Geophysical Abstracts 166 July–September 1956

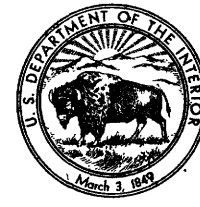
GEOLOGICAL SURVEY BULLETIN 1048-C

Geophysical Abstracts 166 July–September 1956

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

GEOLOGICAL SURVEY BULLETIN 1048-C

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



UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1956

UNITED STATES DEPARTMENT OF THE INTERIOR

Fred A. Seaton, *Secretary*

GEOLOGICAL SURVEY

Thomas B. Nolan, *Director*

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 25 cents (single copy). Subscription price: $1.00 a year; 35 cents additional for foreign mailing. The printing of this publication has been approved by the Director of the Bureau of the Budget, March 5, 1956.

CONTENTS

GEOPHYSICAL ABSTRACTS 166, JULY–SEPTEMBER 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. The table of contents, which is alphabetically arranged, shows 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 other 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, 163, 164, and 165. 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 SSSR Komiss. opredel. absolyut. vozrasta formatsiy Byull.—Akademiya Nauk SSSR Komissiya po opredeleniya absolyutnogo vozrasta geologicheskikh formatsiy Byulletin'. Moskva.

Akad. Neftyanoy Promyshlennosti Trudy—Trudy Akademii Neftyanoy Promyshlennosti. Moskva.

Assoc. Services Géol. Africains Compte Rendu et Commun.—Association des Services Géologiques Africains Compte Rendu et Communications. Bureau d'Études géologiques et minières coloniales, Paris.

Byull. soveta po seysmologii—Byulletin' soveta po seysmologii. Akademiya Nauk SSSR, Moskva.

Cahiers Naturalistes—Cahiers des Naturalistes. Bulletin des Naturalistes Parisiens. Paris.

California Div. Mines Bull.—California Division of Mines Bulletin. San Francisco, Calif.

Geologie u. Bauwesen—Geologie und Bauwesen. Springer Verlag, Wien.

Geol. Práce—Geologické Práce. Slovenská Akadémia Vied, Bratislava.

Illinois Geol. Survey Circ.—Illinois State Geological Survey Circular. Urbana, Ill.

Meteoritika—Akademiya Nauk SSSR, Moskva.

Moskov. Obshch. Ispyt. Prirod. Byull.—Moskovskogo obshchestvo ispytateley prirody Byulletin'. Moskva.

Natl. Inst. Sci. India Bull., Proc.—Bulletin, Proceedings of the National Institute of Sciences of India. New Delhi.

Notas Cuyanas de Ingenieria—Universidad nacional de Cuyo, San Juan, Argentina.

Oberhess. Gesell. Natur- u. Heilkunde Giessen Ber., Naturw. Abt.—Bericht der Oberhessischen Gesellschaft für Natur- und Heilkunde zu Giessen, Naturwissenschaftliche Abteilung. Giessen, Germany.

Observatorio de Cartuja (Granada) Trabajos cient.—Trabajos científicas del Observatorio de Cartuja (Granada). Spain.

Plateau.—Northern Arizona Society of Science and Art, Flagstaff.

Rajputana Univ. Dept. Geology Mem.—Memoirs of the Department of Geology of Rajputana University. India.

Riv. Catasto e Servizio Tecnici Erariali—Rivista del Catasto e dei Servizi Tecnici Erariali. Ministèro delle Finanze, Roma.

Soc. française Mineralogie et Cristallographie Bull.—Bulletin de la Société française de Mineralogie et Cristallographie. Paris.

South Australia Dept. Mines and Geol. Survey Rept. Inv.—South Australia Department of Mines and Geological Survey, Report of Investigation. Adelaide.

Soviet Jour. Atomic Energy—Soviet Journal of Atomic Energy. Translation of Atomnaya Energiya by Consultants Bureau, Inc., New York.

Terra—Geografiska sallskapets i Finland, Helsinki.

Texas Petroleum Research Committee Bull.—Texas Petroleum Research Committee Bulletin. A and M College of Texas, College Station; Railroad Commission of Texas, Austin; and University of Texas, Austin.

Türk Fiz. Derneği Bül.—Türk Fizik Derneği Bülteni. Instanbul.

Univ. Bruxelles Rev.—Revue de l'Université de Bruxelles. Belgium.

Zhur. Tekh. Fiziki—Zhurnal Tekhnicheskoy Fiziki. Akademiya Nauk SSSR, Moskva.

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 by 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, R. G. Henderson, D. R. Mabey, Virginia S. Neuschel, L. C. Pakiser, and Isidore Zietz as well as by the principal authors. The notation "Author's summary" followed by the initials of an abstractor indicates a translation of the author's summary.

AGE DETERMINATIONS

166–1. Due Rojo, Antonio. Cronometría radiactiva [Radioactive chronometry]: Inst. geol. min. España notas y comunicaciones, no. 42, p. 3–22, 1956.

A critical review of several of the modern methods of radioactive age determination, particularly the radiocarbon method.—*D. B. V.*

166–2. Langergausen, G. F. Periodichnosti' v izmenenii klimata proshlykh geologicheskikh eopkh i nekotoryye problemy geokhronologii [Periodicity in climatic variations of former geologic epochs and some problems of geochronology]: Akad. Nauk SSSR Doklady, tom 108, no. 4, p. 707–710, 1956.

There are many periodic variations of climate observed, the shortest being the daily variations of day and night. No traces remain of the geologic effects of these variations. Yearly changes of climate are noticeable in the varve sediments of the last glaciation or in the argillaceous bands in southern Altai Mountains or in Scandinavia. Longer periods have been suggested, such as 2.7, 3.5, 5.9, and 11.35 years in the sediments of southern Urals, in the Precambrian formations of Yenisei Ridge, and in Finland and Chile, for example. A period of 21,000 years, corresponding to the precession of equinox, has been repeatedly mentioned, but no geologic phenomena corresponding to this astronomic phenomenon were ever positively established. Comparison of the time intervals between glacial periods suggests some correlation between them and the galactic year; that is, the full revolution of the solar system around the galactic center. The problem will be settled by the refinement of the methods of geochronology and the studies in celestial mechanics and heliophysics. Paleontology cannot present any serious arguments on this question.—*S. T. V.*

166–3. Marmo, Vladi. Absoluuttisesta iästä geologiassa [On the absolute age in geology]: Terra, Årg. 67, no. 4, p. 105–111, 1955.

The absolute age of minerals is discussed and the most important methods mentioned. The conclusion is drawn that the ages determined from the pegmatite minerals may be dependable, but that there are hardly any real possibilities of giving an age of formation, because the minerals of these probably derive from a previous orogeny. Especially is attention drawn to the fact that often minerals derived from alluvium are tested for their age. In the opinion of the author, such ages are hardly of any value, because the environs of each mineral must be very well known before its age can be used in any way for geological interpretation.—*Author's English résumé*

166–4. Russell, R. D., and Allan, D. W. The age of the earth from lead isotope abundances: Royal Astron. Soc. Monthly Notices, Geophys. supp., v. 7, no. 2, p. 80–101, 1955.

Equations analogous to those of Holmes are derived in a form suitable for use in Houtermans' method with the assumptions that average values of the ratios of different leads can be used, that the average uranium to lead ratio in the outer part

of the earth has not changed systematically during geologic time except for changes caused by radioactive decay, and that variations in uranium concentration are proportional to variations in thorium concentration and for models in which $\partial\overline{V}(t)/\overline{V}$ and $\partial\overline{W}(t)/\overline{W}''$ are constants or vary linearly with time ($V=U^{235}/Pb^{204}$, $W=Th^{232}/Pb^{204}$). Exact lead abundance equations are also derived in another form using the same approach as Jeffreys. Eighty samples analyzed by Vinogradov, Nier, Geiss, and Farquhar were used to determine age; in general the determinations by the different methods are in good agreement, though consistently somewhat higher by the second method. It is concluded that the age of the earth is 4.3×10^9 years.—*M. C. R.*

166–5. Libby, Willard F. Radiocarbon dating, 2d ed.: 175 p., Chicago, Univ. Chicago Press, 1955.

Chapter titles are: Principles, World-wide distribution of radiocarbon, Half-life of radiocarbon, Preparation of the sample for measurement, Measurement of the sample, Radiocarbon dates, and Reflections upon the significance of radiocarbon dates by Frederick Johnson. The dates included are those obtained in the Chicago laboratory before the fall of 1954.—*M. C. R.*

166–6. Broecker, W. S., Kulp, J. L., and Tucek, C. S. Lamont natural radiocarbon measurements III: Science, v. 124, no. 3213, p. 154–165, 1956.

Ages are reported for geologic samples from Alaska, Canada, the United States, Italy, and South Pacific islands; deep-sea cores from the Atlantic; archeological samples from North and South America, Asia, Europe, Africa, the Philippines, and South Australia; soil samples from Iowa; and wood, shell, and other samples from Arctic islands. The Atlantic cores indicate that the transition from Wisconsin glacial time to postglacial time was marked by a rather sharp climatic change about 11,000 years ago. The Lamont Observatory laboratory is now using a carbon dioxide proportional-counting system instead of the black-carbon method.—*M. C. R.*

166–7. Flint, Richard Foster. New radiocarbon dates and late-Pleistocene stratigraphy: Am. Jour. Sci., v. 254, no. 5, p. 265–287, 1956.

Carbon-14 dating has become a valuable means of checking, and in some cases correcting, stratigraphic correlations based on field evidence. A series of dates obtained in the Yale Geochronometric Laboratory, in conjunction with dates of related samples published by other laboratories, contribute to a better understanding of late-Pleistocene stratigraphy of northern North America. Specifically the results fix the time of the Valders glacial maximum at around 10,700 yr B. P., improve the dating of phases of the glacial Great Lakes, advance knowledge of glacial events in central Connecticut, indicate at least local glaciation, northwest of Hudson Bay, subsequent to the Thermal maximum, and add to our information concerning a widespread glaciation that affected North America at a time more than 30,000 years ago.—*Author's abstract*

166–8. Ericson, David B., Broecker, Wallace S., Kulp, J. Laurence, and Wollin, Goesta. Late Pleistocene climates and deep-sea sediments: Science, v. 124, no. 3218, p. 385–389, 1956.

Vertical variations in the frequencies of the most temperature-sensitive planktonic Foraminifera in cores from widely separated points in the Atlantic Ocean have been studied in conjunction with radiocarbon dates and paleotemperatures determined from oxygen-isotope ratios. They indicate that the midpoint of the

major change from glacial to postglacial conditions occurred about 11,000 years ago, was essentially simultaneous throughout the North Atlantic and adjacent seas, and probably occurred in a time interval on the order of 1,000 years.—*M. C. R.*

166–9. Taylor, R. S. Glacial geology of north-central Keewatin, Northwest Territories, Canada: Geol. Soc. America Bull., v. 67, no. 8, p. 943–956, 1956.

Includes a carbon-14 age determination of 4140 ± 150 years on peat buried by the last ice advance.—*M. C. R.*

166–10. Moret, Léon. Données nouvelles sur l'âge absolu et l'origine des argiles d'Eybens, près Grenoble (Isère) [New data on the absolute age and the origin of the clays of Eybens near Grenoble, Isère]: Acad. Sci. Paris Comptes Rendus, tome 242, no. 2, p. 219–221, 1956.

The age of a tree trunk found in these clays has been determined as more than 37,000 years by the carbon-14 method at the U. S. Geological Survey. The clays were deposited in a lake in the valley of the Isère during the third (Riss-Würm) interglacial stage.—*M. C. R.*

166–11. Wetherill, George W. Discordant uranium-lead ages, I: Am. Geophys. Union Trans., v. 37, no. 3, p. 320–326, 1956.

U^{238}/Pb^{206} and U^{235}/Pb^{207} ages will be equal to one another (concordant) and to the true age of the mineral if there have been no gains or losses of uranium or lead since the formation of the system, if there have been no gains or losses of intermediate members of the radioactive decay scheme, if proper corrections have been made for the initial concentration of Pb^{206} and Pb^{207}, and if the chemical analyses have been properly performed and the correct decay constants used. If these conditions are not fulfilled, the ages will be discordant A graphical procedure is described that can be used to calculate the effects of failure of the first three conditions. By this procedure ages resulting from a given history can be calculated uniquely; it is not possible, however, to infer the history uniquely from given discordant ages, though it may be possible to infer possible or probable histories.—*M. C. R.*

166–12. Kosov, N. D., and Cherdyntsev, V. V. Emanirovaniye mineralov i opredeleniye absolyutnogo geologicheskogo vozrasta [Emanation from minerals and the determination of absolute geologic age]: Akad. Nauk SSSR Komiss. opredel. absolyut. vozrasta geol. formatsiy Byull., vypusk 1, p. 22–28, 1955.

The process of radioemanation from minerals consists of liberation of atoms by radioactive disintegration and diffusion of these atoms through microscopic capillaries in the body of the mineral. The latter factor affects the determination of geologic age. The radioemanations of 57 minerals were investigated by different methods. The results show that the coefficients of emanation of actinon and radon are very nearly equal in most minerals, whereas the coefficients of emanation of thoron and radon are clearly different. This shows that atoms of thorium and uranium occupy in the lattices of minerals different positions with reference to the system of microcapillaries in minerals. With an increase of temperature the coefficients of emanation increase. After cooling they decrease sharply, probably owing to dislocations of the crystalline lattice. In the opinion of the authors, the Wickman method of computing the coefficient of the emanation from the ratios of the lead isotopes is probably erroneous.—*S. T. V.*

166–13. Starik, I. Ye., Starik, F. Ye., and Petryayev, Ye. P. Sravnitel 'noye vyshchelachivaniye urana i izotopov radiya iz uraninita [The comparative leaching of uranium and radium isotopes from uraninite]: Akad. Nauk SSSR Komiss. opredel. absolyut. vozrasta geol. formatsiy Byull., vypusk 1, p. 29–32, 1955.

Leaching of uranium and radium isotopes from uraninite was studied because of the possible effect of this phenomenon on geologic age determinations. Solutions of nitric acid and of sodium carbonate in different concentrations as well as distilled water were used as solvents; the duration of the experiments was 7 days. Leaching of radium isotopes was found to be greater than that of uranium with all solvents. Of the radium isotopes, Ra^{223} and Ra^{224} are more easily leached out than Ra^{226}.—*S. T. V.*

166–14. Starik, I. Ye., Melikova, O. S., Kurbatov, V. V., and Aleksandruk, V. M. Zavisimost' emaniruyuschhey sposobnosti uraninita po radonu, toronu, i aktinony ot temperatury [The dependence of the capacity of uraninite to radiate radon, thoron, and actinon on the temperature]: Akad. Nauk SSSR Komiss. opredel. absolyut. vozrasta geol. formatsiy Byull., vypusk 1, p. 33–39, 1955.

