioeustatic regressions]: Soc. géol. France Bull., tome 4,
fasc. 4–6, p. 243–254, 1954.

Formation of the Quaternary glaciers, at their maximum, lowered sea level from
120 to 220 meters; taking into account isostatic compensation, this amounted to
a net regression of 90 to 150 meters with respect to present zero level.

It is not impossible that much more widespread continental glaciation with
attendant lowering of sea level occurred in the Precambrian; among other
things, this could explain the submarine canyons, whose depths of 2,200 meters
and over cannot be explained by the maximum glacioeustatic regression of the
Quaternary.—*D. B. V.*

164–209. Nakano, Takamasa. Crustal movement and shoreline development
along the Pacific coast of Japan since Holocene period—A report on
the geomorphological studies of lowlands of Japan: Geog. Survey
Inst. Japan Bull., v. 4, pt. 1, p. 87–113, 1954.

Geomorphological studies of the coastal lowlands of Japan show there have
been three invasions of the sea on the eastern coast since the beginning of the
deposition of the alluvium. Differences in the patterns of emergence and sub-
mergence are the result of differential movements of the crust rather than eustatic
changes of sea level. In the Tokyo area, the maximum vertical displacement is
not less than 40 meters.—*M. C. R.*

ISOTOPE GEOLOGY

164–210. Gentner, W., and Zähringer, J. Argon- und Heliumbestimmungen in
Eisenmeteoriten [Argon and helium determinations in iron meteor-
ites]: Zeitschr. Naturforschung, Band 10a, Heft 6, p. 498–499, 1955.

The direct relationship between A^{36} and He^3 found in helium and argon isotope
determinations on iron meteorites indicates that the two isotopes are of the same
origin, namely, vaporization of the iron nucleus. The A^{36}/A^{38} ratio is about
1/1.7.—*D. B. V.*

164–211.   Friedman, Irving. Deuterium content of natural waters and other substances : Geochim. et Cosmochim. Acta, v. 4, no. 1, p. 89–103, 1953.

Ocean waters analyzed by a mass spectometric method capable of determining the hydrogen-deuterium ratio to ±0.10 percent were found to contain from 0.0153 to 0.0156 mole percent D, fresh waters of the United States from 0.0133 to 0.0154 mole percent D. From the hydrogen in fumarole gases from Yellowstone Park it is calculated that the minimum temperature for the reaction $H_2+HDO \rightleftarrows HD+H_2O$ is 400°C. The isotopic composition of organic hydrogen from abalone was found to be considerably different from that of the hydrogen of the surrounding water; apparently the abalone fractionates its hydrogen by a large factor.—*D. B. V.*

164–212.   Kulp, J. L[aurence], Bate, G[eorge] L., Ault, W. U., and Feely, H. W. Lead and sulfur isotopic abundances in Mississippi Valley galenas : Geol. Soc. America Bull., v. 67, no. 1, p. 123–124, 1956.

In a recent worldwide survey of galena, lead from Mississippi Valley galenas showed unusually large variations in isotopic composition. Isotopic study of the sulfur in the same galenas was undertaken in order to determine whether the variation is due to isotopic fractionation during transportation or deposition, or to changes, either with time or place, in the source of the lead. A table presents comparison of the S^{32}/S^{34} ratio with Pb^{207}/Pb^{206} for 19 samples. The S^{32}/S^{34} ratio is essentially constant in the Illinois-Iowa-Wisconsin and Joplin districts, and in the southeast Missouri district it varies by a maximum of only 2.7 percent, whereas the Pb^{207}/Pb^{206} ratio varies by 15 percent. It is concluded that there must have been several independent sources of lead, or a source which changed with time. Detailed examination of isotopic variation of southeast Missouri samples is being undertaken to permit discrimination between these alternatives.—*D. B. V.*

164–213.   Gillieson, A. H., and Thorne, R. P. Discrepancy between the spectro-isotopic and the mass-spectrometric results for the natural abundance ratio of the lithium isotopes : Nature, v. 176, no. 4495, p. 1228–1229, 1955.

With a correction (proportional to the square roots of the isotope masses) for Doppler broadening applied, the natural abundance ratio of Li^6/Li^7 determined from spectroscopic measurements is 12.5+0.3, in good agreement with mass spectrometric results.—*M. C. R.*

164–214.   Hoering, Thomas. Variations of nitrogen-15 abundance in naturally occurring substances : Science, v. 122, no. 3182, p. 1233–1234, 1955.

Measurements of the variation of N^{15} abundance in several naturally occurring substances are reported in this paper in terms of the difference in the N^{15}/N^{14} ratio in standard atmospheric N_2. Differences in peat and coal samples range from +1.9 to −2.8, in oil and gas wells from +2.9 to −13.0, in two granites, −0.2 and −0.9, and in pitchblende from Great Bear Lake, −2.3.—*M. C. R.*

164–215. Schwander, H. Bestimmung des relativen Sauerstoffisotopen-Verhälnisses in silikatgesteinen und -Mineralien [Determination of the relative oxygen isotope ratios in silicate rocks and minerals]: Geochim. et Cosmochim. Acta, v. 4, no. 6, p. 261–291, 1953

A discussion of the method and apparatus for converting oxygen of silicate minerals and rocks into CO, and a tabulation of 70 determinations of the relative O^{18}/O^{16} ratio on rocks and minerals of wide stratigraphic and geographic distribution.—*D. B. V.*

164–216. Marquez, L., and Costa, N. L. The formation of ^{32}P from atmospheric argon by cosmic rays: Nuovo Cimento, ser. 10, v. 2, no. 5, p. 1038–1041, 1955.

It is shown by experiments that radioactive ^{32}P is formed as a spallation product of argon by cosmic rays. This ^{32}P is found in the rainwater, and its average activity in fresh rainwater of Rio de Janiero is 0.20 counts per minute per liter.—*Authors' summary*

164–217. Eberhardt, P[eter], Geiss, J[ohannes], Lang, C., Herr, W[ilfrid], and Merz, E[rich]. Zur frage des Zerfalls von ^{180}Ta [On the question of the decay of Ta^{180}]: Zeitschr. Naturforschung, Band 10a, Heft 9/10, p. 796, 1955.

In the light of the discovery of the unstable isotope Ta^{180} [see Geophys. Abs. 160–143] two Precambian tantalites from South Africa have been examined for possible products of its decomposition. The W^{180}/W ratio in the specimen from Swaziland was the same as that in normal tungsten from tungsten ore, but in the sample from Bikita, Southern Rhodesia, a loss in tungsten could be definitely established. The upper limit of the decay constant was found to be $\lambda_\beta—<7\times10^{-13}a^{-1}$, which is consistent with the presence of tantalum decay products. Should it be shown that the K-capture Ta$^{180}\rightarrow$Hf^{180} is so strong that the half-life of Ta^{180} is comparable to the age of the mineral being investigated, the upper limit of the decay constant could be calculated from the ratio of radiogenic W^{180} to Ta^{180} without a new tungsten determination.

How useful the method of seeking possible result products of unsolved, long-lived radioactive isotopes can be, is shown by a rough estimate of the β-activity of Ta to be expected from the above decay constant: an infinitely thick tantalum layer 100 cm^2 on the surface would emit less than one β-particle per minute, assuming that $E_0=400$–600 Kev.—*D. B. V.*

164–218. Kaufman, Sheldon, and Libby, W. F. The natural distribution of tritium: Phys. Rev., v. 93, no. 6, p. 1337–1344, 1954.

The abundance of cosmic-ray produced tritium in a variety of natural waters in the Mississippi Valley, the Chicago area, and elsewhere ranges between 0.5 to 67 tritium atoms per 10^{18} hydrogen atoms. This corresponds to an average cosmic-ray production rate of about 0.12 tritium atoms per cm^2 per second, if the total rate of transfer of tritium into the oceans is taken as equal to the total production rate. This is equivalent to assuming short land-storage time in terms of 18 years, the average life of tritium. At such a production rate, the total amount of existing tritium would be 1,800 grams, of which only about 1 percent is in the atmosphere. The present production rate corresponds to a rate of escape of He^3 from the earth of about 5×10^7 years, or less.

The tritium contents of vintage wines seem to agree with time elapsed since bottling, indicating that tritium abundances over the past 18 years have been essentially the same as at present. In meteorology, the time elapsed since rain-water evaporated from the ocean can be calculated from the tritium content; in hydrology, it should be possible to distinguish ground water from surface runoff, or to measure storage times of underground reservoirs.—*D. B. V.*

MAGNETIC FIELD OF THE EARTH

164–219. Rikitake, Tsuneji. Magneto-hydrodynamic oscillations in the earth's core: Tokyo Univ. Earthquake Research Inst. Bull., v. 33, pt. 1, p. 1–25, 1955.

Possibilities of magnetohydrodynamic oscillations in the earth's core are discussed in relation to the stability of Elsasser-Bullard-Takeuchi's dynamo. If there are stable magnetic fields which are caused by the dynamo action in the earth's core, there will be oscillations of magnetic field and fluid motion around the steady state. This sort of oscillation is here studied under some simplifications. Although the study is rather crude, it is tentatively concluded that the toroidal magnetic field is not so large, otherwise the small oscillations of dynamo would not be stable. Since the fundamental equations for magnetic changes in the earth's core are obtained, we may forecast the magnitude of magnetic field of certain type, say S_1^0-type, starting from suitable initial conditions. This is done in this paper on the basis of the spherical harmonic analyses for various epochs. Although no definite result is obtained because the observation period of the earth's magnetism seems too short for close comparison between the observation and theory, the conclusion concerning the internal magnetic field is compatible with that obtained in the stability problem.—*Author's summary*

164–220. Takeuchi, Hitoshi, and Elsasser, W. M. Fluid motions near the core boundary and the irregular variations in the earth's rotation: Jour. Physics of Earth, v. 2, no. 2, p. 39–44, 1954.