A study was made of the influence of temperature on the emanation of radon, thoron, and actinon from a specimen of uraninite containing 2.16×10^{-7} g per g Ra, 2.39×10^{-2} g per g Th, and 8×10^{-11} g per g Ac. Radiometric measurements were made with a sensitive electrometer. Temperature was regulated with deviations less than ±3 percent; the specimen was kept at each temperature 5 hours. Two sets of measurements were made, one with temperatures varying from 20° to 230°C, the other with the temperature ranging from 20° to 900°C. Radon emanation was almost constant between 20° and 90°; at about 90° it decreased to one-half that value and then increased slowly to 230°C. The thoron emanations decreased slightly between 40° and 100°, and increased slightly between 100° to 230°; actinon emanation was constant from 20° to 230°. There was a sharp increase in the emanation of all these elements at temperatures exceeding 400°. X-ray analysis indicated the variations in emanating capacity are related to changes in crystal structure.—*S. T. V.*

166–15. Starik, I. Ye., Melikova, O. S., and Sobotovich, E. V. Raspredeleniye radioelementov v razlichnykh chastyakh uraninita [The distribution of radioactive elements in different parts of uraninite]: Akad. Nauk SSSR Komiss. opredel. absolyut. vozrasta geol. formatsiy Byull., vypusk 1, p. 39–44, 1955.

Radium, uranium, thorium, and lead were determined in different parts of several specimens of uraninite. The outer crust was obtained by sawing off the surface to a depth of at least 0.3 mm. The intermediate layer was obtained by sawing the surface of the specimens down to 1 mm. The remaining part was considered as the homogeneous "center." Both chemical and radiometric analyses were made. The crust was found to be enriched in lead and thorium compared to the central part. The migration of radium into the surrounding formations was greater than that of uranium and the secondary products of the disintegration of actino-uranium. Age determinations of the central portion were in better agreement with the geologic evidence. Age determinations of the outer crust were either higher or lower than the value of the central portion, a consequence of leaching of the radium isotopes.—*S. T. V.*

166–16. Zhirov, K. K., and Kurbatov, V. V. Rentgenometricheskoye izucheniye prigodnosti monatsitov dlya opredeleniya geologicheskogo vozrasta [The X-ray analysis of monazites for their fitness for geologic age determinations]: Akad. Nauk SSSR Komiss. opredel. absolyut. vozrasta geol. formatsiy Buyll., vypusk 1, p. 53–56, 1956.

Thirteen specimens of monazite from different parts of the U.S.S.R. were tested for their age, for radioemanation, and for the soundness of crystal structure, the last by X-ray spectrometer. In all specimens with abnormal ages clear abnormalities in the X-ray spectra were observed, which indicates modifications in crystal structure or presence of cracks.—*S. T. V.*

166–17. Holmes, A[rthur], and Cahen, L[ucien]. Géochronologie africaine. Résultats acquis au 1er septembre 1954 [African geochronology. Results available to September 1, 1954]: Assoc. Services Géol. Africains, Réunion de Nairobi 1954, Compte Rendu et Commun., p. 59–95, 1955.

The French version of the paper published in Colonial Geology and Mineral Resources [see Geophys. Abs. 161–131].—*D. B. V.*

166–18. Macgregor, A. M. Significance of atomic dates: Assoc. Services Géol. Africains, Réunion de Nairobi 1954, Compte Rendu et Commun., p. 97–98, 1955.

A supplementary note to the paper by Holmes and Cahen [see preceding abstract] in which the geologic significance of some of the age determinations is assessed.—*D. B. V.*

166–19. Wasserstein, B. The ages of uraninites by a new method: Assoc. Services Géol. Africains, Réunion de Nairobi 1954, Compte Rendu et Commun., p. 99–103, 1955.

Additional work on the method of age determinations based on shrinkage of the unit cell of uraninite with time [see Geophys. Abs. 160–145, 163–135 and 136] indicates that the anomalies in the preliminary results are caused by the existence of different oxides of uranium, characterized by different unit cell parameters. Alpha-uraninites correspond to UO_2, with a cube edge of 5.470 A; these yield results in agreement with the theory. Beta-uraninites correspond to "β–UO_2" (possibly U_3O_7), with a cube edge of 5.440 A; these are the pitchblendes and must be disregarded for dating purposes until their role is more clearly understood. Gamma-uraninites correspond to U_4O_7, with a cube edge of 5.488 A; these yield the anomalous ages.

The results of five corrected determinations by the X-ray method are discussed and compared with available isotope ages. It is concluded that the limitations of the new method have yet to be established, but that for certain uraninites it provides a simple approximate determination which may complement the isotope method advantageously. One advantage is that the smallness of the sample required may avoid difficulties arising from weathering.—*D. B. V.*

166–20. Barnes, J. W., Lang, E. J., and Potratz, H. A. Ratio of ionium to uranium in coral limestone: Science, v. 124, no. 3213, p. 175–176, 1956.

The content of ionium in coral limestone cuttings from the upper 200 feet of a drill hole on Elugelab Island, Eniwetok, varies with depth and near the surface

is less than the equilibrium amount. "The data obtained thus far suggest that, in the absence of leaching or other processes which would lead to differential movement of uranium and ionium in the coral deposit, the magnitude of the ionium-uranium ratio in a particular specimen may indicate the age of the specimen."—*M. C. R.*

166–21. Amirkhanov, Kh. I., Gurvich, I. G., Shanin, L. L., and Sardarov, S. S. Mass-spektrometricheskiy metod izmereniya kolichestva radiogennogo argona v geologicheskikh obrazovaniyakh dlya opredeleniya ikh absolyutnogo vozrasta [A mass-spectrometric method of measuring the amount of radiogenic argon in geological formations to determine their absolute age]: Zhur. Tekh. Fiziki, tom 25, vypusk 3, p. 558–561, 1955.

Describes a new rapid method of isolating argon from minerals by heating in a high-frequency furnace to a temperature somewhat higher than the melting point of the minerals and passing them through a series of purifying furnaces. The heating and purifying apparatus is described and illustrated by schematic diagrams. The amount of A^{40} liberated, together with A^{36}, is then measured in a mass spectrometer using the isotope dilution method. An accuracy of $\pm$ 7 percent is obtained. As the over-all error is determined mainly by the accuracy of measurement of isotope ratios, it is expected that subsequent refinements, first using a standard gas enriched in A^{36}, should improve the accuracy to ± 1.5 to 2 percent. The method can also be used for determination of other gases, such as xenon or helium, for age determinations on minerals [see also Geophys. Abs. 164–29].—*D. B. V.*

166–22. Gerling, E. K. O vozrastnykh otnosheniyakh granitnykh intruziy Ukrainy na osnovanii dannykh argonovogo metoda [Age relations of the granite intrusions of the Ukraine on the basis of the data obtained by argon method]: Akad. Nauk SSSR Komiss. opredel. absolyut. vozrasta geol. formatsiy Byull., vypusk 1, p. 5–8, 1955.

Argon age determinations were made on mica from some 30 specimens of granite from different parts of the crystalline shield of the Ukraine. Results were in good agreement with those obtained by the lead method. Three groups were found from about 1,500 to $1{,}950 \times 10^6$ years. These ages are much greater than usually assumed in geologic studies, but they are in close agreement with the data obtained for Karelia.—*S. T. V.*

166–23. Gerling, E. K., and Rik, K. G. Novyye opredeleniya vozrasta kamennykh meteoritov argonovym metodom [New determinations of the age of stony meteorites by the argon method]: Meteoritika, p. 117–120, 1954.

The ages of several meteorites have been determined by the method, previously suggested by Gerling, which involves the precise determination of the argon occluded in the body of meteorites. The argon content was determined volumetrically, using the apparatus designed and constructed by Gerling and Khlopin, in which the meteorite is heated for 10–20 hours at the temperature of 1,250° C; the amount of potassium was determined by chemical analysis. The age t was determined from the established masses of A^{40} and K^{40} from the equation:

$$t = \frac{[lg(mA^{40}/mK^{40}) + 0.1107] - lg\ 0.1107}{2.39 \times 10^{-10}}$$

Twelve samples were tested; in many of them the age was found to be (3.0 to 3.9) $\times 10^9$ years; that is, approaching the age of the earth.—*S. T. V.*

166–24. Mawdsley, J. B., and Farquhar, R. M. Report of the Committee on Precambrian and related dating: Royal Soc. Canada Trans., v. 49, ser. 3, sec. 4, p. 37–45, 1955.

A brief review of recent developments in the field of geological age determination by the various uranium-lead, thorium-lead, potassium-argon, and rubidium-strontium age methods. It includes a table of recent published age determinations made on material from Canadian Precambrian areas.—*Authors' abstract*

166–25. Cumming, G. L., Wilson, J. T[uzo], Farquhar, R. M., and Russell, R. D. Some dates and subdivisions of the Canadian Shield: Geol. Assoc. Canada Proc., v. 7, pt. 2, p. 27–79, 1955.

Over 300 analyses of Canadian minerals suitable for age determination purposes, carried out between 1891 and the spring of 1954, have been examined and the ages recalculated. The results provide a basis by which the major tectonic subdivisions of Canada may be distinguished. The various methods of age determinations are described and discussed.

It is believed that the ages of feldspars, micas, and uraninites from pegmatites date periods of orogenic activity. Such ages indicate that individual orogenies take place during periods of a few hundred million years. Ages of galenas, pitchblendes, and some secondary uranium minerals may also date orogenies, but more often date subsequent hydrothermal activity.

The ages appear to be in accord with the theory of continental growth by successive marginal additions around nuclei. These nuclei are characterized by their great age (>2,000 million years), abundant greenstone lavas and poorly sorted greywackes, conglomerates, and tuffs. The ages of the surrounding provinces become progressively younger towards the margins of the continent.—*Authors' abstract*

166–26. Wilson, J. Tuzo, Russell, R. D., and Farquhar, R. M. Economic significance of basement subdivision and structures in Canada: Canadian Min. Metall. Bull., v. 49, no. 532, p. 550–557, 1956.

The results of age determinations of Canadian minerals are presented as aids in recognizing and interpreting some of the geologic subdivisions of Canadian rocks. The ages and the lead isotope ratios for any one area tend to be uniform but they differ markedly from one geologic province to another. The writers believe that the Canadian Shield can be divided into basement provinces, separated by fault zones. Ore bodies tend to be more closely related to faults in old basement areas of shields than in young regions.—*L. C. P.*

166–27. Wanless, R. K., and Traill, R. J. Age of uraninites from Blind River, Ontario: Nature, v. 178, no. 4527, p. 249–250, 1956.

Two uraninite and three galena samples from the Blind River district of Ontario have been analyzed chemically and by mass spectrometry; ages of the uraninites have been determined from the lead-uranium, lead-thorium, and lead-lead ratios. The average ages are 1,300 million years for the Algom galena and 600 million years for the Pronto galena. Both galenas are alike in the hand specimen and occur in a pyritized formation that has been traced along the strike for more than 80 miles. The lower age of the Pronto specimen results from a lower lead

content but the distribution of ages calculated from the various ratios characteristic of samples with loss of lead is not present.—*M. C. R.*

166–28. Folinsbee, R. E. Archean monazite in beach concentrates, Yellowknife geologic province, Northwest Territories, Canada: Royal Soc. Canada Trans., v. 49, ser. 3, sec. 4, p. 7–24, 1955.

Gneiss-derived monazite occurs as a minor constituent of small, well-sorted beach placers on the south shore of Yamba Lake, in the Yellowknife geologic province, Northwest Territories. The source of the monazite has been assigned to the Archean (2,200–2,400 million years) on the basis of field relations confirmed by potassium-argon and other methods of age determination. The dating suggests a short-lived series of Archean granite intrusions in the Yellowknife geologic province that crystallized about 2,340 million years ago. It is likely that the intrusives of the Yellowknife continental nucleus were contemporaneous with the granitic intrusions of the Superior or Keewatin nucleus, and a correlation of these two nuclei is indicated.—*V. S. N.*

166–29. Aldrich, L. T., Davis, G. L., Tilton, G. R., and Wetherill, G. W. Radioactive ages of minerals from the Brown Derby mine and the Quartz Creek granite near Gunnison, Colorado: Jour. Geophys. Research, v. 61, no. 2, p. 215–232, 1956.

Radioactive age determinations have been made on 16 minerals from the Brown Derby pegmatite and the Quartz Creek granite. A high degree of consistency has been found among the Rb-Sr ages measured on micas and feldspars. A similar degree of consistency exists in the K-A ages of micas. These consistencies are indicative of the usefulness of measurements of the decay of K^{40} and Rb^{87} in determining relative ages of igneous rocks. U-Pb and Th-Pb ages determined from minerals obtained from the pegmatite and granite were not concordant. Different minerals showed different types of partial separation of parent and daughter elements. Comparisons of Rb-Sr and K-A ages with concordant U-Pb ages have been made on other pegmatites. The measurements are most consistent with an age of $1{,}350 \pm 100$ m. y. for the pegmatite and the granite.—*Authors' abstract*

166–30. Roques, Maurice. Determination de l'âge absolu du granite carbonifère du Mayet (Allier) [Determination of the absolute age of the Carboniferous granite of Mayet de Montagne, Allier]: Acad. Sci. Paris Comptes Rendus, tome 242, no. 4, p. 528–530, 1956.

The absolute age of a granite at Mayet de Montagne, near Vichy, was determined by the Larsen method ("lead-alpha-zircon"). Three samples taken from places several kilometers apart gave ages of 220, 200, and 206 million years. The average, 209 million years, places the granite in the Upper Carboniferous according to the Holmes scale of geologic time. Its Upper Carboniferous age had been previously well established by geologic evidence.—*M. C. R.*

EARTH CURRENTS

166–31. Miguel y González-Miranda, Luis de. Corrientes telúricas, año 1948 [Telluric currents, 1948]: Inst. Geog. y Catastral Mem., tomo 21, no. 1, 40 p., 1951.

A description of the instrumentation and tabulation of the results of measurements of telluric current potential made at the Observatorio Central Geofísico at Toledo, Spain, in 1948. Monthly, seasonal, and annual variations are summarized in graphs, and 25 major disturbances are described briefly.—*D. B. V.*

166–32. Miguel y González-Miranda, Luis de. Corrientes telúricas, año 1949 [Telluric currents, 1949]: Inst. Geog. y Catastral Mem., tomo 21, no. 2, 164 p., 1951.

The results of telluric current potential measurements at the Toledo observatory (Spain) are presented in tables and graphs as for 1948 (see preceding abstract). The introductory section includes discussion of the resistivity of the ground, direction of telluric currents, and relation to diurnal magnetic variations.—*D. B. V.*

166–33. Miguel y González-Miranda, Luis de. Registrador rapido para corrientes telúricas [Rapid recorder for telluric currents]: Inst. Geog. y Catastral Mem., tomo 21, no. 3, 12 p., 1951.

A description of the apparatus constructed at the Observatorio Geofísico at Toledo, Spain, for continuous rapid registration of telluric currents. The basic difference from the Schmidt and La Cour apparatus is that the drum, making 8 revolutions in 24 hours, moves past a fixed window. Photographs and diagrams are included.—*D. B. V.*

166–34. Burkhart, Kurt. Mikropulsationen des Erdstroms und der erdmagnetischen Horizontalkomponenten [Micropulsations of earth currents and the horizontal component of the earth's magnetism]: Zeitschr. Geophysik, Jahrg. 21, Heft 2, p. 57–80, 1955.

Earth current observations with large electrode spacing have been compared with those for short spacing; phase differences of both magnetic and earth current variations are fixed by the proportion of reactance and resistance, but the former increases more than the latter at large distances and short periods. The law of induction between magnetism and earth currents holds also for the pulsations. It is possible to use the same formulas for earth current problems as for calculation of the sensitivity of H and D equipment, but the influence of the skin effect must be considered in the case of earth currents. Earth currents in the meridional direction have to overcome a resistance three times as strong as currents in the other direction. The meridional inductivity is 2.5 times as strong as that in the zonal direction. The anisotropy is attributed to Alpine structure. Pulsations of 10 to 40 sec period show a distinct maximum at noon; the frequency of pulsations of sunlight hours surpass that of the long periods produced by particles; long-period pulsations show a 27-day recurrence.—*M. C. R.*

166–35. Yanagihara, Kazuo. Abnormal variations of earth currents accompanied with the 'Boso-Oki earthquake', Nov. 25, 1953: Kakioka Magnetic Observatory Mem., v. 7, no. 2, p. 19–26, 1956.

Abnormal variations in earth potentials, the amplitude ratio of the universal earth-current potentials, and earth resistivities were observed at Kakioka several hours (or sometimes days) before the occurrence of the earthquake. The physical mechanism causing the variations is unknown.—*M. C. R.*

166–36. Rikitake, Tsuneji, and Yokoyama, Izumi. The anomalous behaviour of geomagnetic variations of short period in Japan and its relation to the subterranean structure. The 6th report. (The results of further observations and some considerations concerning the influences of the sea on geomagnetic variations): Tokyo Univ. Earthquake Research Inst. Bull., v. 33, pt. 3, p. 297–331, 1955.

Observations at Ooshima do not materially change the statistical distribution of $\Delta Z/\Delta H$ previously reported [Geophys. Abs. 162–41] and do not define the southern

limit of the area of anomalously large ΔZ. Study of the possible influence of the sea on the geomagnetic variations from the standpoint of electromagnetic induction theory indicates the observations cannot be explained by the effect of the electric currents induced in the sea. The observations suggest a roughly circular circuit in which electric current flows clockwise (viewed from above) while the inducing magnetic field is directed to the north. The intensity of the current suggests an origin at some depth and a high conducting passage to bring the currents near the surface.—*M. C. R.*

EARTHQUAKES AND EARTHQUAKE WAVES

166–37. Benioff, H[ugo], and Gutenberg, B[eno]. General introduction to seismology: *in* Earthquakes in Kern County, California during 1952, California Div. Mines Bull., no. 171, pt. 2, p. 131–135, 1955.

A review of the present status of some of the more important concepts in seismology.—*V. S. N.*

166–38. VanderHoof, V. L. The major earthquakes of California: A historical summary: *in* Earthquakes in Kern County, California during 1952, California Div. Mines Bull., no. 171, pt. 2, p. 137–141, 1955.

The major recorded earthquakes of California from 1769 through 1952, with brief descriptions and intensities.—*V. S. N.*

166–39. Richter, Charles F., and Gutenberg, Beno. Seismicity of Southern California: California Div. Mines Bull., no. 170, p. 19–25, 1954.

California contributes from ½ to 1 percent of the total seismic activity of the circumpacific belt and is the largest of the sectors in which the structures are not evidently arcuate, earthquakes are shallow, and tectonics are primarily block faulting including rift zones associated with strike-slip faults. A continuous belt of seismicity extends from the north coast southeastward through the Gulf of California. The chief seismic zone widens south of the westward-trending transverse ranges because of the branching of the San Andreas fault and the occurrence of other parallel active faults. A table gives the epicenter, origin time, and magnitude of some of the shocks.

For such shocks as those in 1906, 1940, and 1952, where there is linear faulting, the instrumental epicenter is above the point of initial rupture. Not uncommonly the epicenter lies at one end of the active fault segment and is eccentric with respect to the heavily shaken area. Observations within the past few years have led to revision of interpretation for recorded seismic waves at short epicentral distances. The investigation is still in progress and will be affected by the unusually accurate and copious data from the Kern County earthquakes of 1952.—*V. S. N.*

166–40. Richter, C[harles] F. Seismic history in the San Joaquin Valley: *in* Earthquakes in Kern County, California during 1952, California Div. Mines Bull., no. 171, pt. 2, p. 143–146, 1955.

A listing of major recorded earthquakes in that part of Kern County most affected by the major earthquake of 1952. The exact location, magnitude, and quality of earthquakes from 1932 through 1952 are listed in table form.—*V. S. N.*

166–41. Oakeshott, Gordon B. The Kern County earthquakes in California's geologic history: California Div. Mines Bull., no. 171, pt. 1, p. 15–22, 1955.

The fault pattern in southern California probably had its beginning in Jurassic time. The pattern is dominated by the northwest-trending San Andreas right-lateral fault. The Garlock-Big Pine fault zone, offset 6 miles by the San Andreas, dominates the northeast-trending left-lateral fault system. The earthquake threat of this latter system was not appreciated until the 1952 series of earthquakes in Kern County initiated by movement on the White Wolf fault. A third system of faults is formed by short east-trending reverse faults showing recent movement although no earthquakes have been traced to any of them.

The epicenter of the Arvin-Tehachapi earthquake of July 21, 1952, was near the eastern end of Wheeler Ridge. The principal component of movement was reverse with lesser left-lateral movement along a northeast-trending fault. Most of California's great earthquakes have been caused by strike-slip movement on right-lateral faults of northwest trend. The magnitude of the shock, 7.7, makes it one of the three greatest in California history and the White Wolf fault, traceable for 34 miles, is one of the shortest known responsible for a major earthquake in California. Distribution of the large number of aftershocks shows that movement was triggered on many other faults in the area.—*V. S. N.*

166–42. Oakeshott, Gordon B., and others. Earthquakes in Kern County, California during 1952: California Div. Mines Bull., no. 171, 283 p., 1955.

A symposium on the major Arvin-Tehachapi earthquake of July 21, 1952, and the series of related earthquakes and aftershocks, including studies of the stratigraphy, structural geology, and origin of the earthquakes; their geologic effects; seismologic measurements; application of seismology to petroleum exploration; and structural damage and design of earthquake-resistant structures.—*V. S. N.*

166–43. Gutenberg, B[eno]. Epicenter and origin time of the main shock on July 21 and travel times of major phases: *in* Earthquakes in Kern County, California during 1952, California Div. Mines Bull., no. 171, pt. 2, p. 157–163, 1955.

The epicenter of the main shock was determined from the arrival times of P at nearby stations and from comparison of the arrival times with those found previously for shocks in the same region and with times of aftershocks originating near the main shock. The epicenter was located at Lat. 35° N., Long. 119° 02′ W. by the first two methods and confirmed by the third within 1 minute of arc. The origin time was calculated from the relation $t=K\pm b\Delta$ where K is the intercept time (the extrapolated travel time at $\Delta=0°$) of the travel time curve of Pn for each station in a number of aftershocks near the main epicenter. From investigation of seven shocks, the average time is $0=11{:}52{:}14.3\pm0.1$ sec. Finally the method of least squares was applied to the residuals with the result: epicenter at Lat. 35°00′ ± ¾′ N., Long. 119°01′ ± 1¼′ W.; origin time $11^h\ 52^m\ 14.2^s\pm0.13^s$.

The depth of focus cannot be found accurately, but from other data from southern California shocks and artificial explosions a focal depth was established of 15 km with an estimated uncertainty of ±6 km.

Records of longitudinal waves in the main shock at distances of less than 20° confirm Gutenberg's previous conclusions on the structure of the upper 300 km of the earth's crust [see Geophys. Abs. 157–184].—*V. S. N.*

406832—56——2

166–44. Richter, C. F. Foreshocks and aftershocks: *in* Earthquakes in Kern County, California, during 1952, California Div. Mines Bull., no. 171, pt. 2, p. 177–197, 1955.

The major earthquake of July 21, 1952, was preceded by one true foreshock 2 hours earlier. Aftershocks for the first 36 hours were all located on or south of the White Wolf fault and tended to diverge from it toward Tehachapi, consistent with the known dip of the fault. After 36^h 46^m aftershocks occurred both north and south of the White Wolf fault, within an area with sharp straight boundaries on at least three sides, presumably indicating faults. The mechanical unity of the whole phenomenon is indicated by a tendency for successive shocks to occur in different parts of the active area and not from the same point. The effect of the root of the Sierra Nevada in modifying the paths of seismic waves is shown clearly in the times of arrival at the Tinemaha station. The foci of most of the shocks were at a depth of 16 km; many, especially those in the northeast, were at a depth of 10 km; and other small ones were at still shallower depths. One hundred ninety-nine shocks of magnitude 4.0 and higher were recorded to the end of June 1953; investigated smaller shocks increased the total to 267. Twenty-one additional shocks of magnitude 4.0 and higher occurred by the end of June 1955.—*V. S. N.*

166–45. Neumann, Frank, and Cloud, William K. Strong-motion records of the Kern County earthquakes: *in* Earthquakes in Kern County, California during 1952, California Div. Mines Bull., no. 171, pt. 2, p. 205–210, 1955.

The intensity in the 160,000-square-mile area in which the shock was felt is summarized by an isoseismal map. Intensities 10 and 11 (modified Mercalli intensity scale of 1931) in the central area of the shock were based on the cracking and permanent shifting of the ground because of the lack of earthquake effects on buildings and other structures in this sparsely settled area. On the basis of vibrational effects in buildings, it would be difficult to assign intensity 9 to more than a few points in the central area of the shock.

The nearest strong-motion accelerograph was 35 miles from the area of greatest intensity but from a study of past records it is estimated that the maximum accelerations in the central area of the July 21 shock may have been 0.35 to 0.5 g at points where intensity 9 is indicated on the strength of damage to buildings and 0.20 to 0.35 g where intensity 8 is indicated. Data obtained at 22 strong-motion stations indicate that any forcefulness the ground motion loses at greater distances because of its lower acceleration is compensated for by the longer duration of the disturbance. In the Kern County earthquake the acceleration associated with a given intensity was reduced to roughly one-half when the same intensity was registered instrumentally 100 miles from the epicenter, and approximately one-fourth at 200 miles.—*V. S. N.*

166–46. Gutenberg, B[eno]. Magnitude determination for larger Kern County shocks, 1952; effects of station azimuth and calculation methods: *in* Earthquakes in Kern County, California during 1952, California Div. Mines Bull., no. 171, pt. 2, p. 171–175, 1955.

A magnitude of 7.6 was determined from about 200 data on body wave amplitudes, and only a slight variation with azimuth was observed. However, amplitudes of surface waves at a given distance show a clear variation with the azimuth in which they start; the maximum, towards the northeast in the direction of the fault, is about 10 times the minimum, found in waves starting towards the south-

west. This is considered to be a consequence of the fact that in the main shock the breaking proceeded northeastward from the neighborhood of the southwest end of the active fault segment. In the largest aftershocks there was no appreciable difference in the amplitudes of surface waves in those azimuths for which data are available. The magnitude of the main shock determined from surface waves is 7.6 to 7.7. Magnitudes of the largest aftershocks are also listed. Only small differences were found among those calculated from maximum amplitudes at nearby stations, from amplitudes of body waves at distant stations, and from surface waves.—*V. S. N.*

166–47. Gutenberg, B[eno]. The first motion in longitudinal and transverse waves of the main shock and the direction of slip: *in* Earthquakes in Kern County, California during 1952, California Div. Mines Bull., no. 171, pt. 2, p. 165–170, 1955.

From data on compressions and dilatations in the direct longitudinal waves from the first motion in transverse waves recorded at stations in the hemisphere around the epicenter, it is calculated that "at the depth of the source (about 10 miles) the fault plane has a dip of about 60° to 66° towards E. 50° S.; the slip along the fault at this depth was roughly up towards north in the upper (southeastern) block relative to the lower (northwestern) block; the vertical component of the slip was about 1.4 times that of the horizontal; the horizontal component corresponds to a relative movement northeastward in the upper block (southeast of the fault), southwestward in the lower block".—*V. S. N.*

166–48. Benioff, Hugo. Mechanism and strain characteristics of the White Wolf fault as indicated by the aftershock sequence: *in* Earthquakes in Kern County, California during 1952, California Div. Mines Bull., no. 171, pt. 2, p. 199–202, 1955.

The strain rebound characteristics of the aftershock sequence of the Kern County earthquake of 1952 indicated that the aftershocks southeast of the fault were generated by compressional strains whereas those on the northwest side were produced by shearing strains. Assuming that the original strain zone is outlined by the aftershocks spatial pattern, values for the strain characteristics of the strain zone preceding the earthquake can be computed as follows: volume of strained rock $=7.3\times10^{19}$ cm^3; average strain $=8.7\times10^{-5}$; average stress $=26$ kg per cm^2; purely elastic strain energy density $=6.6\times10^{2}$ erg per cm^3; creep strain energy density roughly 5×10^{2} ergs per cm^3.—*Author's abstract*

166–49. Milne, W. G. Seismic activity in Canada, west of the 113th meridian 1841–1951: Dominion Observatory Ottawa Pubs., v. 18, no. 7, p. 119–146, 1956.

From a search of available data, a list of the earthquakes felt or centered in the western mountain region of Canada has been prepared. From December of 1841 to August of 1951, a total of 242 earthquakes were located in this general area. These vary in intensity from very weak shocks to the Queen Charlotte Islands earthquake of magnitude 8.0. A description is given for the major tremors. An additional list contains those tremors recorded at Victoria after the sensitive seismograph was installed in 1948 but for which epicenters could not be determined. A map is included to show the area studied; it does not contain a complete record of the earthquakes.—*Author's abstract*

166–50. Hamamatsu, O. On the Queen Charlotte Islands earthquake (Aug. 22, 1949) observed in Japan (the 1st paper) [in Japanese with English summary]: Quart. Jour. Seismology, v. 19, no. 3–4, p. 29–37, 1955.

Arrival times, amplitudes, and periods of seismic waves from the earthquake in the Queen Charlotte Islands, British Columbia, have been determined at 48 Japanese stations. All initial motions were south, west, and upward. Observed amplitudes and periods of *S* waves were large.—*D. B. V.*

166–51. Hodgson, J. H., and Cock, J. Irma. Direction of faulting in the Greek earthquakes of August 9–13, 1953: Dominion Observatory Ottawa Pubs., v. 18, no. 8, p. 149–167, 1956 (Reprinted from Annales Géologiques des Pays Helléniques, v. 8, p. 29–47).

The direction of faulting is determined for eight earthquakes of the sequence which damaged the Ionian Islands in August, 1953. The solutions obtained suggest that faulting occurred either on a plane striking NNW.–SSE. or on a plane striking ENE.–WSW. Field evidence collected by Galanopoulos suggests that in fact faulting occurred on both these planes which constitute a conjugate system of faulting. The agreement between the solutions and the field evidence is satisfactory.—*Authors' abstract*

166–52. Wadati, K[iyoo], and Iwai, Y. The minute investigation of seismicity in Japan (2d paper): Geophys. Mag., v. 27, no. 1, p. 11–15, 1956.

A map showing the distribution of earthquakes in and near Japan has been compiled from data on 2,088 earthquakes that occurred during the 28-year period from 1926 through 1953, most of magnitude 5 or greater. In the Hokkaido and Tōhoku districts (as in the Kwanto and Kyushu areas, see Geophys. Abs. 158–144) the foci of most shocks are along the Pacific side and at shallow depths. Focal depths increase inland, and intermediate depth shocks are observed in volcanic areas. Deep-focus earthquakes occur in the Japan Sea and Soya Strait areas.—*M. C. R.*

166–53. Shima, Etsuzo, and Sibano, Muturo. Futatsui earthquake of October 19th, 1955 [in Japanese with English summary]: Tokyo Univ. Earthquake Research Inst. Bull., v. 34, pt. 1, p. 113–129, 1956.