Observed irregular fluctuations in the earth's rate of rotation can be explained by an exchange of angular momentum between the earth's mantle and core. Bullard and others have also shown that the observed westerly drift of the geomagnetic secular variation requires the existence of an electromagnetic couple between the core and mantle. In Bullard's model the earth is represented by three concentric solid spheres in mutual electrical contact and rotating relative to each other. In this paper the actual hydrodynamic equations for the regions of the core near the boundary are used, and the transmission of electromagnetic torques from the core to the mantle investigated. The motion near the boundary will break up into large-scale eddies, similar to the major perturbations of the atmosphere, due mainly to the deflection action of the Coriolis force. Elsasser and Takeuchi have previously approached the problem by using averages over circles of latitude and lumping the effects of eddies together in a mechanical and magnetic eddy viscosity. In this paper the frictional terms are considered to correspond to molecular viscosities and are small compared to other terms, especially the Coriolis and pressure terms in the equations of motion. Although this does not lead to a specification of the mean flow in the boundary layer, it is possible to show that electromagnetic torques transmitted from the core to the mantle are of the right order of magnitude to account for the observed variations in the earth's rate of rotation.—*M. C. R.*

164-221. Kalashnikov, A. G. Geomagnitnoye pole, svyaz' jego so stroyeniyem zemli i proiskhodyashchimi v ney protsessami [The geomagnetic field, its correlation with the structure of the earth and with the processes going on within it]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 26 (153), p. 198-207, 1955.

After a detailed review of the history of investigations regarding the origin of the geomagnetic field and its secular variation and the electrical conductivity of the earth as conditioned by the oscillations of the magnetic and electric field on the earth's surface, Kalashnikov concludes that the most probable source of terrestrial magnetism is the quasi-metallic core of the earth, as suggested by Haalck, Elsasser, Frenkel, and others. The substance forming the core is ionized, and vortical movements of its free electrons produce the magnetic field. Blackett's hypothesis that the magnetic field is produced by mechanical rotation, must be discarded at least in relation to the earth.

The local variations of geomagnetic field are produced by variations of the depth of the surface corresponding to the Curie temperature of magnetite (580°C.), as the result of subcrustal movements. Thus, a correlation exists between the geomagnetic variations and the deep geologic structure of a region.—S. T. V.

164-222. Kazanli, D. N. Svyaz' magnitnogo i gravitatsionnogo polya zemnogo shara s glubinnymi protsesami [The correlation of the magnetic and gravitational fields of the earth with deep geologic processes]: Akad. Nauk Kazakh SSR Vestnik, no. 2 (119), p. 11-20, 1955.

The magnetic field of the earth is composed of the field produced by a homogeneously magnetized sphere, and a residual field, of an intensity about 40 percent of the first, characterized by several magnetic maximums and minimums in various parts of the earth. The maximums are always on the shields and platforms, the most stable portions of the crust, and the zero isolines of the vertical geomagnetic component are along the boundaries of the shields. Correlations between the pattern of the residual geomagnetic field and the gravitational field indicate that the residual geomagnetic field and gravitational anomalies are produced by the same processes and that these processes take place at great depth, near the boundary of the core. The increase in density with depth goes along with physical processes that completely change other physical properties (as for example, the transformation of phosphorus at a pressure of about 40,000 atmospheres into a substance possessing metallic electric conductivity, because of the concentration of electrons). Geologic dynamic processes as well as the process of the stabilization of the crust correspond precisely to the boundaries and central portions of the shields, and the evolution of transgressions during the history of the crust is closely related to changes in the structure of magnetic and gravitational fields and to local heterogeneities in the crust.—S. T. V.

164-223. McDonald, Keith Leon. Geomagnetic secular variation at the core-mantle boundary: Jour. Geophys. Research, v. 60, no. 4, p. 377-388, 1955.

By placing suitable source functions at the core-mantle boundary and extrapolating them to the surface, the time derivative of the radial component of the magnetic intensity is fitted to maps of the geomagnetic secular variation. The mantle is assumed to be an insulator, and the topography of the magnetic field variation at the core-mantle boundary is then quantitatively described. Al-

though the projection is carried out in terms of circular hills and dales, the magnetic topography at the core is found to be far better described in terms of an extensive system of long ridges radiating from a set of focal points. A typical ridge has a half-width of 150 to 600 km at the core's surface, and extends over several thousand kilometers, with parallel ridges of opposite sign on each side.

The integrated effects at the core are such that for an insulating mantle, radial field intensities of 2 to 5 gauss are common, whereas intensities ranging from 5 to 15 gauss occur in the more active regions. A lower limit of the total root mean square value of the time derivative of the vertical component at the core is estimated to be 0.18 ($\pm$ 0.05) gauss per year.—*P. E. B.*

164–224. Quiring, Heinrich. Erdmagnetismuss und geothermische Tiefenstufe [Geomagnetism and geothermal gradient] : Neues Jahrb. Geologie u. Paläontologie Monatsh., Jahrg. 1955, Heft 9, p. 369–391.

The endogene portion of the earth's magnetic field, determined by the magnetic properties of the crust, is stronger in the polar region because there the geothermal gradient is greater and the crust thicker, so that the Curie isobase is deeper. Secular variation is due to a precession to the right of the left-flowing exogene field induced by geo-lunar-helical rotation; the complete cycle is accomplished about every 1,900 solar years (the "great magnetic year"). The ratio of this interval to that of the cycle of polar wandering (25,733 yrs) is approximately 1 :13.48; the figure 13.48 is the number of lunar revolutions in the solar year. The "ideal pole" of the geomagnetic field is the southern focus of the polar light ellipse; this ellipse therefore also precesses to the right around the magnetic pole.—*D. B. V.*

164–225. Olczak, Tadeusz. Secular variation of the magnetic declination at Gdansk: Acta Geophys. Polonica, v. 3, no. 1, p. 27–33, 1955.

Magnetic declination at Gdansk (Danzig) since 1539 has varied from about 13° E to 15° W and now is approaching the zero value. The change is similar to those found at several places in Germany.—*S. T. V.*

164–226. Nicholson, Seth B., and Wulf, Oliver R. The diurnal variation of irregular geomagnetic fluctuations: Jour. Geophys. Research, v. 60, no. 4, p. 389–394, 1955.

The diurnal variation of irregular geomagnetic fluctuations in moderately low latitudes has been studied, using the eight daily K numbers (3-hour-range indices) for the seven years 1940–46 and for the six observatories Alibag, Watheroo, Honolulu, Tucson, San Juan, and San Fernando.

A local time variation is apparent in the data, and a minimum near sunrise and a maximum in the late evening are indicated. The diurnal variation seems to have a small seasonal change. When the local time variation is deducted from the original data for each observatory, the remainders suggest a universal time variation exhibiting a pronounced seasonal change.

The nocturnal prevalence of the irregular fluctuations may be explained in terms of atmospheric turbulence in the ionosphere. The turbulent motions are regarded as hindered during the day by electromagnetic damping. Features of the large-scale circulation of the atmosphere may contribute to the universal time component.—*P. E. B.*

164–227. Sucksdorff, E. The influence of the moon and the inner planets on the geomagnetic activity: Geophysica, v. 5, no. 2, p. 95–106, 1955.

The geomagnetic activity in Sodankylä during some 30 years shows a fairly systematic double-waved variation in a period corresponding to the synodic revolution of the moon, the chief activity minimum occurring during the new moon. A decrease in the activity also appears at the times of the inferior conjunctions of the planets Mercury and Venus. This fact suggests that all these celestial bodies are surrounded by a magnetic field.—*Author's abstract*

164–228. Zmuda, Alfred [J.], and McClung, Lowell. Vertical extrapolation of geomagnetic field components: Am. Geophys. Union Trans., v. 36, no. 6, p. 939–942, 1955.

In the region external to sources of magnetism, both the divergence and the curl of the magnetic intensity are zero. From the corresponding analytic expressions, the derivatives in the vertical direction of each field component are obtained in terms of the values of the components on a surface surrounding the sources. A Taylor series is formed with these derivatives and then used to continue, either upward or downward, the respective components. The rapidity of the convergence depends on the complexity of the surface field and on the distance of the computed point from the surface.—*Author's abstract*

164–229. Zmuda, Alfred J. Limiting form of Taylor series used in extrapolating components of the geomagnetic intensity: Am. Geophys. Union Trans., v. 37, no. 1, p. 9–12, 1956.

In the extrapolation of geomagnetic components, a theoretical treatment of the Taylor series shows that the ratio of the absolute value of successive terms of the series approached the limit h/a where h is the extrapolation distance and a is the radius of the earth. Expressions are presented for the limiting form of the remainder after a certain finite number of terms of the series. These expressions, which comprise the product of a computed term and a binomial series, may be used to limit the number of partial derivatives that need to be computed.—*Author's abstract*

164–230. Wood, F. W., and Everingham, I. B. A provisional isogonic map of Australia and New Guinea showing predicted values for the epoch 1955.5: Australia Bur. Min. Resources, Geology and Geophysics Rept., no. 14, 6 p., 1953.

A provisional isogonic map showing predicted values of declination for the middle of 1955 with an isoporic chart showing the expected annular rate of change of declination for the same epoch. The present map in comparison with that for 1950.5 shows: the declination over Tasmania is from 2/3° to 3/4° greater (more easterly) than was expected from the 1950.5 map; the annual rate of change of declination over southeastern Australia shows an increased positive (easterly) value; and the annual rate of change of declination over the northwestern part of the mainland now shows a small negative (westerly) value instead of the small positive value of previous years.—*V. S. N.*

164–231.   Haáz, István Béla, and Barta, György. A földmágneses elemek külön-
bségei a Budakeszi, Pruhonicei és Ógyallai observatóriumok között
[Differences in geomagnetic elements between the Budakeszi, Pru-
honice, and Ogyalla observatories (with English and Russian sum-
maries)]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz.
Köslemények, kötet 3, szám 11, p. 157–167, 1954.

Measurements with Danish BMZ and QHM instruments at the Pruhonice and
Ogyalla observatories and at the Budakeszi observatory in July 1953 reveal the
following differences in the magnetic elements: declination—Budakeszi-Pru-
honice, +1°32.6′; Budakeszi-Ogyalla, +0°14.7′; vertical intensity—Budakeszi-
Pruhonice, −979γ; Budakeszi-Ogyalla, −133γ; horizontal intensity—Budakeszi-
Pruhonice, +1,335γ; Budakeszi-Ogyalla, +153γ.—*D. B. V.*

MAGNETIC PROPERTIES

164–232.   Bronshteyn, K. G.   O magnitnoy vospriimchivosti osadochnykh porod
[Magnetic susceptibility of sedimentary rocks]: Prikladnaya geofiz.,
vypusk 11, p. 163–174, 1954.

The magnetic susceptibility of about 1,600 specimens of rocks of different
geologic age were determined with Kalashnikov's magnetometer [see Geophys.
Abs. 155–14833]. Each specimen was tested in fields of varying intensity rang-
ing from 150 to 1,500 oersteds. No general correlation between the magnetic
susceptibility and the chemical composition could be found. In more restricted
cases, correlations could be established, as, for example, for the crystalline rocks
of Ukraine where a correlation was found between the susceptibility and the
chemical component of the form $(Fe_2O_3/FeO)(Fe_2O_3+FeO)$. Several tables giv-
ing the results of measurements are included.—*S. T. V.*

164–233.   Kapitsa, S. P.   Magnitnyye svoystva izverzhennykh gornykh porod pri
mekhanicheskikh napryazheniyakh [Magnetic properties of eruptive
rocks exposed to mechanical stresses]: Akad. Nauk SSSR Izv. Ser.
geofiz., no. 6, p. 489–504, 1955.

The magnetic properties of feebly magnetic bodies were tested in a field of
0.5 oersted, frequency 130 cycles per second with the specimens exposed to me-
chanical stresses of varying intensity. The observed change of magnetic sus-
ceptibility K can be divided into two components, one reversible, the other ir-
reversible. The reversible decrease of K in the direction of the stress σ is a
fundamental property characterized by the relation

$$C=\frac{1}{k}\frac{\delta k}{\delta\sigma}.$$

Measurements on specimens with K perpendicular to σ show that K at first in-
creases, and then remains constant. These variations are small and can be
observed only with relatively small values of σ. The value of the C ranges from
0.8 to 1.3×10^{-4} cm² per kilogram.

The measurements of the energy losses produced by the reversal of magnetism
in feeble fields (<3 oersteds) confirm the validity of Rayleigh's rule, in other
words the magnetic susceptibility is linearly related to the amplitude of the
magnetic field. A new method of determination of the mechanical stress of a
formation can be developed using measurements of its magnetic susceptibility.—
S. T. V.

164–234. Doell, Richard R. Palaeomagnetic study of rocks from the Grand Canyon of the Colorado River : Nature, v. 176, no. 4494, p. 1167, 1955.

Magnetic declinations and inclinations of S. 34° E. and 8° in Supai rocks and S. 66° W. and 72° in Hakatai rocks were measured along the Bright Angel and Kaibab trails. The angular difference between these average directions and Runcorn's results [see Geophys. Abs. 163–46] is 19° in the Supai rocks and 7° in Hakatai rocks. No reversals of magnetization were noted.—*M. C. R.*

164–235. Yokoyama, Izumi. Geomagnetic anomalies related to the magnetization of the basalt in the vicinity of Gembudō : Tokyo Univ. Earthquake Research Inst. Bull., v. 32, pt. 3, p. 281–288, 1954.

A dip survey with a miniature earth inductor was made near Gembudō (a rocky cave about 110 km northwest of Kyōto) to study the relation between the geomagnetic anomalies and reverse natural remanent magnetization of the rocks observed by Matuyama. A negative anomaly in the southern part of the region is attributed to the anomalous magnetization, and it is suggested that the basalt welled up near the center of the anomalous area. Experiments at Tokyo show that the reverse magnetization is not due to self-reversal of thermoremanent magnetization, but its origin is not clear.—*M. C. R.*

164–236. Nagata, Takesi. Umgekehrte Magnetisierung eruptiver Gesteine [Reverse magnetization of eruptive rocks] : Naturw., Jahrg. 42, Heft 3, p. 62–64, 1955.

It has been shown experimentally that reverse thermoremanent magnetization in eruptive rocks is produced during cooling by reciprocal action between two different types of ferromagnetic minerals—titanomagnetite and ilmenite-hematite solid solutions. The direction of magnetization may be altered by subsequent oxidation and reduction.—*D. B. V.*

164–237. Wohlfarth, E. P. The remanent magnetization of hematite powders : Philos. Mag., v. 46, no. 382, p. 1155–1164, 1955.

The magnetization of hematite, αFe_2O_3, consists of two parts, one, an isotropic component having a saturation value of about 0.2 emu per unit mass, and another component which is zero below the Morin transition point, 250° to 260°K, but about 0.3 emu above this temperature. This latter component is anisotropic in the basal crystal plane and shows no magnetization along the trigonal axes in moderate fields at any temperature. It is assumed that the hysteretic properties of hematite arise solely from the anisotropic component of magnetization in the basal plane, the isotropic component in that plane being taken to be infinitely "soft" and the anisotropic component parallel to the trigonal axes infinitely "hard." Calculations are described of the remanent magnetization and the remanence after demagnetization as a function of field strength for powders of hematite, αFe_2O_3. The calculations are based on the assumption that the powder particles are single domains and that their hysteretic properties are due to magnetocrystalline anisotropy with threefold symmetry in the basal crystal plane. The calculations are intended for eventual comparison with experiments now in progress.—*J. R. B.*

MAGNETIC SURVEYS

164–238. Wickerham, W. E. Magnetic storm monitor: Mining Engineering, v. 7, no. 10, p. 966–968, 1955.

A magnetic storm monitor, using a fluxgate magnetometer element to detect changes in the earth's total magnetic field at a fixed location, has been developed by the Gulf Research and Development Co. for use in conjunction with airborne magnetometer surveys.—*L. C. P.*

164–239. Glicken, Milton. Uses and limitations of the airborne magnetic gradiometer: Mining Engineering, v. 7, no. 11, p. 1054–1056, 1955.

The airborne magnetic gradiometer, which records the first derivative of the magnetic field with respect to time (or to horizontal distance at constant speed), helps in the location and study of certain types of magnetic anomalies found in mining geology. It should not be used independently, but rather in conjunction with regular airborne magnetic studies.—*L. C. P.*

164–240. Zidarov, D. Elektromagnitnaya model' dlya resheniya pryamoy zadachi magnitometrii i gravimetrii [Electromagnetic model for the solution of the direct problem of magnetometry and gravimetry]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 464–467, 1955.

A model for the solution of the direct problem in gravimetry and magnetometry consists of a system of simple loops of metallic wire, similar in its contours and dimensions to sections made by parallel planes across the body in question. With the current properly adjusted according to a given formula, conditions can be created in which the voltage of the alternating current applied to the ends of the model is equal to a constant multiplied by the magnetic potential of the body. Measurements may also be made with the intensity of magnetization varying in different cross sections.—*S. T. V.*

164–241. Voskoboynikov, G. M. K voprosu ob opredelenii napravleniya namagnichennosti vozmuschchayushchikh tel po dannym magnitorazvedki [On the determination of the direction of the magnetization of disturbing bodies from the data obtained in magnetic exploration]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 483–485, 1955.

An error in Mikov's mathematical computations [see Geophys. Abs. 155–14839] makes his final formula invalid.—*S. T. V.*

164–242. McPharlin, D. Magnetic observations in the Middleback Range area: South Australia Dept. Mines Min. Rev., no. 98, p. 140–149, 1953 [1955].

Vertical magnetic surveys were made along traverses designed to intersect possible buried extensions of iron-bearing quartzite formations. Although much of the evidence was negative, the information has been of assistance in regional geologic mapping.—*M. C. R.*

164–243. McPharlin, D. The geology and iron ore resources of the Middleback Range area: Appendix 1, Magnetic observations in the Middleback Range area: South Australia Geol. Survey Bull., no. 33, p. 199–205, 1954.

Magnetometer surveys were made over soil-covered areas of low relief in the

Middleback Range area to trace subsurface extensions of the highly magnetic hematite quartzite and banded-iron formations.—*V. S. N.*

164–244. Bassompierre, Pierre, and Munck, Fernand. Découverte par prospection magnétique d'une couche de minerai de fer dans les schistes à Calymenes au S du granite de Flamanville (Manche) [Discovery by magnetic exploration of a bed of iron ore in the Calymenes schists south of the Flamanville granite (Manche)] : Soc. géol. France Comptes Rendus, no. 3, p. 32–34, 1955.

A detailed local magnetic survey followed the reconnaissance which revealed two narrow bands of strong anomalies (500–1,000 gammas) south of the Flamanville granite massif. A trench dug through the overburden perpendicular to the direction of the isogams showed the cause of the anomalies to be a black magnetite-rich bed whose iron content (46 percent) is of the same order as the ores of the same horizon exploited in Basse Normandie. Variations in magnetic intensity along the strike are attributed to differences in depth to the ore or in direction of remanent magnetization, rather than to interruptions of the bed or variations in ore content or thickness.—*D. B. V.*

164–245. Wolff, Wilhelm, and Hahn, Albrecht. Die magnetischen Anomalien im Hohen Venn [The magnetic anomalies in the Hohe Venn Mountains] : Geol. Jahrb., Band 69, p. 71–82, 1954.

The Hohe Venn region was surveyed by the Amt für Bodenforschung in 1951, including the area in the southern part previously surveyed by Reich in 1931. The 2–3 km spacing of regional network stations was reduced to 500 meters in the vicinity of the Lammersdorf anomaly, and two parallel profiles, 200 meters apart with stations at 50-meter intervals, were made across its strike. The agreement between old and new surveys was good, a mean difference of —8 gammas being considered insignificant.

The results indicate a large disturbing body 30–200 meters deep trending NE.-SW., but it is not clear whether this is due to the cumulative effect of several similarly magnetized metamorphic or sedimentary layers, or to pyrrhotite disseminated throughout the mass. As the source of the anomaly is not very deep, test borings are recommended to settle the question.—*D. B. V.*

164–246. Geographical Survey Institute. Second order magnetic survey of Japan : Geog. Survey Inst. Japan Bull., v. 4, pt. 1, p. 49–57, 1954.

A second-order magnetic survey "for the purpose of investigating local magnetic anomalies and of making more natural magnetic charts" was started in 1952 with a planned station distribution of 1 per 400 km². A G. S. I. second-order magnetometer designed by Tsubokawa is being used. In Hokkaido 181 second-order stations have been established for a total of 200 magnetic stations. Data have been reduced to 1952.5 using the Memambetsu records. Contour maps of declination, horizontal intensity, and dip are included. Irregularities in declination are more pronounced than those in horizontal intensity or dip.—*M. C. R.*

164–247. Mining Magazine. Ilmenite in Norway : Mining Mag., v. 93, no. 6, p. 361–362, 1955, and v. 94, no. 1, p. 41–42, 1956.