The earthquake of October 19 in the Futatsui area, Akita prefecture, was the first severe earthquake in local history. The maximum intensity of the shock was 8.3 (modified Mercalli scale) and the magnitude, 6.2. The focus was at a shallow depth about 2 km southeast of Futatsui. Most severe damage was to "dozos" or warehouses.—*M. C. R.*

166–54. Merriam, Daniel F. History of earthquakes in Kansas: Seismol. Soc. America Bull., v. 46, no. 2, p. 87–96, 1956.

Thirty-eight earthquakes which have affected Kansas are listed and described; 22 of these have occurred within the state's boundaries since 1867. There were 2 moderately strong ones—on April 24, 1867, and January 7, 1906. A frequency plot reveals that a moderately strong earthquake occurs in the state approximately every 40 to 45 years.

A correlation of earthquakes with structural features in Kansas indicates that the Nemaha anticline is still tectonically active and that the earthquakes are probably occurring along a series of faults on the east side of the structure. Other

positive structural elements such as the Cambridge arch and Central Kansas uplift are considered passive. The state, as a whole, is and probably always has been relatively stable.—*Author's abstract*

166–55. Dellwig, Louis F. The Barker County earthquake of January 6, 1956: Kansas Geol. Survey Bull. 119, pt. 5, p. 175–185, 1956.

The earthquake of January 6, 1956, attained a maximum intensity of V in Barker County, Kans. It was felt over an area of a radius of approximately 120 km. The depth of focus, calculated at 32 km, seems to be too deep to warrant the postulation of a relationship between the earthquake and the Pratt anticline on which the epicentral tract is superimposed. No damage, other than minor cracking of walls, was observed.—*Author's summary*

166–56. Byerly, Perry. The Fallon–Stillwater earthquakes of July 6, 1954, and August 23, 1954: Historic introduction: Seismol. Soc. America Bull., v. 46, no. 1, p. 1–3, 1956.

Nevada's earthquake history, which began in 1860, includes at least 20 shocks of considerable size, noted briefly here. Surface faulting has rarely been observed; before 1954, only in the Pleasant Valley earthquake of 1915 was faulting remarkable. The Fallon-Stillwater shocks were both rated as 6.8 by Pasadena; they would have been more destructive in a region of greater population.—*M. C. R.*

166–57. Cloud, William K. Intensity distribution and strong-motion seismograph results, Nevada earthquakes of July 6, 1954, and August 23, 1954: Seismol. Soc. America Bull., v. 46, no. 1, p. 34–40, 1956.

Data on the intensities of the shocks of July 6 and August 23 are summarized in two isoseismal maps. A maximum intensity of 9 (modified Mercalli scale) was assigned in the area of ruptured ground; at Fallon the intensity was 7, but in the agricultural areas around Fallon the maximum intensity was 8. There were no strong-motion seismographs in the epicentral area but several instruments, the most distant at Hoover Dam, were triggered by the shocks; recorded accelerations and displacements are tabulated.—*M. C. R.*

166–58. Slemmons, David B. Geologic setting for the Fallon-Stillwater earthquakes of 1954: Seismol. Soc. America Bull., v. 46, no. 1, p. 4–7, 1956.

The Fallon-Stillwater area is in the west-central part of the Basin and Range province. The area is near the boundary between the western province of Mesozoic basement rocks and the eastern province of Paleozoic basement rocks. Both are covered by thick but discontinuous deposits of Cenozoic lavas and continental sediments. Three periods of folding and thrusting have been recognized: pre-Lower Pennsylvian, Permian, and Jurassic or Cretaceous. The Cenozoic was marked by relaxation of Mesozoic compressional forces and renewal of regional uplift with high-angle normal faults. Surface faulting in the Pleasant Valley (1915), Cedar Mountain (1932), and Excelsior Mountain (1934) earthquakes is part of a broad belt that extends discontinuously from Lone Pine, Calif., to Winnemucca, Nev., and may define a particularly active belt of basin-and-range development.—*M. C. R.*

166–59. Steinbrugge, K[arl] V., and Moran, D[onald] F. Damage caused by the earthquakes of July 6 and August 23, 1954: Seismol. Soc. America Bull., v. 46, no. 1, p. 15–33, 1956.

Descriptions of damage to structures, and ground breakage in irrigated areas and its effects, originally prepared for the Pacific Fire Rating Bureau for its earthquake insurance rating studies. Twenty-six photographs of damage are included.—*M. C. R.*

166–60. Tocher, Don. Movement on the Rainbow Mountain fault: Seismol. Soc. America Bull., v. 46, no. 1, p. 10–14, 1956.

The earthquakes of 4:13 P. D. T. July 6, 1954 and 22:51 P. D. T. August 23, 1954, were caused by movement along a fault extending along the eastern border of Rainbow Mountain, 15 miles east of Fallon, northward to the southern edge of Carson Sink. Movement in the July 6 shock extended along a line or narrow zone 11 miles long; movement accompanying the August 23 shock extended the dislocation northward an additional 14 miles. Vertical displacement is evident on about two-thirds of the fault, the west side up with respect to the east side. No horizontal displacement was observed. A secondary break was observed parallel to and ½ mile west of the principal fault for a distance of about 2 miles near the north end of Rainbow Mountain. On the secondary fault the west side apparently moved down with respect to the east side. Avalanches and earth lurching were also observed.—*M. C. R.*

166–61. Due Rojo, Antonio. El período sísmico de Granada (abril-mayo 1956) [The seismic period in Granada, April-May 1956]: Inst. geol. min. España notas y comunicaciones, no. 42, p. 159–170, 1956.

The maximum intensity of the initial shock of the very shallow earthquakes of April 19, 1956, was 8 (Wood-Neumann scale) in the villages of Albolote and Atarfe at the northwestern edge of the Granada plain at the foot of the Sierra Elvira, Spain. Six persons were killed, about 40 were injured, hundreds of homes were destroyed, and 4 other deaths resulted from a landslide probably caused by the earthquake. At the Cartuja Observatory in Granada, the first shock put the instruments out of action, and records begin with the first aftershock at $20^h\ 0^m\ 28^s$. The epicentral distances of the three main aftershocks of April 19 indicate migration of the focus along a plane of rupture extending roughly north from the southern limit of the Lias along the Colomera river. Through May 8 a total of 116 aftershocks were recorded; the maximum number in 1 day, 25, occurred on April 22. All are tabulated and briefly described.—*D. B. V.*

166–62. Pastor, Manuel. Nota acerca de los terremotos granadinos del 19 de abril de 1956 [Note concerning the Granadan earthquakes of April 19, 1956]: Inst. geol. min. España notas y comunicaciones, no. 42, p. 171–192, 1956.

A discussion of the effects of the earthquakes of April 19, 1956, near Granada (see also preceding abstract), including felt area, nature of the vibration, velocity of propagation (6.6 kmps), nature of damage to buildings (with six photographs), and probable details of its tectonic origin.—*D. B. V.*

166–63. Rodríguez-Navarro de Fuentes, José, and Bonelli y Rubio, Juan M. El terremoto de Gergal de 1 de julio de 1950 [The Gergal earthquake of July 1, 1950]: Inst. Geog. y Catastral Mem., tomo 21, no. 5, 33 p., 1951.

The earthquake of July 1, 1950, in the province of Almería, Spain, was recorded clearly at Cartuja (Granada), Málaga, Alicante, and Toledo in addition to the Almería observatory. The maximum intensity of the shock was 3 on the Wood-Neumann scale. The epicenter was located at 37° 06′ N. lat, 2° 33.08′ W. long; the time at origin was $12^h\ 19^m\ 43.5^s$; focal depth, 11.1 km, and coefficient of absorption, 0.05109; velocity of P_g, 5.68 ± 0.02 kmps, magnitude, 5¾; and energy, 7.4×10^{18} ergs.—*D. B. V.*

166–64. Puchkov, S. V. Seysmichnost' territorii Ashkhabadskoy Zony po nablyndeniyam 1953 g [Seismicity of the Ashkhabad region from observations in 1953]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 4, p. 469–472, 1956.

After the Ashkhabad earthquake of October 10, 1948, two seismological investigations were undertaken by the Geophysical Institute of the Russian Academy of Sciences. In the second expedition, six temporary seismic stations equipped with precise, high-magnification instruments were set up in the region where the greatest number of shocks had been observed. During 1953, about 200 earthquakes were recorded, most of a very low intensity. The epicenters were determined from the seismograms at all six stations by the methods of Wadati and Ishikawa, and by the method of isochrones. These are shown on a map of the region. The depths of the foci ranged from 8 to 20 km. The $\overline{S}$–$\overline{P}$ curve for earthquakes at depths of 10 to 15 km indicates an apparent velocity of 6.7 kmps.—*S. T. V.*

166–65. Petrushevskiy, B. A. O svyazi seysmicheskikh yavleniy na Uralo-Sibirskoy platforme i v Tyan'-shane s geologicheskoy obstanovkoy etikh territoriy [On the correlation between seismic phenomena of the Ural-Siberian Platform and the Tien Shan Mountains with the geologic conditions in these regions]: Moskov. Obshch. Ispyt. Prirod. Byull., Otdel geol., tom 30, vypusk 6, p. 31–53, 1956.

Analysis of the correlation between such parameters as the position of the epicenter and depth of focus of an earthquake and the geology of the area, Central Asia, as an example, indicates that the prediction of earthquakes is more complicated than is thought by the followers of the seismotectonic theory of I. Ye. Gubin. In about 40 percent of the observed earthquakes the epicenters do not coincide with the geomorphologically determined contemporary movements of the ground, and only in some 10–15 percent is it possible to correlate the epicentral zones with known faults. Several seismological maps and statistical data on the observed earthquakes are given. The greater part of the article is a geologic description of Central Asia, where, since the beginning of this century, more than 40 earthquakes of intensity 7, 8, and 9 have occurred. At the present time few general laws can be established for determining the seismicity of a region—perhaps only that the younger the folding of the mountains, the more seismically active is the area. Other correlations vary from region to region and can be discovered only by extensive geologic and geophysical studies.—*S. T. V.*

166–66. Svyatlovskiy, A. Ye. Zemletryaseniya i osobennosti tektonicheskogo stroyeniya Kurilo-Kamchatskoy oblasti [The earthquakes and the peculiarities of the geologic structure of the Kurile-Kamchatka region]: Byull. Soveta po seysmologii, no. 2, p. 31–34, 1956.

The distribution of intensity of earthquakes of the Kamchatka Peninsula-Kurile Islands region, many of maximum intensity 9 and 10, indicated a linear extension of the focus. Recent oceanographic surveying discovered the existence of a deep trench in the ocean bottom northeasterly from near Japan to the Kamchatka Peninsula parallel to the Kurile Islands and the eastern shores of Kamchatka. A similar depression extends in a northwest direction along the Aleutian arc. Numerous tsunami are apparently generated in the Kurile-Kamchatka trench but none can be attributed to Aleutian depression. A geologic map illustrates the seismotectonic characteristics of the region.—*S. T. V.*

166–67. Savarenskiy, Ye. F., and Dzhibladze, E. A. O seysmichnosti Bol'shogo Kavkaza [On the seismicity of the Great Caucasus]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 577–583, 1956.

The potential energy E accumulated in crust at the moment preceding an earthquake is partly transformed into kinetic energy of seismic waves and partly into irreversible deformation. The energy of the waves is primarily that in the body waves to which must be added the energy in surface waves. The energy E is assumed to be proportional to the energy of body waves, and by use of the Galitzin and Jeffreys formula the energy of the eight most important earthquakes in the Caucasus during 1953 was calculated. The average energies determined from the records of at least three seismic stations ranged from 4×10^{11} to 9×10^{20} ergs; the corresponding distance D from the epicenter to the furthermost station at which the earthquake could still be recorded ranged from 340 to 4,400 km. Increase of the energy E by 10 doubled the distance D. A table is given of $\log_{10}E$ and the corresponding distances D.

The intensity N of an earthquake and its energy E are related by the equation $N=\log E-13\frac{1}{2}$. By this relation the energy of an earthquake may be determined from the available macroseismic data.

A map shows the epicenters of the observed earthquakes and their energy and zones of different seismic energy in different parts of the Caucasus.—*S. T. V.*

166–68. Gutenberg, B[eno]. Seismograph stations in California: *in* Earthquakes in Kern County, California during 1952, California Div. Mines Bull., no. 171, pt. 2, p. 153–156, 1955.

A short history of seismograph stations in California is given. Stations in neighboring states which contributed information to the study of the Kern County earthquakes in 1952 are listed. Detailed information is given for stations in California which recorded the shocks in 1952; this includes a list of installations with portable instruments in the epicentral area from July 21 to November 13, 1952.—*Author's abstract*

166–69. Sretenskiy, L. N. Vozbuzhdeniye uprugikh kolebaniy poluploskosti volnovymi dvizheniyami zhidkosti [Production of elastic vibrations in a semiplane by undulatory movements of a liquid]: Byull. Soveta po seysmologii., no. 2, p. 12–26, 1956.

The method used in the Cauchy-Poisson problem of plane wave motion propagating on the surface of elastic semispace is used to determine vibrations

caused on this surface by gravitational waves produced by a pressure impulse, and formulas are found for the elastic displacements at a given point on the surface after a given time. The resulting motion has the characteristics of a tsunami.—*S. T. V.*

166–70. Brekhovskikh, L. M. O tsunami i nablyudeniyakh nad sverkhdal-'nim rasprostraneniyem zvuka v okeane [On tsunami and observations of very distant propagation of sound in the ocean]: Byull. Soveta po seysmologii, no. 2, p. 8–11, 1956.

Prediction of approaching tsunami is possible because the velocity of acoustic waves in water is much greater than that of tsunami; the velocity of sound in ocean water is about 5,500 km per hr, but that of the tsunami is only about 600 to 700 km per hr. For sound waves, there is a wave-guide effect in a layer 600 to 700 m deep, with very small attenuation, and therefore tsunami can be heard from considerable distance. The range of the acoustic effect in ocean water is limited by the action of such seemingly silent creatures as fish and crayfish.—*S. T. V.*

166–71. Savarenskiy, Ye. F. Problema tsunami [The tsunami problem]: Byull. Soveta po seysmologii, no. 2, p. 3–7, 1956.

Tsunami are caused by abrupt changes in the volume of an ocean basin and therefore are often produced by tectonic earthquakes with shallow foci accompanied by disruptions and dislocations of the ocean bottom. Warning of an approaching tsunami can be obtained from the acoustic waves it produces which are propagated through the water with a velocity of about 5.5 kmps, compared with the velocity of only 0.2 kmps of the tsunami. Observations of shallow earthquakes or of the advancing tsunami from at least three stations make possible determination of the tsunami position and the direction of its movement. —*S. T. V.*

166–72. Ozawa, Izuo. On the observation of changes of the Earthcrust in the time of earthquakes [in Japanese with English summary]: Zisin, v. 8, no. 1, p. 45–47, 1955.

It was almost impossible to eliminate all meteorological effects on crustal deformation from the observed curves of our highly sensitive extensometer. The seasonal differences of range of fluctuations of observed linear strain-variations of the earth crust at Osakayama (Otsa) Observatory computed in this paper are confined to a small range as compared with the anomalies of strain of the ground accompanied by strong earthquakes.—*Author's abstract*

166–73. Miyamoto, Sadao. New nomographs for estimating epicenter [in Japanese with English summary]: Zisin, v. 8, no. 1, p. 34–37, 1955.