An aeromagnetic survey of 300 square miles in southwestern Norway was made in August and September 1954 by Hunting Geophysics. The maps were interpreted by J. M. Bruckshaw and J. A. W. Bugge and a followup ground magne-

tometer survey made.   On the first aeromagnetic anomaly drilled, a body of more than 100 million tons of ilmenite-magnetite ore assaying 17–18 percent titanium oxide and 20 percent iron was found.   An aeromagnetic map of the area is shown in the second part.—*M. C. R.*

164–248.   Andreyev, B. A.   Opredeleniye glubiny poverkhnosti kristallicheskogo fundamenta platformennykh oblastey po magnitnym anomaliyam [Determination of the depth of the upper surface of the crystalline bedrock in the (Russian) shield regions from magnetic anomalies] : Prikladnaya geofiz., vypusk 13, p. 80–98, 1955.

The author emphasizes the efficacy of gravitational and magnetic surveys in the investigations of the Russian shield.   Magnetic anomalies discovered in many regions of this shield characterize not only the geologic composition of its upper layer, but also indicate the depth and composition of the crystalline Precambrian basement.   This is explained by the fact that, as a rule, these anomalies are found over the places where the deeply seated, magnetically active masses come up to the surface of the basement or even protrude from it.

Magnetic anomalies make it possible to determine the approximate depth of this boundary surface, by methods previously discussed [see Geophys. Abs. 152–14239 and 157–5].   In such determinations it is necessary to have precise and sufficiently detailed data.   For instance, with the depth to the crystalline basement from 1,000 to 3,000 meters, the distance between stations must not be greater than 250 to 500 meters.   With these conditions fulfilled, the depth to the basement can be determined with an error not exceeding 15 percent.—*S. T. V.*

MICROSEISMS

164–249.   Savarenskiy, Ye F., Proskuryakova, T. A., and Tsirel'-Sprinstsson, V. S. O svyazi mezhdu mikroseymicheskimi kolebaniyami i polozheniyem tsiklonov nad okeanom [The correlation between microseismic vibrations and the position of cyclones over the ocean] : Meteorologiya i gidrologiya, no. 6, p. 13–18, 1955.

Work of Gilmore and Ramirez on microseisms is reviewed ; Galitzin in 1910 pointed out the possibility of predicting the approach of cyclones from observations of microseisms.   Similar observations have been made at tripartite stations in the Crimea and at Pulkovo Observatory near Leningrad.—*S. T. V.*

164–250.   Das Gupta, S[ushil] C[handra].   Note on microseisms produced on the surface of the earth due to storm in the deep sea : Naturw., Jahrg. 42, Heft 5, p. 119, 1955.

To explain the observation that the period of sea waves generating microseisms is about twice that of the microseisms produced, it is suggested that the storm constitutes a travelling disturbance that generates periodic waves at sea.   The compressibility of water is a possible reason for carrying the pressure from the surface to the sea bottom.—*D. B. V.*

164–251.   Kanai, Kiyoshi ; Tanaka, Teiji ; and Osada, Kaio.   Measurement of the micro-tremor. I : Tokyo Univ. Earthquake Research Inst. Bull., v. 32, pt. 2, p. 199–209, 1954.

Systematic measurements of microtremor (continuous vibration of the ground) have been made at several places in Tokyo.   Frequency curves of

their periods can be divided in three groups which correspond to different geologic conditions, a sharp peak for areas over very thin unconsolidated material, several peaks for areas where there is several meters of alluvium, and a flat curve where the alluvium is more than 25 meters thick. In some places there are differences between day and night records. In general the midnight curves are like those for periods of local earthquakes, and daytime curves those of distant earthquakes. The relation of displacement to period $D \propto T^{1.7}$, at least in the range of periods from 0.1 to 1.—*M. C. R.*

RADIOACTIVITY

164–252. Wasserburg, G. J., and Hayden, R. J. The branching ratio of K^{40}: Phys. Rev., v. 93, no. 3, p. 645, 1954.

Redetermination of the A^{40}/K^{40} ratio, by isotopic dilution technique, for a potassium feldspar yielded 75 percent more A^{40} per gram of sample and 17 percent more K than Russell and others reported for the same sample [see Geophys. Abs. 157–144]. Using this new A^{40}/K^{40} ratio and a branching ratio of 0.13, the age is calculated to be 7.0×10^8 yrs, which is closer to the lead age of 9.4×10^8 of a uraninite from the same locality. In view of the uncertainty as to the age of the mineral, 0.13 is probably a better value for the branching ratio than Russell's 0.06 [see also Geophys. Abs. 161–132 and 164–253].—*D. B. V.*

164–253. Shillibeer, H. A., Russell, R. D., Farquhar, R. M., and Jones, E. A. W. Radiogenic argon measurements: Phys. Rev., v. 94, no. 6, p. 1793–1794, 1954.

An improved method of argon extraction, using sodium hydroxide flux, on a microcline sample previously measured [see Geophys. Abs. 157–144] leads to a branching ratio of 0.090 for K^{40} instead of 0.006. This is in better agreement with the value of 0.88 which Wasserburg's measurements (see preceding abstract) yield when used with an age of 9.4×10^8 yrs.—*D. B. V.*

164–254. McNair, A., Glover, R. N., and Wilson, H. W. The decay of potassium 40: Philos. Mag., 8th ser., v. 1, no. 2, p. 199–211, 1956.

The branching ratio of K^{40}, defined as the ratio of gamma or electron capture to beta transitions, has been determined by two methods as 0.124 ± 0.002 and 0.121 ± 0.004. The half-life has been determined as $1.28 \pm 0.02 \times 10^9$ years. The energy of the K^{40} gamma ray has been confirmed as 1.46 ± 0.01 Mev [see also Geophys. Abs. 162–188].—*M. C. R.*

164–255. Curatolo, M., Palumbo, Donato, and Santangelo, M [ariano]. Contenuto di uranio e torio nelle meteoriti [Uranium and thorium content of meteorites]: Annali Geofisica, v. 8, no. 4, p. 371–378, 1955.

The thorium/uranium ratio in a stony meteorite (the "Chateau Renard" described by Dufreney) has been measured using a nuclear emulsion method. The ratio of 2.66 is not significantly different from the ratio in materials of the earth's crust.—*M. C. R.*

164–256. Aswathanarayana, U. Distribution of radioactivity in the rocks of South India: I—charnockites and associated rocks: Jour. Sci. Indus. Research (India), Sec. B, v. 13, no. 2, p. 87–92, 1954.

The radioactivity of charnockites and associated rocks from four areas in Madras State is closely related to the order of decreasing mafic content. The

marked contrast in radioactivity of the four groups of charnockites may reflect the nature of their petrogenesis; granitization increases the radioactive content appreciably. The results of the measurements are tabulated, giving the radioactivity in terms of equivalent uranium content in grams per gram of rock.— *D. B. V.*

164–257.   Mahadevan, C., and Aswathanarayana, U.   Radioactivity of sea floor sediments off east coast of India: Andhra Univ. Mem. in Oceanography, v. 1, p. 36–50, 1954.

The β-activity and equivalent uranium content of eight samples from off Viaskhapatnam and nine from the east coast from Madras to Gangetic Delta were determined. A zonal pattern of radioactivity is related to the composition of the sediments off the Visakhapatnam coast. High radioactivity near shore is attributed to monazite in the black sand concentrates along the coast. A second group of sediments from the submarine canyon zone of the Ganges and deltaic zones of Mahanadi, Gadavari, Kistna, and Pennar rivers showed that geologic formations and hydrographic conditions in the drainage basin of the rivers have a profound effect on the distribution of radioactivity.—*M. C. R.*

164–258.   Adams, J. A S. The uranium geochemistry of Lassen Volcanic National Park, California: Geochim. et Cosmochim. Acta, v. 8, no. 1/2, p. 74–85, 1955.

Fluorimetric uranium analyses of 38 samples from Lassen Volcanic National Park range from 0.86 to 3.6 parts per million, in excellent overall agreement with values calculated for 12 Lassen rocks by Evans and Williams in 1935 from radon concentration. Relative alpha-particle activities determined for the same samples by means of a scintillometer ranged from 8 to 51 counts per hour. One other specimen, from outside the park boundary, showed only 0.36 ppm of uranium and 2 alpha-counts per hour. A definite linear relation between potassium and uranium, confirming the relation between radium and potassium found by Evans and Williams is both a result and a proof of secular radioactive equilibrium between the thorium and uranium series in these rocks. During differentiation at Lassen, uranium, potassium, and probably thorium were concentrated in the residual magmas at almost the same rate; this can be explained by fractional crystallization. In mud-pot clays, the uranium was found to be present in small zircons.—*D. B. V.*

164–259.   Ford, I. H., and Oliver, C. D.   Radioactivity of zircons: Nature, v. 176, no. 4487, p. 834, 1955.

Zircons from a Triassic sandstone of the Bristol district, England, were embedded in nuclear emulsions and exposed for 20 days. By dividing the estimated total surface area of each grain by the total number of alpha tracks associated with it, four groups of zircons were distinguished with mean area emission ratios of 18, 40, 85, and 250. As uranium and thorium can substitute for zirconium in the zirconium silicate structure, and as zircon is one of the first minerals to crystallize, the specific activity of a zircon can be considered as a function of the uranium-thorium concentration in the magma. Zircon may therefore be used as a radioactive tracer, and because of its durability may be particularly useful in sedimentary petrology.—*M. C. R.*

164–260. Huntley, H. E. Radioactivity in quartz inclusions: Nature, v. 176, no. 4495, p. 1129–1230, 1955.

On a nuclear emulsion film left in contact with a quartz microscope slide for 6 months, alpha tracks were observed from cavities in the quartz. The longest has been identified as emitted by a thorium C (thallium[208]) nucleus.—*M. C. R.*

164–261. Rivière, André. Intérêt sédimentologique de la mesure des radio-activitiés naturelles [Sedimentological interest in the measurement of natural radioactivity] : Akad. Sci. Paris Comptes Rendus, tome 241, no. 15, p. 964–966, 1955.

Measurements of radioactivity along the beach from the rocks of St. Aygulf to the St. Raphael river, the shingle beach between Nice and Antibes, and the Gulf of Lyon have been used in studies of the origin and distribution of littoral sediments. In the last area it is noted that the processes which have resulted in the concentration of heavy minerals have also caused variations in the radio-active minerals, and the concentrations depend on complex phenomena rather than simply distance from source.—*M. C. R.*

164–262. Jurain, Georges. Radioactivité anormale dans le Trias supérieur des Vosges [Abnormal radioactivity in the Upper Triassic of the Vosges] : Acad. Sci. Paris Comptes Rendus, tome 241, no. 15, p. 975–977, 1955.

Measurements of the radioactivity of the middle Keuper show a concentration of uranium in the lignites clearly higher than average. The concentration of uranium is believed to be the result of a biogeochemical process. The possibility of absolute age determinations is suggested.—*M. C. R.*

164–263. Dutt, Amitava. Quelques observations sur la mobilité et la diffusion du potassium au cours du métamorphisme [Some observations on the mobility and diffusion of potassium during metamorphism] : Soc. géol. France Bull., tome 5, fasc. 4–6, p. 279–286, 1955 [1956].

Radioactive K^{40} has been used in a petrographic study of the migration and diffusion of potassium during metamorphism, in rocks of the Mount Sorrel district, Leicestershire, England. As the K^{40}/K ratio is constant, the total potassium content can be determined from radioactivity measurement of a sample of rock. The method used was to surround a Geiger tube to a constant height with 20 g of perfectly fresh rock ground to −60 mesh. Secondary minerals containing other radioactive elements were at first eliminated from the samples by gravimetric procedures, but it was later found desirable to choose rocks free of such minerals.—*D. B. V.*

164–264. Guigue, Simone. Radioactivité des sources thermales de l'Algérie [Radioactivity of the hot springs of Algeria] : Annales Inst. Hy-drologie et Climatologie, tome 23, no. 73, p. 93–113, 1952.

The radon content of specimens of water from 50 hot springs of Algeria has been measured, and in 7 of them found to be as much as 35×10^{-9} curie per liter of water. In general, Algerian hot springs were found to be more radioactive than those in France.—*S. T. V.*

164–265. Kikkawa, Kyōzō. Study on radioactive springs: Japanese Jour. Geophysics, v. 1, no. 1, p. 1–25, 1954.

Amounts of discharge, temperature, chlorine, and radon contents of Zuihōzi spring in Arima were measured daily from December 1949 to January 1953. Rainfall increases the radon content, but mixture with ground water at shallow depths during and after rainfall decreases the amount, so there is a complicated relationship. Highest radon contents are associated with cold as well as wet ground. A simple model with a horizontally infinite source of radon beneath the ground surface from which radon diffuses in only one dimension is assumed and equations solved for the steady state, when radon is exhaled freely from the ground surface, and when the surface is closed so perfectly that radon is not exhaled, and the nonsteady state, when exhalation is suddenly controlled (corresponding to the beginning of snow, freezing, or rain). Characteristics of the actual states are approximated by the models.—*M. C. R.*

164–266. Pohl, Egon, and Pohl-Rüling, Johanna. Radioaktive Luftmessungen im Raum von Badgastein und Böckstein [Radioactive measurements of the air in Badgastein and Böckstein]: Österreich. Akad. Wiss. Sitzungsber., Abt. 2, Band 163, Heft 5–7, p. 147–165, 1954.

In 1949–50 about 150 measurements were made by Pohl and Pohl-Rüling of the radon in the atmosphere at the health resort of Badgastein and Böckstein. Samples were collected in rubber bags of 15-liter volume and radioactivity measured in laboratory with an emanometer. The greatest radon content found was about 11×10^{-9} curie per liter.—*S. T. V.*

164–267. Reiter, Reinhold. Der Emanationsgehalt der Luft in den nördlichen Kalkalpen in Abhängigkeit von atmosphärischen Schichtung und Windrichtung [The emanation content of the air in the northern Bavarian Alps in relation to stratification of the atmosphere and wind direction]: Naturw., Jahrg. 42, Heft 23, p. 622–623, 1955.

According to measurements carried on from mid-August to late September, 1955, the emanation content of the air on the Zugspitzplatte (2,580 meters above sea level) showed a notable increase during temperature inversions. Under such conditions, 530 counts per minute were counted, in contrast to 335 counts per minute for thoroughly mixed air. Furthermore, the emanation content varied appreciably with wind direction. Winds with a southerly component, coming from an area of primitive rocks, contained 4.3 times as much radon as those from the northern quadrants; in one instance the radon content, during a southeasterly wind, increased by a factor of 7.3.—*D. B. V.*

164–268. Pohl-Rüling, Johanna, and Pohl, Egon. Neue Bestimmungen des Radium- und Radongehaltes einiger Austritte der Gasteiner Therme [New determinations of the radium and radon content of some outlets of the Gastein hot springs]: Österreich. Akad. Wiss. Sitzungsber., Abt. 2, Band 163, Heft 5–7, p. 173–177, 1954.

The radium content of many samples of water from the Gastein hot springs was determined using Pohl's emanometer, first calibrated by comparison with a standard condenser of Clay. The radon content was determined with an error of about ±2 percent, but the error in radium content was about ±20 percent. The values were scattered, the greatest being 0.36×10^{-7} milligrams radium per liter in some outlets.—*S. T. V.*

164–269. Muchemblé, Georgette. Observations sur les eaux souterraines radioactives du nord de la France et la radioactivité des roches encaissantes [Notes on radioactive underground waters of northern France and the radioactivity of the enclosing rocks] : Annales Inst. hydrologie et climatologie, tome 23, no. 72, p. 29–64, 1952.

The radon and radium content of several sources of mineral waters of northern France and of geologic formations containing them were determined by Lepape's method. The greatest radium content, 230×10^{-12} g per liter of water, was found in fossil chlorine water of the Bruay region; a much lower radium content was found in the rocks. The most radioactive substances are concluded to be the fossiliferous marine deposits, rich in organic detritus.—*S. T. V.*

RADIOACTIVITY LOGGING AND SURVEYING

164–270. Kantor, S. A. Osnovy teorii neytronnogo karotazha [The foundations of the theory of neutron logging] : Prikladnaya geofiz., vypusk 13, p. 3–22, 1955.

A theory of neutron logging is developed on the basis of the physical laws of radioactive diffusion of neutrons in different media. In summary it is concluded that the density of thermal neutrons and of the secondary gamma radiation in a layer containing hydrogen is primarily determined by the retardation of the neutrons and to a lesser degree by the process of diffusion of the thermal neutrons; the relation between the density of thermal neutrons and the distance between the source and the indicator can be approximately expressed by an exponential law; the intensity of the secondary gamma radiation also varies according to an exponential law; and the distribution of neutrons and the intensity of the secondary gamma radiation are both affected by the chemical composition of the rocks.—*S. T. V.*

164–271. Edwards, J. M., and Simpson, A. L. A method for neutron derived porosity determination for thin beds: Am. Inst. Min. Metall. Engineers Trans., v. 204, Jour. Petroleum Technology, v. 7, no. 8, p. 132–136, 1955.

When neutron logs measured with a Geiger-tube system are used for the determination of porosity, such determinations are restricted to thick beds by the length of the Geiger tube and by the fact that the time constant of the recording equipment prevents the maximum value of radioactivity from being recorded as the tube passes a thin bed. When a scintillation counting system is used, the first of these difficulties is eliminated because a detection system only a few inches in length may be used. Curves for the correction of deflections opposite thin formations for the time constant of the recording equipment are given.— *G. V. K.*

164–272. Knapman, W. H. Radiometric borehole logging in the Kadina district: South Australia Dept. Mines Min. Rev., no. 98, p. 150–157, 1953 [1955].

Four holes were logged, two located on radioactivity anomalies. No definite copper lodes were intersected, but mineralized zones had a higher-than-normal activity. Differentiation among rock types was possible on the basis of radioactivity.—*M. C. R.*

164–273.   Herzog, G[erhard].   Geophysical prospecting by the use of radio-activity surveying : Mines Mag., v. 46, no. 1, p. 25–28, 1956.

Radioactivity surveys conducted on foot revealed that known faults could be located by that method with reproducible results.   These earlier investigations were followed by carborne and airborne radioactivity studies.   Both multiple-cathode and scintillation counters were used.   It was found that radioactive ore deposits buried beneath the surface apparently cause radiation anomalies detectable at the surface.   In the airborne work favorable results were obtained at flight elevations between 75 and 800 feet with some of the best results at about 150 feet.

Radioactivity surveying has been useful not only in prospecting for radioactive ore deposits, but also in prospecting for base metal deposits and in geologic studies.   Faults, sedimentary-igneous contacts, and other geologic features are often revealed by radiation anomalies.—*L. C. P.*

SEISMIC EXPLORATION

164–274.   Slutskovskiy, A. I.   Ob avtomaticheskom regulirovanii usileniya v seysmicheskikh usilitelyakh [The automatic amplified gain control in seismic amplifiers] : Prikladnaya geofiz., vypusk 12, p. 210–216, 1955.

This is a brief discussion of the theory of automatic gain control.—*S. T. V.*

164–275.   Stegena, Lajos, and Járányi, Istvan.   Horizontális torziós szeizmom-éter [Horizontal torsion seismometer] : Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 4, szám 1, p. 63–66, 1955.

The torsion seismometer previously described [see Geophys. Abs. 156–77] can be changed easily to a horizontal seismometer if the need arises, without practical effect on the constant.   The same instrument can thus be used to register all three components.—*D. B. V.*

164–276.   Gurvich, I. I.   Vibratsionnaya platforma dlya issledovaniya seysmo-priyemnikov [Shaking table for testing seismometers] : Prikladnaya geofiz., vypusk 11, p. 142–151, 1954.

A shaking table constructed for the calibration of seismometers consists of an elastically suspended platform to which two electrodynamic seismometers are rigidly attached.   One seismometer serves to measure the displacements of the platform and receives electric impulses of varying frequency and intensity and is the source of the vibrations of the table.   The movable element of this seismometer must have a mass only a few percent of the combined mass of the table and of the fixed elements of both seismometers.   The displacement of the table can also be measured by independent optical or electromechanical instruments.   The calibration of the seismometers usually consists of determination of the frequency characteristic, an operation which can be done with great precision on this shaking table.   The table is similar to one designed by Pasechnik.—*S. T. V.*

164-277. Gálfi, János, and Liptay, István. Nyomásmérö szeizmikus kutátasi célokra [Pressure gage for seismic investigation purposes] : Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 3, szám 10, p. 148-156, 1954.

A device for measuring pressure waves from subsurface or surface explosions consists of an elastic plate, the deformations of which are transformed into electric signals. These signals can be registered on an oscillograph by means of an indicator based on inductance changes, so that the signal movement measured is directly proportional to the effective pressure. Operation of the device is illustrated by two examples, of air shooting and shothole fatigue.—*D. B. V.*

164-278. Groshevoy, G. V., and Kopylov, V. P. Malogabaritnyy zerkal'nyy gal'vanometr vysokoy chuvstvitel'nosti [A reflex galvanometer of small dimensions and high sensitivity] : Akad. Nauk SSSR Geofiz. Inst. Trudy no. 29(156), p. 73-77, 1955.