Two nomographs for estimating the epicenter take into account the two crustal layers. As an example of the use of the nomographs the epicenter of the Fukui earthquake was estimated as $\lambda=136°\ 17.1'$, $\varphi=36°\ 7.1'$, and the focal depth as 35 km.—*V. S. N.*

166–74. Satō, Yasuo. On the direction of earthquake sound: Zisin, v. 8, no. 3, p. 149–154, 1956.

A study of the direction of earthquake sounds indicates that it may be possible to use these directions to locate the epicenter.—*V. S. N.*

166–75. Arkhangel'skaya, V. M. Opredeleniye napravleniya na epitsentr zemletryaseniya po zapisyam poverkhnostnykh voln pri udalennykh zemletryaseniyakh [Determination of the azimuth of the epicenter of an earthquake from the records of surface waves of distant earthquakes]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 30(157), p. 82–88, 1955.

The azimuth of a distant earthquake can be determined rapidly and fairly accurately from the direction of motion of surface waves as interpreted from seismograms. This paper is a discussion of criteria for recognizing the direction of motion of Love and Rayleigh waves. Examples are given of application of the method to records from several Russian seismological stations; accuracy in many cases is better than 2°.—*S. T. V., D. B. V.*

166–76. Solov'yev, S. L. O klassifikatsii zemletryaseniy po velichine ikh energii [On the classification of earthquakes according to their energy]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 30(157), p. 3–21, 1955.

Earthquakes should be classified not in accordance with their destructive effects but according to the amount of energy liberated at the focus and dissipated over a certain part of the earth. Using the formulas by Richter and Gutenberg (slightly modified), Solov'yev has computed the energy of 86 earthquakes that have occurred since 1912 in the Turkmen S. S. R., one of the seismically very active regions of the U.S.S.R.—*S. T. V.*

166–77. Wadati, K[iyoo], and Hirono, T. Magnitude of earthquakes—especially of near, deep-focus earthquakes: Geophys. Mag., v. 27, no. 1, p. 1–10, 1956.

The magnitude is determined by comparison of the curve of log A/T versus Δ (A=maximum amplitude, T=period, and Δ=distance) with standard curves for each focal depth and magnitude. Standard curves were obtained from observations of the Tokachi (March 4, 1952) and Amami-Oshima (December 1, 1953) earthquakes with the effect of the attenuation coefficient as a function of depth considered.—*M. C. R.*

166–78. Gutenberg, B[eno], and Richter, C[harles] F. Earthquake magnitude, intensity, energy, and acceleration (2d paper): Seismol. Soc. America Bull., v. 46, no. 2, p. 105–143, 1956.

This supersedes Paper 1 (Gutenberg and Richter, 1942). Additional data are presented. Revisions involving intensity and acceleration are minor. The equation $\log a = I/3 - \frac{1}{2}$ is retained. The magnitude-energy relation is revised as follows: $\log E = 9.4 + 2.14M - 0.054M^2$. A numerical equivalent, for M from 1 to 8.6, is $\log E = 9.1 + 1.75M + \log(9 - M)$. The former is based on $\log (A_0/T_0) = -0.76 + 0.91M - 0.027M^2$ applying at an assumed point epicenter. This is derived empirically from readings of torsion seismometers and USCGS accelerographs. Amplitudes at the USCGS locations have been divided by an average factor of 2½ to compensate for difference in ground; previously this correction was neglected, and $\log E$ was overestimated by 0.8. The terms M^2 are due partly to the response of the torsion seismometers as affected by increase of ground period with M and partly to the use of surface waves to determine M. If M_S results from surface waves, M_B from body waves, approximately $M_S - M_B = 0.4\ (M_S - 7)$. It appears that M_B corresponds more closely to the magnitude scale determined for local earthquakes.

A complete revision of the magnitude scale, with appropriate tables and charts, is in preparation. This will probably be based on A/T rather than amplitudes.—*Authors' abstract*

166–79. Utsu, Tokuji, and Seki, Akira. A relation between the area of aftershock region and the energy of main shocks [in Japanese with English summary]: Zisin, v. 7, no. 1, p. 233–240, 1955.

The logarithm of the area A in square kilometers and the magnitude M are assumed to be linearly related (that is, $\log A = aM + b$) and the constants a and b are computed for 39 shallow earthquakes. These are 1.02 and −4.01 for all 39 earthquakes, 0.93 and −3.18 for 23 oceanic earthquakes, and 0.85 and −3.05 for 16 land earthquakes. From the relation between magnitude and energy, $A \propto E^m$, where $m \doteqdot \frac{1}{2}$, and $E/A \propto A \propto \sqrt{E}$, which indicates that the surface density of energy increases as the energy increases.—*M. C. R.*

166–80. Vvedenskaya, A. V. Opredeleniye poley smeshcheniy pri zemletryaseniyakh s pomoshch'yu teorii dislokatsiy [The determination of the displacement fields produced by earthquakes using the dislocation theory]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 3, p. 277–284, 1956.

Point sources of disturbances in the focus of an earthquake are usually assumed [see Geophys. Abs. 159–105, 160–115]. In this paper, the source of the disturbance is assumed to be a rupture of finite dimensions along a certain plane, produced by two opposite parallel forces of a given direction acting in a given small volume at the focus of the earthquake, and the relation between the intensity and the direction of the rupture and the resulting displacement of any point of elastic space is determined. If a and c are the longitudinal and transverse seismic velocities in the medium, r and R the distances from the considered point in space to the nearest and the farthest points of the volume involved in the rupture, and the interval of time between $(R-r)/a$ or $(R-r)/c$ can be measured on the seismograms, the volume in which the forces act at the focus can be estimated.

With such observations from several stations around the epicenter, it is possible to compute the displacement at any point in space produced by the assumed rupture in the focus and thus to solve the problem. By varying the assumptions as to the dynamic type of the rupture, it is possible to find the solution of the inverse problem.—*S. T. V.*

166–81. Keylis-Borok, V. I. K voprosu o svyazi tochechnykh i ob'emnykh istochnikov [On the relation between point sources and three-dimensional sources]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 4, p. 404–409, 1956.

In studying motions at the foci of earthquakes, point sources are ordinarily assumed, but in reality the geologic dislocations causing earthquakes always occupy a certain, often quite substantial, volume. With regard to the strains produced in the ground, at a sufficient distance from the focus, many three-dimensional dislocations are equivalent to combinations of point sources. Thus, a three-dimensional symmetrical dislocation is equivalent to a point source formed of a dipole and a moment; an asymmetric dislocation is equivalent to a dipole with a moment to which an additional simple force is added. Seven combinations are discussed and their equivalents expressed in terms of point sources and simple forces. The equivalency is always supposed to be at some distance from the focus.—*S. T. V.*

166–82. Kogan, S. D. Opredeleniye dinamicheskikh parametrov ochagov zemletryaseniy, priblizhenno ekvivalentnykh kombinirovannym istochnikam [Determination of the dynamic parameters of earthquake foci, approximately equivalent to a combined source]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 584–594, 1956.

In previous Russian studies the relations in the foci were only studied for simple dynamic sources. In the present paper the effect of the sum of different simple sources is considered for the following cases: simple force plus a dipole producing a moment; simple force plus a dipole without a moment; dipole plus a moment; dipole without a moment; and superposition of two dipoles with a moment. Analytical expressions are given for the individual components of the displacements, but the basic method is graphoanalytical, using stereographic projections and Wulf's net.—*S. T. V.*

166–83. St. Amand, Pierre. Two proposed measures of seismicity: Seismol. Soc. America Bull., v. 46, no. 1, p. 41–45, 1956.

Two measures of seismic activity are proposed. The first, called specific seismicity, is the sum of the energy released by all the earthquakes occurring in an area in a given time, divided by the area and the time. The second is called tectonic flux and is the sum of the square roots of the energies of all the earthquakes occurring in a given area in a given time, divided by the area and the time. Tectonic flux is proportional to the rate of strain release in the area. Maps contoured in either measure are convenient for expressing the seismic activity of a region.—*Author's abstract*

166–84. Katsumata, M. Ground coefficient for amplitude of earthquake [in Japanese with English summary]: Quart. Jour. Seismology, v. 19, no. 3–4, p. 7–10, 1955.

Observed amplitudes of earthquakes depend on the nature of the ground near stations. Corrections (ground coefficients) are given for Japanese stations so that observed amplitudes can be reduced to a common base.—*M. C. R.*

166–85. Fujimoto, F. On vibrational characteristics of the ground assumed from seismogram data [in Japanese with English summary]: Quart. Jour. Seismology, v. 20, no. 4, p. 1–12, 1956.

Amplitudes and periods of *P*, *S*, and *ScS* were measured on Wiechert records of the deep earthquake of July 10, 1940, in Manchuria, and the relative energies calculated from Blut's equation. Where the felt intensity was high, there was much energy in short-period waves and less in longer period waves; in "continental" areas (Korea, Manchuria), there was considerable energy in long-period waves and little or no energy in short-period waves; in some areas there were two maximums of different periods; and in others one maximum of a definite period. The distribution of energy in *ScS* was entirely different than that in *P* and *S*. Apparently waves of a wide range of periods were sent out from the focus; the differences may be attributed to accentuation of the natural period of the area around the station.—*M. C. R.*

166–86. Giuliani, Francisco. Empuje activo en suelos incoherentes y cohesivos; accion sismica [Active stress in unconsolidated and consolidated ground; seismic action]: Notas cuyunas de Ingenieria no. 1, 23 p., 1955.

This is a discussion, from the civil-engineering standpoint, of the distribution of stresses in consolidated and unconsolidated ground; the positions least favorable

for fracture planes can be determined by graphic calculation. The effect of horizontal and vertical seismic acceleration on the development of fractures is treated mathematically and graphically.—*D. B. V.*

166–87. Bullen, K. E. Features of seismic *pP* and *PP* rays: Royal Astron. Soc. Monthly Notices, Geophys. supp., v. 7, no. 2, p. 49–59, 1955.

Bullen's previous theoretical work on features of seismic rays (see Geophys. Abs. 125–8521) has been extended to the case of *pP* and *PP* rays with foci at finite depths below the surface of the earth. *pP* in this paper refers to all rays leaving the focus at angles inclined above the horizontal. It is shown that for a wide class of velocity variations in the mantle there is a cusp in the *pP* traveltime curve that corresponds to a ray that leaves the focus at finite depth in a direction inclined at a finite angle above the horizontal through the focus, and that the cusp is in general theoretically similar to the cusp in the *PKP* traveltime curve.—*M. C. R.*

166–88. Hodgson, J. H., Allen, J. F. J., and Cock, J. Irma. Tables of extended distances for *PPP*, *pPP*, *pPKP*, and for *P* at very short distances: Dominion Observatory Ottawa Pubs., v. 18, no. 5, p. 85–100, 1956.

The paper presents tables of extended distances for several secondary phases which are occasionally useful in fault-plane solutions, and extends earlier tables for *P* to very short distances. The tables are given for surface focus and for focal depths ranging from 0.00R to 0.12R in steps of 0.01R. They are consistent with earlier tables of extended distances so that the several phases can be used in a single solution.—*Authors' abstract*

166–89. Hodgson, J. H., Allen, J. F. J., and Cock, J. Irma. Tables of extended distances for *S*, *SS* and *sS*: Dominion Observatory Ottawa Pubs., v. 18, no. 6, p. 103–116, 1956.

Tables of extended distances, consistent with those already published for the *P* phases, are presented for those *S* phases which are likely to be useful in fault-plane studies. As in earlier papers, the extended distances are given for surface focus, and for focal depths from 0.00R to 0.12R in steps of 0.1R.—*Authors' abstract*

166–90. Stoneley, R[obert]. Rayleigh waves in a medium with two surface layers (2d paper): Royal Astron. Soc. Monthly Notices, Geophys. supp., v. 7, no. 2, p. 71–75, 1955.

The group velocities of Rayleigh waves, as measured by Rohrbach on the Göttingen records of two Asian earthquakes for which the azimuth of arrival was from the East, have been discussed in terms of a two-layer model, in which the upper layer, of granite of thickness T_1, rests on a basaltic layer of thickness T_2, with ultrabasic material below extending to a great depth. The wave velocity equation, in the form of a ten-row determinant, was solved by means of the EDSAC electronic computing machine of the Mathematical Laboratory, Cambridge; the ratio c/β_2 of wave velocity to distortional wave velocity in the T_2 layer was calculated for a sequence of values of KT_1 for the three values 1, ½, ⅓ of the ratio T_2/T_1. The values for $T_2=0$ on slightly different data were available from earlier work. The group velocity was obtained from the wave velocity by numerical differentiation.

For the earthquake of 1930 July 2 in Eastern Bengal the mean values of T_1 over the whole range of periods from 65.3 sec to the shortest periods that the dispersion curves permitted (24 to 27 sec) were respectively 27.1, 30.6, 32.7 km on the

three hypotheses, with 37.8 km for $T_2=0$. The internal consistency of the results is in favour of the third case, with $T_1=32.7$ km; $T_2=10.9$ km. The independent evidence of other lines of investigation favours a continental structure with a granitic layer 30 to 35 km thick and a basaltic layer of small or zero thickness; studies of near earthquakes and of large explosions suggest that the intermediate layer may be of only local occurrence. These determinations fit closely an empirical formula $T_1+0.35T_2=36.3$ km.

The corresponding thicknesses derived from the shock of 1924 July 11, in the Kuen Lun Mountains, are a little smaller and are closely represented by the formula $T_1+0.646T_2=36.6$ km. Since the waves from Eastern Bengal traverse the Himalaya region this difference is to be expected.

The results fully justify the use of seismograms that record the vertical component of motion, and indicate the desirability of further research along these lines.—*Author's summary*

166–91. Korschunow, A[lex]. Tiefherdbeben aus Göttinger Seismogrammen [Deep-focus earthquakes on Göttingen records]: Zeitschr. Geophysik, Jahrg. 21, Heft 3, p. 113–134, 1955.

A statistical review of deep-focus earthquakes recorded at the Göttingen station from 1930 to 1937. The records of 103 earthquakes have been classified in five groups on the basis of number and clarity of phases recorded, and into four groups on the nature of the first arrivals. Sample records are shown.—*M. C. R.*

166–92. Tamaki, Ituo. The anomalies of incident time of *P*-waves of deep earthquakes in Japan [in Japanese with English summary]: Zisin, v. 8, no. 1, p. 48–54, 1955.

The geographic distribution of the observed deviations from normal traveltime curves of the *P* waves of 41 deep earthquakes between 1935 and 1953 is in good agreement with the deviations calculated on the basis of Tamaki's proposed crustal structure and there is a linear correlation between the two.—*V. S. N.*

166–93. Utsu, T. Some remarkable phases on seismograms of near earthquakes (Part 1) [in Japanese with English summary]: Quart. Jour. Seismology, v. 20, no. 4, p. 13–16, 1956.

At the Matushiro observatory, two phases have been found on seismograms of shallow earthquakes in the east part and off the east coast of Kwanto. X_1 follows *P* by 9 to 20 sec, and X_2 is about 6 sec earlier than *S*. X_1 may be a surface *P* wave and X_2 an *S* wave transformed to *P* at a discontinuity within the crust.—*M. C. R.*

166–94. Utsu, T. On deflection of the direction of initial motion of *P* wave [in Japanese with English summary]: Quart. Jour. Seismology, v. 21, no. 1, p. 13–20, 1956.

Directions of initial motions of the *P* wave from about 130 earthquakes in and near the Kwanto District at 24 stations in Japan are not always the same as the epicenter-station direction. Deflections may be partly due to inaccuracies in observation but also to structural differences. The deflections may be qualitatively explained by the distribution of regions of high and low velocity (or thick and thin crust).—*M. C. R.*

166–95. Dohr, G. Perioden der ersten Vorläufer in Göttinger Seismogrammen [Periods of first motion on Göttingen seismograms]: Zeitschr. Geophysik, Jahrg. 21, Heft 3, p. 165–174, 1955.

The range of periods of P waves recorded at Göttingen from earthquakes in North America is characteristically different from that of earthquakes originating in East Asia; periods of 11–14 secs are most frequent in records of North American shocks, those of 3–5 secs in Asiatic shocks.—*M. C. R.*

166–96. Sagisaka, S., and Yamagishi, N. Observation of surface waves of the near earthquakes [in Japanese with English summary]: Quart. Jour. Seismology, v. 19, no. 3–4, p. 23–28, 1955.

Surface waves in the earthquake swarm of October–November 1952, off the coast of the Sanriku district, were registered very clearly by the 1-ton C. M. O. horizontal seismograph (T_0=30 sec) at the Matsushiro observatory. They appear to be Love waves, with a velocity of 3.54 kmps and period of 22 sec.—*D. B. V.*

166–97. Benioff, Hugo. Seismograph development in California: *in* Earthquakes in Kern County, California during 1952, California Div. Mines Bull., no. 171, pt. 2, p. 147–151, 1955.

The new forms of seismographs which have been developed in California include the torsion seismograph, the variable reluctance transducer electromagnetic pendulum seismograph, the electromagnetic linear-strain seismograph, and the fused-quartz secular-strain gage.—*V. S. N.*

166–98. Ichikawa, M. Sur non-linèaires oscillations de séismographe vertical (pour grand tremblement de terre) [On nonlinear oscillations of the vertical seismograph (for strong earthquakes) (in Japanese with French summary)]: Quart. Jour. Seismology, v. 19, no. 3–4, p. 11–17, 1955.

Calculation of the second- and third-order coefficients of θ in the equation of motion of the C. M. O. vertical seismograph (Ewing type, nonmagnification, 5-sec period) indicates that the effect of the second-order term is relatively small and that of the third order, completely negligible.—*D. B. V.*

166–99. Akamatu, K. The variable inductance type seismograph [in Japanese with English summary]: Zisin, v. 7, no. 4, p. 241–247, 1955.

A differential transformer of the variable inductance type used with a seismograph as a transducer proportional to displacement satisfies the requirement for linearity over a wide range of displacement, is compact and simple, and permits increase in magnification to 10^5 by amplifying circuits.—*M. C. R.*

166–100. Skatskiy, V. I. Elektromekhanicheskiy akselerograf s p'yezokvartsevym datchikom [Electromechanical accelerograph with a piezoelectric crystal transducer]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 562–568, 1956.

An electromechanical accelerograph with a piezoelectric crystal as the initial indicator of changes in velocity was constructed for measurements in an airplane; in a simpler form this was used long ago by Galitzin for measurement of the accelerations produced by seismic waves. It can also be used for investigations of the

vibrations created in buildings and other important structures by explosions or earthquakes. A wiring diagram of the instrument is given and several accelerograms obtained in experiments are reproduced.—*S. T. V.*

166–101. Ullmann, W[olfgang]. Zur allgemeinen Bewegungsgleichung von Seismographen mit einem Freiheitsgrad [On the general equation of motion of seismographs with one degree of freedom]: Gerlands Beitr. Geophysik, Band 65, Heft 1, p. 56–63, 1955.

Renunciation of the usual limitations regarding the motion of the support and suspension of a seismograph, oscillation- or vibration-meter with one degree of freedom makes possible a satisfactory physical interpretation of the individual terms of the general equation of motion, especially the so-called "translation factor". In the case of a multiple-member pendulum the effect of sufficiently strong individual components on the motion of the suspension is formally treated. For vibrometers with practicable suspension structure the questions of the replaceability by an "equivalent point pendulum" and the exact disappearance of Wiechert's "second class disturbing members", under the assumption of arbitrary motion of the support are considered.—*Author's summary, D. B. V.*

166–102. Ullmann, Wolfgang. Zur Klassifikation der Seismographen, Schwingungs- oder Erschütterungsmesser [On the classification of seismographs, oscillation- or vibration-meters]: Gerlands Beitr. Geophysik, Band 65, Heft 2, p. 91–108, 1955.

Gassmann's classification is based on translation factors which vary with location. Each of the three so-called fundamental forms requires a different type of suspension construction, insensitive to any velocity and acceleration of rotation of the support.—*D. B. V.*

166–103. Neumann, Frank. Sensitivity controls on Galitzin-type seismographs: Am. Geophys. Union Trans., v. 37, no. 4, p. 483–490, 1956.

Galitzin has shown that in a standard Galitzin instrument it is not possible to reduce the sensitivity of the instrument through circuit changes alone until the sensitivity is reduced to about 20 percent of the maximum. However, by a slight modification in the damping adjustment, the sensitivity control can be extended to 70 percent of maximum. Circuit and selector switch designs used at the University of Washington to control the sensitivities of the Sprengnether instruments are described.—*M. C. R.*

166–104. Teupser, Christian. Zur Theorie der Aufzeichnung von mechanischen und elektrodynamischen Erschütterungsmessern [On the theory of recording of mechanical and electrodynamic vibration meters]: Gerlands Beitr. Geophysik, Band 65, Heft 2, p. 109–116, 1956.

This shows mathematically that errors in recording of mechanical and electrodynamic vibration meters (seismometers) depend mainly on phase displacement. For a known frequency range of ground movements the constants of the apparatus can be determined diagrammatically.—*D. B. V.*

166–105. Tazime, Kyozi. Some notices on the design of the electromagnetic recorder having no amplifier [in Japanese with English abstract]: Zisin, ser. 2, v. 8, no. 3, p. 138–148, 1956.

A method for eliminating the coupling effect is proposed, an expression for the magnification obtained, and a design conforming to these considerations discussed.—*M. C. R.*

166–106. Ventskevich, E. V., Pasechnik, I. P., and Fedoseyenko, N. Ye. Primeneniye zhdushchey razvertki pri registratsii seysmicheskikh kolebaniy [The use of "preliminary unrolling" in recording of seismic vibrations]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 525–533, 1956.

Among the innovations at Russian seismic observatories to improve recording of seismic waves from earthquakes or explosions is a method of increasing the speed of the recording film to as much as 50 mm per sec. For example, in recording explosions, the film, in the form of a loop about 1 m long, rolls continuously from one cylinder to another without any illumination and the lamps are switched on only at the moment of shooting. To reduce the time required to bring the filaments of the lamps to full glow, the lamps are kept preheated by a voltage slightly below that for incandescence so that no photographic effect is produced, and at the given signal the voltage is increased to normal so recording starts.

For recording earthquake waves three seismographs placed around the station at appropriate distances, as much as a few kilometers, and preferably in drill holes, send signals to the station and start the necessary recording apparatus. Speed of 50 mm per sec is sufficient for recording 12 different waves simultaneously.—*S. T. V.*

166–107. Omote, Syun'itiro, Miyamura, Setumi, and Yamazaki, Yoshio. Triggered magnetic tape recorder for routine seismic observations: Tokyo Univ. Earthquake Research Inst. Bull., v. 33, pt. 3, p. 397–409, 1955.

Description of a seismometer that records on magnetic tape by means of a density type recording device.—*M. C. R.*

ELASTICITY

166–108. Heaps, H. S. The effect of elastic intrusions upon a gravitational stress: Am. Geophys. Union Trans., v. 37, no. 4, p. 477–482, 1956.

Formulas are obtained for the state of stress within an elastic material subject to the force of gravity and containing intrusions of different elastic properties. It is assumed that the elastic properties of the intrusions do not differ greatly from those of the surrounding medium. The formulas are first expressed in a form that is independent of the specific shape of the intrusions. When the intrusions are distributed uniformly throughout the material the additional shearing stress at any place is inversely proportional to the fourth power of the spacing of the intrusions. Figures are included to show the effect of a single intrusion upon the shearing stress at distant points within the surrounding material. A further figure shows the distribution of shearing stress at points just outside a spherical intrusion. This stress is independent of the radius of the intrusion.—*Author's abstract*

166–109. Skuridin, G. A. O skachkakh razryvnykh resheniy dinamicheskikh uraveniy teorii uprugosti [The jumps in the discontinuous solutions of the dynamic equations of the theory of elasticity]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 625–633, 1956.

Discontinuous solutions of the dynamic problems of the theory of elasticity are discussed and an asymptotic method of their solution is presented. A proof is given that the differential equations determining the frontal surface of the wave at the points of discontinuities of the longitudinal and the transverse waves

coincide with the differential equations determining the amplitudes of the corresponding approximate solutions obtained by asymptotic method. The method of establishing differential equations for the points of discontinuities can be applied to the solution of the dynamic boundary value problems, both for homogeneous and heterogeneous media. Use of the asymptotic method in problems of heterogeneous media leads to the situation where the longitudinal and transverse waves propagate independently from each other, which simplifies the solution.—*S. T. V.*

166–110. Chakraborty, S. K. Disturbances of cylindrical origin in an isotropic elastic medium: Geofisica Pura e Appl., v. 33, p. 9–16, 1956.

Elastic waves of cylindrical origin have been previously investigated on the assumption that the exciting function is distributed over the entire inner surface of a cylindrical hole. In this paper, the problems considered are those of disturbances produced by a normal stress over a narrow band of the surface of the cylindrical hole, disturbances produced by an axial shear over a narrow band of the inner surface of the cylindrical hole, and disturbances produced by localized torsional forces over a small portion of the inner surface of the cylindrical hole. The medium is assumed to be isotropic and homogeneous and of infinite extent for the first two cases; for the last an infinite slab of finite thickness is assumed.—*M. C. R.*

166–111. Chakraborty, S. K. On disturbances produced in an elastic medium by twists applied on the inner surface of a spherical cavity: Geofisica Pura e Appl., v. 33, p. 17–22, 1956.

A mathematical study of elastic waves produced in an isotropic elastic medium by twists applied on the surface of a spherical cavity.—*M. C. R.*

166–112. Knopoff, L. The attenuation of compression waves in lossy media: Seismol. Soc. America Bull., v. 46, no. 1, p. 47–56, 1956.

It is shown, theoretically, that at large distances from a source in a viscoelastic medium the acceleration due to a spherical stress impulse falls off inversely as the 5/2 power of the distance. At short range the 5/2-power law does not hold. By means of modeling experiments on a wax slab, oil-coupled lithium sulfate transducers are found to have excellent directional properties. The experimental data agree admirably with theory assuming a loss mechanism for the wax of the internal viscosity type. Investigation of the several orders of multiple reflection amplitudes shows that consistency in the measured reflection coefficients is achieved if the 5/2-power law holds.—*I. Z.*

166–113. Yamakawa, N. Investigation of the disturbance produced by spherical obstacles on the elastic waves (I). On the scattering of the elastic waves by a spherical obstacle [in Japanese with English summary]: Quart. Jour. Seismology, v. 21, no. 1, p. 1–12, 1956.

If primary waves incident upon a spherical obstacle whose radius is sufficiently small as compared with wave length λ are denoted by $\Delta = Ae^{i(hx-pt)}$, $u_x = (-iA/h)e^{i(hx-pt)}$, then the scattered P waves, reckoned at the distant point whose polar coordinates are $r(\gg\lambda)$, θ, are given by $u_1 = -[iha^3/r]\,[B_0 - B_1 \cos\theta - B_2/4\ (3\cos 2\theta + 1)]e^{i(hr-pt)}$, $v_1 = 0$, and the scattered S waves are given by $u_2 = 0$, $v_2 = -[iha^3/r]\,[C_1 \sin\theta + 3/2\ C_2 \sin 2\theta]e^{i(hr-pt)}$, where U_i, v_i are respectively the r, θ component of the displacement, and B_i, C_i are constants.—*Author's abstract*

166–114. Sato, Ryosuke. The reflection of elastic waves on corrugated surface [in Japanese with English summary]: Zisin, v. 8, no. 1, p. 8–22, 1955.

The reflection of elastic waves on a corrugated free surface is investigated, assuming the depth of the corrugations to be small in comparison with the length of the waves. If the wavelength of the corrugation is small in comparison with that of the distortional wave, the waves reflected as body waves are regularly reflected waves; their amplitudes diminish as depth increases, and they are propagated in both directions with the velocity depending upon the wavelength of the corrugated surface and the angle of incidence. When the wavelength of the corrugations is large, there is an increase in number of spectra of reflected body waves but as long as the wavelength of the corrugations is finite, the waves are propagated along the surface.—*V. S. N.*

166–115. Homma, S. Boundary waves of longitudinal type along a continuously varying intermediate layer: Geophys. Mag., v. 27, no. 1, p. 35–59, 1956.

A posthumous paper, prepared for publication by T. Hirono and T. Nagamune, on the possible existence of a longitudinal boundary wave in a medium in a part of which properties vary continuously.—*M. C. R.*

166–116. Usami, T. The reflection and refraction of elastic waves at sea bottom: Geophys. Mag., v. 27, no. 1, p. 77–92, 1956.

Amplitudes of reflected and refracted waves are determined for the case when a *SV* wave is incident in a solid against water, taking into account the compressibility and depths of the water and gravity. The existence of the water surface leads to resonance phenomena, predominantly in the water, under certain depth-period relationships.—*M. C. R.*

166–117. Sato, Ryosuke. On Rayleigh waves generated at rough surfaces (1) (two dimensional case) [in Japanese with English abstract]: Zisin, ser. 2, v. 8, no. 3, p. 121–137, 1956.

A mathematical investigation of Rayleigh waves generated at a "rough surface" when the incident waves have the form of a unit function and when it is assumed that the slope and magnitude of roughness are small compared with the wavelength of the incident waves. Under these conditions Rayleigh pulses appear both in the direction of incident pulse (positive direction) and in the opposite direction (negative), and are generally larger in the positive than in the negative direction, though confined to the neighborhood of the surface. When *SV* waves are incident at an angle larger than the critical angle, the pulse is very large compared to those for other angles of incidence. The larger the angle of incidence, the sharper the Rayleigh pulse is in the positive direction.—*V. S. N.*

166–118. Homma, S. Rayleigh waves in a medium with superficial double layers: Geophys. Mag., v. 27, no. 1, p. 17–34, 1956.

A posthumous paper, prepared for publication by T. Hirono and T. Nagamune which deals with Rayleigh waves in a doubly stratified layer superposed on a semi-infinite medium. The solution is obtained in matrix form and checked by considering extreme cases that reduce it to simpler well-known cases.—*M. C. R.*

166–119. Yamaguchi, Rinzo, and Satō, Yasuo. Stoneley wave—its velocity orbit and the distribution of amplitude: Tokyo Univ. Earthquake Research Inst. Bull., v. 33, pt. 4, p. 549–559, 1955.