To satisfy the needs of seismologists, a galvanometer of very small dimensions was designed and constructed in the workshops of the Geophysical Institute, adapted to difficult conditions of transportation in many regions of the U. S. S. R., and at the same time of high sensitivity. In design, the instrument is not much different from other galvanometers, except that it is provided with very reliable locking device. A description is given of the instrument with several diagrams illustrating the details of the construction. The sensitivity of the galvanometer was measured as 8.8×10^{-9} amperes per mm.—*S. T. V.*

164-279. Keller, George V. Dispersion of seismic waves near a small explosion : Am. Geophys. Union Trans., v. 36, no. 6, p. 1035-1043, 1955.

The characteristics of the ground vibrations caused by the detonation of small dynamite charges were studied at distances from ten to 3,070 ft from the point of detonation. The motion which was observed could be separated into several types on the basis of velocity and particle motion paths. The major part of the recorded motion following the arrival of body waves exhibited strong dispersion. A comparison of this dispersion with that theoretically predicted for Rayleigh waves by Love, Sezawa, and others, showed that these motions are probably Rayleigh waves of the first and second types. The complex particle motion orbits observed near the shot point are probably a result of the overlap of these two normal modes of surface wave propagation.—*Author's abstract*

164-280. Slutskovskiy, A. I. Po povodu stat'i A. M. Yepinat'yevoy "Povtornyye udaru pri seysmicheskikh nablyudeniyakh" [On A. M. Yepinat'yeva's paper "Secondary pressure-bubble pulses in seismic exploration"] : Prikladnaya geofiz., vypusk 10, p. 109-113, 1953.

The theoretical analysis of secondary pressure-bubble pulses by Yepinat'yeva [see Geophys. Abs. 147-13222] was based on the assumption that the duration of the first explosion is always shorter than that of the secondary pulses and that the pressure produced by this explosion grows exponentially. These assumptions were based on experiments in reservoirs of relatively limited dimensions. However, Slutskovskiy during 1950 participated in a long series of experiments on the frequency spectrum of the first explosion and the following "seismic reverberation" in the conditions of the open sea. Frequency spectra

of the explosions obtained with a 24-channel receiver show that Yepinat'yeva's assumptions were wrong.—*S. T. V.*

164–281. Muir, F., and Hales, F. W. A rational approach to the design of electrical filters and of shot-hole and geophone patterns in seismic reflection prospecting: Geophys. Prosp., v. 3, no. 4, p. 350–358, 1955.

An optimum filtering theory for reflection recording is presented. A set of wavelets superimposed on a random noise background is assumed, and on that basis optimum filter characteristics for electrical filters and geophone and shothole patterns are developed. The patterns which result in the best signal consist of shot or detector elements on concentric circles of constantly increasing radii, each circle containing an equal number of elements and the outermost having a diameter of $V/2f$, where V is the lowest average velocity to a reflector and f is the peak frequency of this reflection. The random noise is minimized in a pattern of n-rings by having $2n+1$ elements in each ring and by radially offsetting every other ring.—*W. H. D.*

164–282. Posgay, Károly, and Erös, János. Rengéshullámok terjedési sebességének meghatározása felszínközeli rétegekben [Determination of seismic wave velocities in near-surface layers (with English and Russian summaries)]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 3, szám 7, p. 99–105, 1954.

This describes a procedure for determining velocity in near-surface layers with a seismic field instrument, using four closely spaced boreholes.—*D. B. V.*

164–283. Posgay, Károly. Erősen tagolt, töréses szerkezeteken végzett reflexiós szeizmikus mérések középhibája [Mean error of seismic reflection measurements in the case of intensely jointed fault structures (with English and Russian summaries)]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 4, szám 1, p. 15–23, 1955.

This is a discussion of rapid methods of approximation suitable for determination of the mean error of arrival time, mean velocity, and mean horizontal coordinate of the image point in seismic reflection investigations of strongly jointed fault structures.   In 1954 in the vicinity of Dorog, the following mean errors were found: in time of arrival, $\mu_t=1.8$ milliseconds; in velocity, 0.2 meters per milliseconds; and in image point, 45 meters. Data and graphs are presented which are of practical importance not only in interpretation of the Dorog measurements but in planning, execution, evaluation, and interpretation of other reflection measurements and also in examination of disturbing phenomena.—*D. B. V.*

164–284. Krouskij, L. Auftragung eines einzelnen Reflexionselementes durch Kreisbogen [Diagramming of a single reflection element by means of arcs]: Erdöl u. Kohle, Jahrg. 8, Heft 5, p. 293, 1955.

This describes a modification of a common trigonometric method of determining depth to a reflecting horizon, applicable to the case of a single reflecting layer. The method is based on the calculation of radii of circles tangent to the layer at the end points of the spread as well as at shot point.—*D. B. V.*

164–285. Brauch, Wolfgang. Die Lotzeitkurve in der Reflexionsseismik [The perpendicular-time curve in seismic reflection] : Erdöl u. Kohle, Jahrg. 8, Heft 4, p. 231–234, 1955.

The German term "Lotzeit" ("perpendicular-time") corresponds to the English "shot-point travel time." A "perpendicular-time profile" comprises a group of "perpendicular time curves" from different reflecting layers. This paper gives several examples of the mathematical relation between the shape of the perpendicular-time curve and the "Untergrundskurve" (the curve of intersections between the boundary layer and plane of the profile). Three cases are considered : where both the "Untergrundskurve" and the wave front are straight, where the former is curved but the latter straight, and where the former is straight but the latter curved. Determination of velocity from the perpendicular-time curve is shown to be possible in the two latter cases under favorable geologic conditions. Calculation of theoretical error shows that this method of velocity determination is limited in practice to cases where dip is less than 25° and the distance from shot point to geophone less than 2,000 meters.—*D. B. V.*

164–286. Korschunov, A. On surface waves in loose materials of the soil: Geophys. Prosp., v. 3, no. 4, p. 359–379, 1955.

A method of observing the effects of hammering and of small blasts has been applied in a series of experiments on various soils, using a three-component set of small mechanical leaf-spring seismographs. The seismograms were subjected to harmonic analysis. The experiments confirm the theoretical concept of Rayleigh waves generated in a layer overlying a semi-infinite medium. The dispersion curves resulting from different experiments correspond well with theoretical dispersion curves. A method of determining the absorption of surface waves is discussed.

It may be concluded that every seismic pulse generates a specific Rayleigh wave mechanism in loose layers and that most of the delivered energy is transformed into surface waves. The depth of penetration of the Rayleigh wave mechanism and its frequency spectrum depend upon the delivery of energy and upon the consistency of the particular soil.

Practical implications regarding refraction surveying are mentioned.—*W. H. D.*

164–287. Favre, B. Détermination de la position dans l'espace d'un miroir situé sous un réfracteur séparant deux milieux de vitesses différentes, à partir des données d'un tir en croix isolé. [Determination of the position in space of a reflector underneath a refracting interface separating two media of different velocity, from the information derived from a shot at a single cross spread] : Geophys. Prosp., v. 3, no. 4, p. 339–349, 1955.

Graphical, analytical, and combination solutions are presented for the problem of determining from dip-shooting data the position of a reflector underneath a refracting interface separating two media of different velocity. Favre proposes a combination of graphical and analytical solutions to obtain the quickest result.—*W. H. D.*

164–288. Hagedoorn, J. G. Templates for fitting smooth velocity functions to seismic refraction and reflection data : Geophys. Prosp., v. 3, no. 4, p. 325–358, 1955.

Velocity functions can be grouped into families, any one of which results in seismic pictures differing among themselves only in their scales of time and dis-

tance but similar in all other respects. For any one of these families it follows that curves drawn on logarithmic scales of time and distance to represent a particular relationship between seismic quantities will be similar in shape. This leads to the use of templates with logarithmic scales for fitting a smooth velocity function to a set of seismic data. Suitable templates for fitting refraction and reflection data to velocity distributions linear with either depth or vertical time are presented. An insight into the uncertainties involved is obtained with the aid of numerical examples.—*Author's abstract*

164–289. Gaither, V. U. Index of wells shot for velocity—fourth supplement: Geophysics, v. 21, no. 1, p. 156–178, 1956.

Information is listed on 1,072 well velocity surveys hitherto unreported. Most of these are new surveys made since July 1952 and include those made in 1953, 1954, and a few in 1955.—*M. C. R.*

164–290. Denton, E. R. The continuous velocity log in Canada: Canadian Oil and Gas Industries, v. 8, no. 12, p. 43–45, 1955.

Denton describes the use of the continuous velocity log as a correlation tool in the Central Alberta Plain area. The log has been used for obtaining interval-velocity data to assist in interpretation of seismic reflection surveys. Comparison of logs from wells in the same area indicate that the method can be useful in studying lithologic changes.—*V. S. N.*

164–291. Seelis, Karl-Heinz. Seismische Geschwindigkeiten im Kalibecken des Oberelsass [Seismic velocities in the Upper Alsace potash basin]: Erdöl u. Kohle, Jahrg. 8, Heft 9, p. 610–615, 1955.

In order to clarify problems unsolved by previous well shooting, velocity measurements were made in several potash mines in Upper Alsace in shafts extending down as far as the potash horizon in the Upper Salt Zone. Because the geology was well known, zones free of disturbance could be chosen. From this information on the velocity distribution in the various formations of the basin (including the effect of changes in thickness and depth, and of salt content in the Sannoisian), working values of velocities were established which are valid for the basin from Ensisheim to Mülhausen and possibly farther to the north and south, and from the Vosges border to the Rhine in an east-west direction.—*D. B. V.*

164–292. Hiller, Heinz, and Ruprecht, Leo. Seismische Untersuchungen im Steinkohlenbergbau [Seismic investigations in coal mining]: Glückauf, Jahrg. 91, Heft 37–38, p. 1039–1045, 1955.

Seismic methods are used more than other geophysical methods in coal operations, where their value is so great that contacts and structures can be mapped to depths that will not be mined until well in the future. Practical examples of the application of seismic methods are presented in some detail, involving the Wealden of Barsinghausen and the Carboniferous of the Ruhr.—*D. B. V.*

164–293. Reich, H[ermann]. Feststellung über diluviale Bewegungen am Nordrand der bayrischen Alpen auf Grund seismischer Untersuchungen [Determination of Quaternary movements on the northern border of the Bavarian Alps on the basis of seismic investigations]: Geol. Rundschau, Band 43, Heft 1, p. 158–168, 1955.