From tables and graphs calculated of the relations among ρ^1/ρ, μ^1/μ and $(V/Vs)^2$, if any two are given, the third can be obtained. The calculations show that the Rayleigh wave (the velocity of which is $\sqrt{0.8453}...Vs$) is the limiting case of the Stoneley wave in which ρ^1/ρ and μ^1/μ both tend toward zero. The ratio of vertical to horizontal displacement is a minimum and equal to that of the Rayleigh wave when $(V/Vs)^2=0.8453$; the ratio increases as ρ^1/ρ increases and the horizontal displacement vanishes when ρ^1 becomes equal to ρ. The sense of rotation is retrograde. The distribution of amplitudes is shown in nine figures. In the strict sense a Stoneley wave (one propagated along the surface of separation of two semi-infinite mediums) cannot exist, and the term should be used for the phenomenon that approximately shows the properties of the Stoneley wave because the thickness of the layer is sufficiently large compared with the wavelength.—*M. C. R.*

166–120. Oblogina, T. I. Dynamichezkiye karakteristiki diffragirovannykh uprugikh voln [Dynamic characteristics of diffracted elastic waves]: Akad. Nauk SSSR Izv. Ser. geofiz. no. 4, p. 377–390, 1956.

A discussion of the dynamic properties (the variations of amplitudes and phases) of diffracted seismic waves. The incoming wave is considered as a sequence of impulses undergoing interference bringing about variations of the amplitudes of individual impulses. The dynamic traveltimes of individual waves are computed, first for a plane diffracted wave; later the three-dimensional problem is treated and the vertical and the horizontal components of the diffracted wave are determined. Some applications of the theory in seismology and seismic prospecting are discussed.—*S. T. V.*

166–121. Terry, N. B., and Woods, H. J. The measurement of elastic wave velocity in small cylindrical specimens: British Jour. Applied Physics, v. 6, no. 9, p. 322–325, 1955.

A modification of the composite oscillator method developed by Quimby is suitable for determining elastic constants of minerals with a natural rodlike shape or that can be prepared in such form and can give results with an accuracy of the order of 1 percent for specimens only 5 mm long and 0.5 mm across. Specimens are cemented to a nickel rod that is excited magnetostrictively so the resonant frequency can be measured and the elastic wave velocity in the specimen calculated. Mismatching of specimen and transducer cross sections does not seriously affect results of the ratios if the cross sections are within the range 1 to 3. Wave velocities are given for barite, gypsum, wollastonite, kyanite, and wave velocities and Young's modulus for crocidolite, tremolite, and chrysotile.—*M. C. R.*

166–122. Kasahara, Keichi. Experimental studies on the mechanism of generation of elastic waves V: Tokyo Univ. Earthquake Research Inst. Bull. v. 33, pt. 3, p. 411–417, 1955.

Elastic waves were generated at a cavity in a block of agar-agar and observed at the free surface of the block. The initial motion at the epicenter was impulsive, and the amplitude decreased as the focal depth increased. Motion begins simultaneously at points close to the epicenter in an area that increases as the depth

of the origin increases. The amplitude of the main disturbance is a maximum at a critical distance depending on the focal depth. The free surface wave has a linear traveltime curve from the epicenter.—*M. C. R.*

166–123. Shimozuru, Daisuke. Study on the elasticity near the melting point. Part 2. Velocity of dilatational wave in sodium: Tokyo Univ. Earthquake Research Inst. Bull., v. 34, pt. 1, p. 87–96, 1956.

The velocity of ultrasonic longitudinal pulses in a cylindrical rod of sodium was determined as a function of temperature from room temperature to several degrees above the melting point. The velocity decreases almost linearly with temperature from room temperature to several degrees below the melting point, then begins to drop sharply and decreases discontinuously at the melting point by about 7 percent. The thermal variation of the modulus of rigidity was calculated from thermodynamical considerations using Bridgman's measurement of the compressibility of sodium. Rigidity decreases almost linearly with temperature and then sharply several degrees below the melting point; rigidity does not vanish at the melting point but seems to decrease by a factor of 3 when the temperature is raised from room temperature to the melting point.—*M. C. R.*

166–124. Korschunow, Alex. Ein Beitrag zur Seismik der Lockerböden und oberflächennahen Schichten [A contribution to the applied seismology of unconsolidated ground and near-surface layers]: Gerlands Beitr. Geophysik, Band 65, Heft 1, p. 11–49, 1955.

Experimental field observations of Rayleigh waves from hammer blows and small explosions indicate that the Rayleigh wave mechanism affects a group of layers whose lower limit is the refracting horizon that represents the threshold for the amount of energy involved. Extrapolation of these results to large explosions and near earthquakes shows that the thickness of the group of layers affected by Rayleigh waves increases with energy, hence the assumption is invalid that the theoretical model of Rayleigh waves, limited to one layer over semispace, can be applied to other orders of magnitude.

Comparison of direct interpretation of the seismograms with the results of harmonic analysis shows that the usual refraction scheme does not work for the uppermost unconsolidated layer, because instead of direct longitudinal waves the group velocity of Rayleigh waves is being evaluated. Finally, a practical method is proposed for determining the absorption coefficient of surface waves from the group wave length.—*D. B. V.*

166–125. White, J. E., Heaps, S. N., and Lawrence, P. L. Seismic waves from a horizontal force: Geophysics, v. 21, no. 3, p. 715–723, 1956.

As part of a program of fundamental research on seismic waves, a generator was built for applying a transient horizontal force at the surface of the ground and the resulting seismic waves were observed in some detail. The force is applied when a mass swinging through an arc strikes a target anchored to the earth. Surface geophones along a line in the direction of the force register vertically polarized shear waves refracted back up to the surface, whereas geophones on a line perpendicular to the force register horizontally polarized shear waves. The speeds of the two types of shear waves are often different, indicating anisotropy. Geophones buried below the target show a down-going shear wave. Variation of amplitude with angle, and other features, are in qualitative agreement with the results given by Rayleigh and others for the waves due to a force at a point in an infinite solid. Love waves and other surface waves were observed, which of course would not be expected from an interior force.—*Authors' abstract*

166–126. Paterson, Norman R. Seismic wave propagation in porous granular media: Geophysics, v. 21, no. 3, p. 691–714, 1956.

Theoretical and experimental studies have been made of the manner in which sound waves are propagated in porous granular aggregates. A cylindrical piezoelectric source is used and this simulates the explosion of a charge in a seismic shot-hole.

It is found that in general two waves of volume expansion are propagated and that these involve coupled displacements of both constituents of the media. The waves are termed frame-waves, air-waves or liquid-waves depending upon the nature of the pore-filler and the relative displacements of the constituents.

The frame-wave velocity is dependent upon the strength of the frame, the densities of solid and pore-filling materials, and the texture of the medium. Air- and liquid-wave velocities are related to the texture of the medium and to the density and viscosity of the pore-filler. Frame-strength is important to a lesser degree. Waves are dispersive only in the case of media of very low permeability.

Attenuation is related to viscosity, texture, and frequency. Scattering is probably important only at the highest frequencies and largest particle diameters used in the experiments.

It is shown that porosity and permeability of a beach sand can be inferred from velocity measurements. These properties provide information regarding grain-size, sorting, and the nature of the pore-filler.—*Author's abstract*

166–127. Takahasi, Ryutaro. A short note on a graphical solution of the spectral response of the ground: Tokyo Univ. Earthquake Research Inst. Bull., v. 33, pt. 3, p. 259–264, 1955.

A graphical method is described for determining the spectral response of the ground (the amplitude of oscillation at the surface of the ground when an infinite train of harmonic elastic waves of unit amplitude is propagated from beneath to a stratified ground) and the responses of three different structures are shown. "The propagation of elastic waves in the ground normally to layers is similar to the propagation of electric waves in a transmission line with one end open. The soil particle velocity and stress due to the elastic wave correspond to the current and voltage in the line. The present method is, in effect, a modification of the well-known method of the position angle."—*M. C. R.*

ELECTRICAL EXPLORATION

166–128. Tikhonov, A. N., and Shakhsuvarov, D. N. O vozmozhosti ispol'zovaniya impedantsa yestesvennogo elektromagnitnogo polya zemli dlya izucheniya eye verkhnikh sloyev [On the possibility of using the impedance of the natural electromagnetic field of the earth in exploration of the upper layers of the earth]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 4, p. 410–418, 1956.

The electromagnetic field pattern produced in stratified plane-parallel ground by a plane electromagnetic wave arriving from the air is determined by the evaluation of the impedance of the ground; the expression for the impedance is given in a general form that can be specialized to given properties of the ground. Information on the conductivity and the thickness of the deep layers of the ground, even if covered with electrically poorly conductive strata, may be obtained in this way. Data on the damping of the waves as a function of their frequency and the electric properties of the ground are given.—*S. T. V.*

166–129. Khalfin, L. A. Pole tochechnogo istochnika v prisutstvii szhatogo i vytyanutogo sferoidov [The field of a point source in the presence of an oblate and a prolate spheroid]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 657–668, 1956.

A solution is obtained for the distortion produced by spheroidal bodies of finite electrical conductivity in the field of a point source.—*S. T. V.*

166–130. Kebuladze, V. V. O vozmozhnosti ispol'zovaniya elektrotelluricheskikh vozmushcheniy i dlinnoperiodnykh variatsiy v geologicheskoy razvedke [On the possibility of using electrotelluric disturbances and the long-period variations in geologic exploration]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 613–616, 1956.

Long period variations of telluric currents are more suitable for geologic exploration than short-period variations, which may be affected by disturbances from industrial or atmospheric conditions. Long-period variations also give more reliable information on deep layers than the short-period variations. For this purpose two sets of identical galvanographs record daily variations of telluric currents both at a base station and at a temporary station. The measuring lines 100 m to 200 m long, were laid out in the same directions at both stations and with identical electrodes.—*S. T. V.*

166–131. Coulomb, J[ean]. Les variations rapides du champ magnétique et des courants telluriques [Rapid variations of the magnetic field and telluric currents]: Maden Tetkik ve Arama Enstitüsü Mecmuasi, no. 46/47, p. 92–105, 1954/55.

This is a detailed explanation of the new "magneto-telluric" method of prospecting [see Geophys. Abs. 154–14645], based on measurement of the electrical field produced in the earth during geomagnetic disturbances. The theory, instruments, types of geomagnetic disturbances, and actual examples of measurements are discussed.—*D. B. V.*

166–132. Chetayev, D. N. Teoriya zondirovaniya impul 'sami vklyucheniya postoyannogo toka v nezazemlennuyu petlyu [Theory of sounding using direct current impulses in a nongrounded loop]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 595–598, 1956.

An electromagnetic exploration technique is described involving a loop formed on the ground and a measuring frame in which an electric impulse is induced every time the loop S is energized by switching of the direct current. The theory of this method is given. The results are presented as general analytical formulas, then applied to specific cases, and also in the form of graphs.—*S. T. V.*

166–133. Ovchinnikov, I. K. K teorii raspredeleniya toka tochechnykh i lineynykh zazemleniy v neodnorodnom poluprostranstve [Contribution to the theory of the dissemination of current from point and linear electrodes in a heterogeneous semispace]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 4, p. 419–430, 1956.

The spreading of current from a point electrode is analyzed for the case of a stratified heterogeneous semispace and by application of Hankel's functions the potential distribution is obtained in general form. The solution is extended by integration to the case of a linear electrode of infinite length over the earth's sur-

face, and an expression is derived for the apparent resistivity of the ground. Current distribution in the ground when two parallel electrode lines are spread on the earth's surface over homogeneous as well as heterogeneous semispace is also discussed. The solutions are illustrated by graphs.—*S. T. V.*

166–134. Enenshtein, B. S., Rybakova, E. V., and Skugarevskaya, O. A. Nekotoryye rezul'taty eksperimental'nykh issledovaniy reshima stanovleniya elektricheskogo toka v zemle [Some results of experimental investigations on the building up of electric current in the ground]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 4, p. 475–478, 1956.

Oscillographic records of field experiments show that the building up of the front of the feeding impulse takes place in about 2×10^{-3} sec; the duration of the transient period for an electrode spacing of 1,000 m is then only 0.042 sec. Graphs obtained with different electrode arrangements over different structures show that the results of the experiments in the field are in good agreement with theoretical computations by Tikhonov and Skugarevskaya (see Geophys. Abs. 129–9235 and 148–13476).—*S. T. V.*

166–135. Vladimirov, N. P., Naumenkov, N. L., Rassomakhin, G. I., and Skugarevskaya, O. A. Ob eksperimental 'nykh issledovaniyakh yavleniya stanovleniya elektromagnitnogo polya v mnogosloynoy srede [Experimental investigations of the building-up of the electromagnetic field in a multilayer medium]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 708–711, 1956.

The building up of the electromagnetic field in a three-layer medium was studied with current-electrode spacings of 600, 1,200, and 1,800 m; a portable generator, a direct-current amplifier, a calibrating element for measuring impulses, and an oscillograph with a recording speed of as much as 8 m per sec were used. With the electrode spacing of about 1,800 m, the curve of the building up of the electromagnetic field is clearly affected by the electrical properties of the ground; thus, the electromagnetic method can be used for determination of the electrical properties of the ground in profiles more than 1,800 m long.—*S. T. V.*

166–136. Teisseyre, Roman. The conducting half-plane problem in geophysical exploration: Acta Geophys. Polonica, v. 2, no. 3, p. 140–148; v. 2, no. 4, p. 169–175, 1954.

The assumption of a conducting half-plane in the theory of inductive methods leads to serious mathematical difficulties, unsolved accurately even for the problem of plane waves. In these papers a solution is obtained for the problem of diffraction on a perfectly conducting half-plane for a magnetic dipole directed in a plane perpendicular to the conductor by methods based on those of Clemmov, Senior, and Vandakurov. These solutions are of significance in low-frequency electromagnetic exploration techniques as the conducting half-plane can be taken to represent a conducting vein. For the so-called inductive profile method (in which a constant distance is maintained between the transmitter and receiver), curves are obtained for conducting planes perpendicular to and parallel to the surface of the earth. These indicate that discovery of a conducting half-plane by the inductive method is possible only if the plane is at shallow depths.—*M. C. R.*

166–137. Sawicki, Jerzy. Magnitnoye pole magnitnogo dipolya nakhodyashchegosya na poverkhnosti zemli [The magnetic field of a magnetic dipole placed on the surface of the earth]: Acta Geophys. Polonica, v. 2, no. 2, p. 97–104, 1954.

This is an analysis of the field produced by a magnetic pole of oscillating intensity on the surface of the ground. The surface is assumed to be a plane separating a medium in which the electrical conductivity is 0 and the magnetic permeability is 1 from one in which the electrical conductivity and magnetic permeability can assume any arbitrary values. By using cylindrical coordinates with the zero point at the pole, Sommerfeld's formulas for the magnetic potentials in either medium can be readily obtained. Two special cases are considered: one in which the magnetic permeability is much greater than 1, and that corresponding to long waves used in geophysical exploration.—*S. T. V.*

166–138. Sato, Gakuji. Study on equilibro-four-electrode method (I).—Theoretical curves of apparent resistivity for simple ore models: Butsuri-Tankō, v. 8, no. 3, p. 104–114, 1955.

The "equilibro-four-electrode method" is most suitable for prospecting for deep ore bodies. Calculated resistivity curves for a vein, a good conductive hemispherical filled sink, and a buried conductive sphere are shown.—*M. C. R.*

166–139. Yoshizumi, Eizaburo. On a electrical prospecting by traveling waves—Introduction: Butsuri-Tankō, v. 8, no. 3, p. 115–122, 1955.

A proposal for a new electrical prospecting method that uses traveling waves and can be considered as a kind of transient method.—*M. C. R.*

166–140. Yoshizumi, Eizaburo. On a electrical prospecting by traveling waves—Traveling waves in the case of a semi-infinite medium [in Japanese with English summary]: Butsuri-Tankō, v. 9, no. 1, p. 16–22, 1956.