Seismic investigations indicated an unusual amount of Pleistocene burial (as much as 300 meters or more). In a narrow strip parallel to the Alpine border,

astonishing velocities of 2,600 to 2,900 meters per second were found in glacial deposits. The consolidation indicated by this high velocity is attributed to the action of orogenic processes in addition to uplift and subsidence; that these processes are still operating is attested by the earthquakes and tremors of the northern Bavarian Alps.—*D. B. V.*

165–294. Bortfeld, Reinhard. Über Oberflächenwellen im Raume Minden-Steinhuder Meer [On surface waves in the Minden-Steinhuder Meer area]: Erdöl u. Kohle, Jahrg. 8, no. 12, p. 857–861, 1955.

Seismic reflection seismograms in many parts of the Minden-Rehburg concession, between Minden and the Steinhuder Meer, are complicated by surface waves. These waves, apparently of Rayleigh type, usually appear wherever clay shale is overlain by a minimum of 5 meters of Quaternary sediments. A linear arrangement is proposed, involving 6 simultaneous shots and 18 geophones, which reduces the distortion by surface waves by at least 4 percent.—*D. B. V.*

164–295. Ádám, Oszkár. Egyes DNy-Dunántúli területek némaságának okai [Causes of nonreflection of some southwestern Transdanubian areas]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 4, szám 1, p. 3–10, 1955.

Determination of the signal-to-noise ratio indicates that the nonreflecting zones in some southwestern Transdanubian areas are due to absorption by thick near-surface strata.—*D. B. V.*

164–296. Szénás, György, and Geresben, László. Szeizmikus refrakciós mérések alkalmazása a bauxitkutatásban [Application of seismic refraction measurements to bauxite exploration]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 4, szám 1, p. 67–74, 1955.

The refraction method is suitable for investigation of the bauxite deposits in karst terrain of Hungary, because there is a substantial unconformity, with resulting strong velocity contrast, between basement and cover. Torsion-balance data for the area can be interpreted in the light of the seismic survey results.—*D. B. V.*

164–297. Lányi, János. Gépjárművek által okozott útrezgések mérése szeizmikus mérőeszközökkel [Measurements of road vibrations due to motor vehicles by means of seismic instruments (with English and Russian summaries)]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 3, szám 8, p. 107–119, 1954.

This presents the results of the first seismic measurements of road vibrations to be carried out in Hungary. Instruments, methods, and interpretation are discussed, and data on amplitude, velocity, acceleration, force, and work performed are tabulated.—*D. B. V.*

164–298. Kailasam, L. N. Thickness of the Gangetic alluvium near Calcutta as deduced from seismic reflection measurements: Current Sci. (India), v. 23, no. 4, 113–114, 1954.

Seismic reflection measurements were made in the Sodepur-Madhyamgram area near Calcutta to test the feasibility of the method in this region and to

study the seismic characteristics of the area.   Using the continuous-profiling method with a split-spread arrangement and shallow (10–16 feet) shotholes, six well-defined reflections were generally obtained.   The character and thickness of the alluvium along the two profiles are described.   The area seems to be well suited for the use of the reflection method.—*D. B. V.*

164–299.   Barenboym, M. I.   O registratsii podsolevykh gorizontov [The recording of subsalt horizons] : Prikladnaya geofiz., vypusk 10, p. 97–102, 1953.

In seismic surveys of the region of the southern Emba River, where profiles were as much as 33 km long with geophone spacing of only 25 meters, records were obtained in several places with clear evidence of subsalt strata in which the velocity was estimated to be more than 4,500 meters per second.   These layers were at depths of 5.0 to 5.8 km in some places, 6.3 to 6.6 km in others, and between 7.2 to 7.6 km deep in one place.   Shots were made with only 1–2 kilograms of explosives in drill holes 16 to 18 meters deep.—*S. T. V.*

STRENGTH AND PLASTICITY

164–300.   Riznichenko, Yu V., and Myachkin, V. I.   Impul'snyy seysmicheskiy metod izucheniya gornogo davleniya [The seismic impulse method in the investigation of rock pressure] :   Akad. Nauk SSSR Doklady, tom 102, no. 3, p. 507–509, 1955.

In mines where rock bursts occur it is very important to know the pressure under which the walls and the supporting columns of mining galleries stand. The best method of determining this pressure is by measuring the seismic velocity using the ultrasonic method.   In the experiments described a special seismoscope was used, and the stress in the supporting columns was measured during the mining process.   A correlation was found between the stress and the seismic velocity in the rock.   The velocity regularly increased with pressure until a point near the destruction of the specimen was reached, where it sharply decreased owing, probably, to the formation of microscopic cracks.—*S. T. V.*

164–301.   Riznichenko, Yu. V.   Seysmoakusticheskiye metody izucheniya napryazhennogo sostoyaniya gornykh porod [Seismoacoustic methods of studying the stressed conditions of rocks] :   Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 538–540, 1955.

The velocity and amplitudes of elastic waves under varying stress conditions were experimentally determined in the coal mines of Donets and the Urals during 1953–54.   Two methods were used : seismic impulses of known frequency were sent through the columns of mine galleries and their velocity measured; or the velocity propagation of acoustic waves produced by cracking of the formations or by hammer blows was determined.   It was found that with increasing mechanical stress both the velocity of propagation and the amplitude at first increase, but shortly before the limit of the destruction is reached the velocity sharply decreases.   This is often followed by abrupt destruction of the rocks, similar to rock bursts.—*S. T. V.*

164–302. Sabatier, Germain, and Saucier, Henry. Quelques expériences sur la déformation de roches éruptives acides à haute température [Some experiences with the deformation of acid eruptive rocks at high temperature] : Acad. Sci. Paris Comptes Rendus, tome 241, no. 17, p. 1145–1147, 1955.

A cube of side a with equal compression P acting on two opposing faces will be deformed into a prism of height h at the end of time t. By plotting $\log_{10} (a/h—1)$ as ordinates and $\log_{10} Pt/3$ as abscissas, a straight line of unit slope is obtained. The viscosity may be obtained from the graph as the abscissa of the point where the ordinate is 0. For obsidian from Erivan the viscosity was thus determined as 2.6×10^{10} poises at 904°C and 5.2×10^{9} at 979°C. Experimental data on a semicrystalline paste of trachyte at 1,060°C resulted in a series of straight lines but of different slopes. The deformation is thus not purely viscous. The "apparent viscosity" changes from 3.3×10^{12} to 2×10^{12} poises as pressure varies from 4.7 to 26 bars. The slope of the line representing the measurements tends toward unity at the higher pressures.—*M. C. R.*

VOLCANOLOGY

164–303. Binge, Hans-Jost. Vulkanismus und Intrusionen als Folge der Zeitabhängigkeit von x in der Jordanschen Kosmologie [Volcanism and intrusions as a result of the dependence of x on time in Jordan's cosmology] : Zeitschr. Naturforschung, Band 10a, Heft 11, p. 900, 1955.

According to Jordan's theory, the configuration of the Earth, Moon, and Mars can be explained by expansion due to gradual decrease of the gravitational constant (x), and hence of compression. Binge attempts to show by means of formulas that the ascent of magma is a logical result of this decompression. Volcanic periods result whenever the critical state is attained which allows matter in the interior to transform from a high-pressure to a low-pressure phase. Migration toward the surface follows during which part of the material may reach the surface through expansion cracks in the shell, and the rest forms intrusions.—*D. B. V.*

164–304. Reich, Hermann, and Horrix, Wilhelm. Geophysikalische Untersuchungen im Ries und Vorries und deren geologische Deutung [Geophysical investigations of the Ries and its environs and their geological interpretation] : Geol. Jahrb. Beihefte, Heft 19, 119 p., 1955.

Results of seismic and magnetic investigations, which are presented in some detail, lead to the conclusion that the Ries structure near Nördlingen in southern Germany is a caldera.

The seismic measurements show a central, horizontally floored depression, 8 km wide and 700 km deep, filled with 250 to 300 meters of lake deposits. This is walled by a ring of crystalline rocks, in part shattered, 1 to 1.5 km wide. Positive magnetic anomalies are due to the abnormally magnetized Tertiary basalt intrusions which form ring dikes in the large inner Ries caldera, in the smaller satellite Baldingen crater, and the Wornitzöstheim chimney; and to the normally magnetized old crystalline rocks.

A comparison of various ring structures of explosive origin shows that there are four phases of development, all of which are recognized in the Ries through

the geophysical surveys. The first phase is uparching due to magma or gas pressure, which was the basis of the "Riesberg" hypothesis offered by Branco and Fraas ; second is the explosion proper (Kranz' central explosion theory) ; third, intrusion of magma (or mud) into ring fractures in the walls; fourth, subsidence of the core. Theories involving orogenic forces are ruled out by the fact that the seismic velocities in both crystalline rocks and cover formations are lower than normal rather than higher. Seidl's fracture theory and meteorite-impact theories are also incompatible with the geophysical evidence.—*D. B. V.*

164–305.   Escher, B. G.   Three caldera-shaped accidents: volcanic calderas, meteoric scars, and lunar cirques: Bull. volcanolog., sér. 2, tome 16, p. 55–70, 1955.

The geomorphic features of calderas and meteorite scars on earth are discussed in detail and compared with the craters of the moon. The lunar cirques are nearly all circular and never elliptical. Without exception where they intersect, the smallest cirque is entire, the rim of the middlemost being interrupted by the smallest, the biggest by the middlemost. These phenomena, together with the evidence of multiple concentric rims, order of magnitude, and alinement of lunar craters in straight chains, all suggest a volcanic origin for the craters of the moon rather than meteor impacts.—*D. B. V.*

164–306.   Malz, H.   Beobachtungen an nichtvulkanischen Schlammkegeln [Observations of nonvolcanic mud cones] : Natur u. Volk, Band 84, Heft 4, p. 101–107, 1955.

A description of some mud craters and cones resulting from eruption of gas from an oil boring in northwest Germany. Their development illustrates, in a brief time and space, phenomena comparable to those of true volcanic processes [see also Geophys. Abs. 163–179].—*D. B. V.*

164–307.   Weyl, Richard.   Glutwolken, Gluttuffe und Schmelztuffe [Glowing clouds, glowing tuffs, and welded tuffs] : Natur u. Volk, Band 84, Heft 8, p. 275–282, 1954.

This is a description of peléean eruptions and the resulting deposits, including estimated amounts of such material erupted in New Zealand, Sumatra, El Salvador, and Idaho, and petrography of typical welded tuffs.—*D. B. V.*

164–308.   Bullard, Fred M.   Volcanic activity in Costa Rica and Nicaragua in 1954 : Am. Geophys. Union Trans., v. 37, no. 1, p. 75–82, 1956.

The volcanic activity in Costa Rica in 1954 was limited chiefly to Irazú and Poás volcanoes, although fumarolic activity was reported at Rincon de la Vieja. The activity of Irazú is entirely fumarolic and of about the same intensity as in previous years. Volcano Poás, which has maintained a geyser-like activity from a lake which filled the bottom of the active crater for many years, began a new eruption in March or April, 1953. This, which appears to be a major eruption, is continuing with a large gas column frequently visible from San José and some fresh ash, cinders, and scoria on the upper slopes of the active cone. The volcanic activity in Nicaragua was limited to the following vents : Concepción has been in a mild state of activity since 1948. The explosions, which sent out a cloud of gas, occur at intervals of about 30 minutes. Santiago, which has been in a vigorous state of fumarolic activity since 1947, is continuing with some increase in the volume of gas and a corresponding increase in the area in which

vegetation is being damaged. Momotombo exhibited fumarolic activity at the summit crater in about the same intensity as in previous years. Las Pilas began fumarolic activity in October, 1952, which has increased steadily in volume. The activity is localized along a fracture near the summit. Cerro Negro contains some active fumaroles in the summit crater. Telica has vigorous fumarolic activity in the summit crater in about the same intensity 'as in previous years. El Viejo is reported to have some fumaroles in the crater but none were observed in a flight over it in a small plane.—*Author's abstract*

164–309. McBirney, Alexander R. The Nicaraguan volcano Masaya and its caldera : Am. Geophys. Union Trans., v. 37, no. 1, p. 83–96, 1956.

The Masaya Caldera and its included vents offer the volcanologist unusual opportunities for study. The caldera, which measures 11.2 by 6.0 km, is of the Hawaiian type and contains eleven recently active vents. The Masaya-Nindiri group of vents have been the most active in historic times and descriptive accounts of them go back to 1529. A sympathetic relationship between at least four or five volcanoes in the Nicaraguan chain is indicated by coincidence of eruptions. Cyclic activity in these volcanoes is strongly suggested by records of eruptions during the 19th and 20th centuries and may be substantiated by further data. The Masaya rocks are augite-olivine basalts of uniform composition. Attempts to control the emission of gases which have devastated a valuable coffee-producing region have proved futile but have provided new insights into the structure and behavior of the volcano.—*Author's abstract*

164–310. Banfield, A. F., Behre, Chas. H., Jr., and St. Clair, David. Geology of Isabela (Albemarle) Island, Archipelago de Colon (Galapagos) : Geol. Soc. America Bull., v. 67, no. 2, p. 215–234, 1956.

Several of the five craters and shield volcanoes which constitute Isabela, the largest of the Galapagos Islands have erupted during this century. This geologic study includes descriptions of the volcanic features, recent eruptive history, rift patterns, and active solfataras. Darwin's concept that the main crater lines are twofold (ENE.–WSW. and NNW.–SSE.) is fully supported, and the further suggestion is made that the deeper vents are controlled by fissure intersections. The sulfur deposits are associated with breaching of cones and with vents emitting steam, hydrogen sulfide, and sulfur dioxide. The general relations of the volcanoes and relative newness of the western ones suggest that the Archipelago is being extended westward along the southwestward rift line; available soundings suggest linkage of the Galapagos group to Central America rather than to Ecuador.— *D. B. V.*

164–311. Snodgrass, James M., and Richards, Adrian F. Observations of underwater volcanic acoustics at Bárcena Volcano, San Benedicto Island, Mexico, and Shelikof Strait, Alaska : Am. Geophys. Union Trans., v. 37, no. 1, p. 97–104, 1956.

Magnetic tape recorders and sonobuoy equipment have made possible a practical approach to the study of underwater volcanic acoustics. Underwater audio energy originating from Bárcena Volcano on San Benedicto Island, Mexico, was studied from plane and ship between November, 1952, and May, 1955, and tape recorded on four different occasions. The recorded sounds are of two kinds : a rumble with a pitch of approximately 125 cycles, and a higher frequency hiss. These sounds, unlike any of known biological or other origin, are discussed and a frequency

analysis of the rumble is given. In order to determine the source of audio energy produced from Bárcena a triangulation method was devised by making an effectively simultaneous time and frequency analysis of selected portions of the acoustic spectrum from pairs of strategically placed sonobuoys. This technique was successfully used from shipboard in November, 1953. An unsuccessful attempt was made in August, 1953, to determine if audio energy generated from the active volcano Mt. Trident, in the Katmai National Monument, could be received in Shelikof Strait. The attempt is described to illustrate the technique used.—*Authors' abstract*

164–312. Imbō, G[iuseppe]. Oscillations de la colonne magmatique révélées grâce aux observations au statoscope [Oscillations of the magma column revealed by statoscope observations] : Bull. volcanolog., sér. 2, tome 16, p. 177–179, 1955.

From statoscope observations during the March 1944 eruption of Vesuvius it is deduced that the initial displacement of the magma column amounted to about 200 meters; that the column involved in this movement was about 4,500 meters thick and of very low density (0.3), so that the volume of liberated gas was about 88 percent; that the maximum coefficient of viscosity must have been about 9×10^4; and that the viscosity increased as gas escaped from the magma. These figures should be considered merely a groundwork for studies of the dynamics of Vesuvian eruptions.—*D. B. V.*

164–313. Tsuya, Hiromichi; Morimoto, Ryōhei; and Ossaka, Joyo. The 1950–1951 eruptions of Mt. Mihara, Oshima volcano, Seven Izu Islands, Japan. Part II. The 1951 eruption. A. Activity of the second period : Tokyo Univ. Earthquake Research Inst. Bull., v. 32, pt. 3, p. 289–312 and 26 pls., 1954; B. Activity of the third period : v. 33, pt. 1, p. 79–108 and 31 pls., 1955.

Mihara was quiescent from September 24, 1950 to February 3, 1951 but active from February 4 to June 28, 1951. From February to April activity was almost continuous; from April to June activity was characterized by recurrence of rather short-lived eruptions with intervening quiet phases. Both explosive and extrusive activity during February and March developed along the northwest-southeast rift belt that traverses the southwestern part of the floor of Mihara crater from near the top of the 1950 cinder cone to the northwestern rim of the crater. During the activity characteristic harmonic tremors were registered at the Meteorological Observatory at Motomura almost continuously. Activity came to an end with an unusually heavy explosive eruption on June 27–28 that ruptured the cinder cone.—*M. C. R.*

164–314. Murauchi, Sadanori. Geophysical studies of volcano Suwanose-Jima in the Tokara Islands [in Japanese with English abstract] : Tokyo Natl. Sci. Mus. Bull. new ser., v. 1, no. 2, p. 13–29, 1954.

Suwanose-Jima is one of the volcanic islands belonging to the Kirishima volcanic zone which follows the inner side of the Tokara and Ryukyu Islands. The volcano has been intermittently active since 1813 and almost continuously active since 1949.

In 1952 and 1953 Murauchi made a dip-needle survey of the volcano and recorded the earthquakes accompanying the explosions with a vertical seismometer. Analysis of dip-needle data by Rikitake's method indicated an intensity

of magnetization of 0.0082 emu. The average frequency of earthquakes accompanying explosions was 5.4 per 10 minutes, continuous tremors were not recorded, and the duration was less than 1 minute.—*V. S. N.*

164–315. Yokoyama, Izumi. Geomagnetic studies of Volcano Mihara. The 5th paper. (Changes in three geomagnetic components during the period from May 1951 to August 1953) : Tokyo Univ. Earthquake Research Inst. Bull., v. 32, pt 2, p. 169–188, 1954.

The depth of the source of the magnetic anomaly at Mihara was determined from the distribution of Z by determining the point where the solution of the magnetic potential becomes divergent. The upper limit was found to be 2–3 km below the surface. The depth of the magnetic center was also determined by Rikitake's method using the partial distributions of X, Y, and Z, as 4.7 km. These results and other studies indicate that the activity of the volcano which gave rise to the great change in the magnetic field in 1950 is still continuing although there has been some recovering during the 1951–53 period.—*M. C. R.*

164–316. Bellair, Pierre. Le volcanisme de l'Ahaggar dans le cadre du volcanisme africain [The volcanic activity of the Ahaggar in the framework of African volcanic activity] : Acad. Sci. Paris Comptes Rendus, tome 241, no. 17, p. 1152–1154, 1955.

There are three zones of volcanic activity in northern Africa, one from the Gulf of Guinea to the southern part of the Ahaggar mountains, one from Darfour to the coast of Tripoli which may extend through Pantelleria and Sicily to Italy, and the third zone starting in Asia and extending south to include the East African rift valleys. The first two are essentially parallel to the axis of the Red Sea. A series of elongated magma reservoirs is suggested, originating perhaps in Jurassic or Cretaceous time, more or less perpendicular to the Alpine system. Many characteristic phenomena of the Ahaggar region are different from those in the Red Sea area but similar to those in Italy. The difference in the thickness of the crust may have a bearing on the differences in volcanic phenomena.— *M. C. R.*

164–317. Santi, B. Manifestizioni esalativo-idrotermali dell 'Isola d'Ischia [Exhalative-hydrothermal manifestations on the island of Ischia] : Bull. volcanolog., sér 2, tome 16, p. 181–224, 1955.

This extends the catalog of fumaroles and thermal springs and waters of Ischia begun by Rittmann. Each of the various manifestations is described briefly, and results of all temperature and pH measurements through 1954 are tabulated.— *D. B. V.*

164–318. Sappa, Mercurino. Fenomeni geyseriformi dell 'Isola d'Ischia [Geyseriform phenomena of the island of Ischia] : Bull. volcanolog., sér 2, tome 16, p. 225–250, 1955.

From study of geyserlike activity of four artesian wells in Ischia it is concluded that the conditions necessary to produce geysers are the existence of hot water underground, and a temperature distribution such that the temperature-pressure curve coincides in one point at least with the liquid-vapor limit curve.—*D. B. V.*

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