A discussion of traveling waves in a semi-infinite medium and original and "first reflected" potential waves. The resistivity in a semi-infinite medium and the contact between two media of different resistivities can be determined by wave shapes.—*M. C. R.*

166–141. Chetayev, D. N. Odna teorema elektrozarvedki [A theorem of electric exploration]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 4, p. 473–474, 1956.

In any arrangement in electric resistivity methods the introduction of a third electrode between two feeding electrodes cannot produce any improvement by increasing the contrast of the observed anomalies.—*S. T. V.*

166–142. Kiyono, Takeshi, and Kimura, Koichi. Theoretical study on the electromagnetic induction method (IV) [in Japanese with English summary]: Butsuri-Tankō, v. 9, no. 1, p. 23–28, 1956.

This paper deals with the secondary magnetic field due to a spheroidal perfect conductor in the uniform magnetic field, the direction of which is perpendicular to the axis of rotation. The expressions obtained are rather simple, and some numerical examples interesting for exploration problems are shown. By these formulae combined with the results of Part 1 (the case of axial symmetry) [see Geophys. Abs. 162–78] we can compute the secondary field due to a spheroid in the uniform field of arbitrary direction.—*Authors' summary*

166–143. Ohashi, Shuji. On the figures of SP distribution (Part 4)—At the Kutchan mine area [in Japanese with English summary]: Butsuri-Tankō, v. 9, no. 1, p. 29–33, 1956.

A discussion of "dish-type" polarization at a negative center, high potential in limonite areas and low potential near iron-sulfide ore, and the relations between self-potential and resistivity indications.—*M. C. R.*

166–144. Mooney, Harold M., and Wetzel, W. W. The potentials about a point electrode and apparent resistivity curves for a two-, three-, and four-layer earth: 146 p. and curves, Minneapolis, Univ. Minnesota Press, 1956.

Apparent resistivity curves for approximately 2,300 two-layer, three-layer, and four-layer horizontal structures, tables of electric potential about a point electrode at the surface of a layered medium, and tables for the numerical evaluation of an integral of the form $F(r)=\int_0^\infty A(t)J_0(rt)\,dt$, with explanation for their use.—*M. C. R.*

166–145. Krajčovič, Silvester. K hĺbkovemu dosahu geoelektrických odporových metód [On the depth range of the geoelectric resistivity method]: Geol. Práce, zprávy 5, p. 108–119, 1956.

A critical analysis of the accuracy and range of electrical resistivity measurements with four- and three-electrode configurations. There is a rapid decrease in attainable accuracy in the determinations of the thickness of individual layers with the number of layers; with only two layers accurate results cannot be obtained for depth exceeding $0.7d$ where d is the distance between the feeding electrodes. The attainable accuracy is determined not only by the spread of the electrodes but also by the ratio of electric resistivity of invividual layers and their thickness. A table is given of different constants of the arrangement and their effect on the accuracy of the measurements.—*S. T. V.*

166–146. Ŝumi, F[ranc]. Geoelectric exploration of inclined thin beds and ore veins: Geophys. Prosp., v. 4, no. 2, p. 194–204, 1956.

The equation for the deformation of the homogeneous electrical field caused by a long inclined thin plate is given. By means of this equation a diagram is designed for the direct depth determination of the upper and the lower edge and for the inclination of the plate. The equation and the diagram are proved by small scale model measurements and applied in field exploration.—*Author's abstract*

166–147. Chastenet de Géry, Jérôme, and Kunetz, Géza. Potential and apparent resistivity over dipping beds: Geophysics, v. 21, no. 3, p. 780–793, 1956.

The general solution to the problem of the potential of a point source of current located on the surface of the earth near a dipping bed is presented in a closed form involving modified Bessel functions of the second kind. For numerical evaluation, the solution is expressed in terms of elementary circular and hyperbolic functions in a manner that exhibits the image theory solution plus a correction. Theoretical equipotential lines for a bed dipping 45° and reflection coefficient of 0.8 illustrate the character of the solution. Vertical profiles of apparent resistivity are shown with electrode configuration oriented parallel to the strike and perpendicular to the strike. The Schlumberger electrode configuration used in this study provides a simple means of correcting for lateral inhomogeneity.—*R. G. H.*

166–148. Shakhsuvarov, D. N. Metodika interpretatsii resul'tatov nablyudeniy elektromagnitnogo polya pri dipol'nom zondirovanii [The method of interpreting the results of observations of the electromagnetic field in dipole sounding]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 497–503, 1956.

In a modification of the electromagnetic method with alternating current, two current electrodes A and B and two measuring electrodes M and N are placed on two parallel lines, with the midpoints of AB and MN on the common perpendicular. Formulas are derived for the parameters of the electric and magnetic fields produced, and the procedure of constructing and interpreting master charts for this dipole arrangement of the electrodes is described for the cases of two and three layers.—*S. T. V.*

166–149. Tsekov, G. D. Metodika rascheta krivykh VEZ dlya potentsial-ustanovki s ispol'zovaniyem krivykh VEZ dlya gradiyent-ustanovki [Method of evaluating curves of the potential variation along a vertical electric profile, using similar curves for the potential-drop arrangement]: Akad. Neftyanoy Promyshlennosti Trudy, vypusk 2, p. 142–149, 1955.

Curves of the variation of potential along a vertical electric profile fed from one point are often desirable in interpreting the measurements obtained in well logging, when the penetration of the mud into the walls of the formation is to be taken into account. Numerous such charts, computed theoretically, exist for the variation of potential drop. A method is given of computing the potential-value curve from known potential-drop curves with few additional known data. To facilitate the computations, tables are given of numerical values corresponding to different assumptions about the properties of the formations surrounding the drill hole.—*S. T. V.*

166–150. Belluigi, A[rnaldo]. Über ein geoelektrisches inverses Problem [On a geoelectrical inverse problem]: Zeitschr. Geophysik, Jahrg. 21, Heft 3, p. 135–151, 1955.

Two solutions are given for the geoelectric inverse problem with respect to two layers carrying a uniform steady (natural or artificial electrotelluric) current: one by use of Hermite's polynomials, the other by the method of finite differences. A graphical method (referred to as "coincidences of the electric isolines") is also developed for unique determination of the structure.—*M. C. R.*

166–151. King, A. J. The siting of water-borings at Mlali, Morogoro: Tanganyika Geol. Survey Rec., v. 4, p. 79–80, 1954.

Four sites chosen for water boreholes were examined by the electrical resistivity method. Aquifers were predicted at three of the sites and, after drilling, sources of 20,000 gallons per day were located.—*V. S. N.*

166–152. King, A. J. Geophysical investigation at the Kidunda dam site: Tanganyika Geol. Survey Rec., v. 4, p. 74–78, 1954.

An electrical resistivity survey of the alternative centerlines proposed for the Kidunda Dam was made to supplement the information obtained from boreholes and to increase the accuracy of interpolation between them. Tentative subsurface correlation indicates the absence of any major lateral discontinuities.—*V. S. N.*

166–153. Wiebenga, W. D. Geophysical investigations of water deposits, Western Australia: Australia Bur. Min. Resources Geology and Geophysics, Bull. 30, 48 p., 1955.

Resistivity methods and some magnetic work were used to assist in a search for additional ground water in parts of Western Australia. Results show that in 75 percent of the measurements made, errors in depth determinations were within ±20 percent. It was often possible to recognize limestone, cementation zones in limestone, sandstone, and ground-water levels, and the transition, in granite areas, from weathered to fresh granite. Where conditions were favorable and when the porosity of a formation was known, a satisfactory correlation was obtained between resistivity and the salt content of solutions in a formation. In the Cue area conditions favorable for a large supply of good-quality water were found. The value of future surveys for ground water would be enhanced if more comprehensive bore information were available. Such information should include the porosity and permeability of formations, screen analyses of samples. and salt content and resistivity of bore water.—*V. S. N.*

166–154. Wilckens, Friedrich. Geoelektrische Untersuchung der Graphitlagerstätte Kropfmühle im bayerischen Wald [Geoelectrical investigation of the Kropfmühle graphite deposit in the Bavarian Forest]: Geofisica Pura e Appl., v. 33, p. 91–100, 1956.

The Kropfmühle graphite deposit in Bavaria has been delineated by means of self-potential measurements. Supplementary resistivity measurements gave only qualitative results, as too many layers were involved for quantitative interpretation. Comparison with self-potential measurements on other graphite deposits shows that the magnitude of the maximum potential difference is proportional to the carbon content of the graphite, which suggests the possibility of direct estimation of quality of ore by means of self-potential measurements.—*D. B. V.*

166–155. Schenk, E[rwin]. Geoelektrische Untersuchung des Mineralquellengebietes von Selters a. d. Lahn [Geoelectric investigations of the mineral spring area of Selters a.d. Lahn]: Oberhess. Gesell. Natur- u. Heilkunde Geissen Ber., Naturw. Abt., Band 26, p. 51–69, 1954.

Resistivity measurements were made in the Lahn valley near Selters, about 35 km west of Giessen, Germany, in order to define the extent of the underground circulation of the mineral springs. Difficulties in interpretation arising from complicated structure were avoided by adapting the measurements to the structural conditions; vertical and horizontal profiles were generally made along the strike of the schistosity, in other directions only for supplementary measurements on local anomalies. The principal natural springs were found to originate from independent underground systems.—*D.B.V.*

166–156. Mielecke, Walter. Geoelektrische Messungen als Hilfsmittel geologischer Kartierung [Geoelectrical measurements as an aid to geologic mapping]: Zeitschr. angew. Geologie, Band 2, Heft 4, p. 154–158, 1956.

Electrical resistivity measurements can be used to aid geologic mapping in the north German plain, where the irregular unconsolidated near-surface formations are covered by ground moraine and sand and gravel deposits. As the apparent

resistivity here depends on grain size, horizontal profiles obtained at a uniform depth of 5 m provide relative results that can be interpreted in geologic terms.—*D. B. V.*

166–157. Iida, Kumizi, and Nakai, Junji. An investigation of orebody location and spontaneous polarization anomaly [in Japanese with English summary]: Butsuri-Tankō, v. 9, no. 1, p. 13–15, 1956.

Self-potential anomalies over a known ore body at the Hanabusa copper mine in Gifu-ken can be satisfactorily interpreted by Yüngül's analytical method.—*M. C. R.*

166–158. Yosikawa, Haruo. Some example of electrical prospecting in the area bearing black ore ("Kuroko") deposits: Butsuri-Tankō, v. 8, no. 3, p. 96–103, 1955.

Pyrite ore deposits at the Hanaoka mine can be detected by electrical methods but the deposits that contain much sphalerite or barite cannot. However, the silicified zones or argillized zones that are related to the black ore can be recognized by resistivity or self-potential methods.—*M. C. R.*

166–159. Obara, Nobuhiko. Geological researches for Takayama dam site Kyoto Prefecture, accompanied by electric resistivity prospecting: Geol. Survey Japan Bull., v. 6, no. 9, p. 1–10, 1955.

An electrical resistivity survey was made at the site of the proposed Takayama dam to determine the thickness of the weathered zone in the granodiorite at one end of the dam and the thickness of the detritus accumulated in the riverbed.—*V. S. N.*

166–160. Minakawa, Shinya, and Yamagata, Osamu. Report on the resistivity survey of Oami landcreep area in Asumamura, Higashitagawa-gun, Yamagata Prefecture: Butsuri-Tankō, v. 8, no. 2, p. 41–51, 1955.

A zonal arrangement of high- and low-resistivity areas was observed. Some low-resistivity planes not related to the structure of the sedimentary rocks may be related to the base of the slide.—*M. C. R.*

166–161. Shibatō, Kihei; Kobayashi, Hajime; and Ono, Kichihiko. Geophysical exploration at Tsuzura, Miyazaki Prefecture: Geol. Survey Japan Bull., v. 6, no. 12, p. 9–14, 1955.

A report of the magnetic and self-potential surveys of the area of a contact metamorphic, lead-zinc deposit.—*V. S. N.*

166–162. Suyama, Junji; Kobayashi, Hajime; and Ono, Kichihiko. Geophysical prospecting in the Tsumo Mine, Shimane Prefecture: Geol. Survey Japan Bull., v. 6, no. 6, p. 35–42, 1955.

A magnetic and an electrical survey in the Tsumo Mine, Shimane Prefecture resulted in the location of a distinct magnetic anomaly near the Maryuama deposits and an obscure one near the Senninmabu pitmouth.—*V. S. N.*

166–163. Bukhnikashvili, A. V. Opyt izmereniya korotkoperiodnykh variatsiy zemnykh tokov s tsel'yu ustanovleniya geologicheskogo stroyeniya uchastka Voyenno-Gruzinskoy dorogi [Experiences with the measurement of short-period variations of telluric currents as a method of determining geologic structure applied to the section of the Georgian Military Highway]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 609–612, 1956.

To determine subsurface geologic conditions along the Military Georgian Highway crossing the main ridge of the Caucasus, short-period variations of telluric currents were recorded at stations at intervals of 6 to 8 km on identical oscillographs, one recording north-south, the other east-west variations, and at the base station in the Geophysical Observatory in Dusheti. The ratios of ir (i being measured current, and r the specific electric resistivity) were found to be strongly affected by the surrounding geologic formations, thus indicating the presence of slates, or limestones, marls, and so on. On this basis a geologic profile was constructed for a total length of more than 100 km.—*S. T. V.*

166–164. McMurry, H. V., and Hoagland, A. D. Three-dimensional applied potential studies at Austinville, Virginia: Geol. Soc. American Bull., v. 67, no. 6, p. 683–696, 1956.

When an electric current is passed between an electrode imbedded in mineralized body of low resistivity and a remote electrode, potentials measured in drill holes reveal that the host rocks are strongly anisotropic. In the Austinville, Virginia, area biaxial anisotropy can be explained by the bedding of the host rocks. The prominent triaxial anisotropy is thought to be controlled by the mineralization. Applied potential studies are useful in determining the continuity of ore bodies between the current source and drill holes in which potentials are measured, and in guiding the delineation of ore bodies by diamond drilling after penetration by a discovery hole.—*L. C. P.*

ELECTRICAL LOGGING

166–165. Al'pin, L. M. Setochnoye modelirovaniye karottazha soprotivleniy [Model studies of resistivity well logging by mathematical nets]: Prikladnaya geofiz., vypusk 10, p. 48–73, 1953.

The theoretical treatment of problems in electric well logging is time-consuming and difficult in practical application but can be replaced by model experiments. In such cases the data obtained from the measurements are later analyzed and the problems solved by successive approximations. In well-logging problems, because of the cylindrical symmetery always evident, three-dimensional continuous space can be replaced by a network of discrete linear elements built up of conductive wires of determined electrical resistivity, thus presenting a two-dimensional plane problem.

The physical foundations of the method, the mathematical procedures in handling the experimental data, and the determination of the dimensions of various elements and their electric properties are discussed.—*S. T. V.*

166–166. Martin, Maurice, and Dumanoir, J. L. Determining true resistivity: World Oil, v. 143, no. 1, p. 95–105, 1956.

Comparison of different resistivity logging devices indicates that the 40-inch induction log is the most effective in determining true resistivity.—*L. C. P.*

166–167. Moore, E. James. Laboratory analysis of the electric logging parameters of the Wier sand: Producers Monthly, v. 20, no. 9, p. 35–41, 1956.

Measurements were made of the electric logging parameters on 27 samples of the Wier sand at two places. [The Weir (U. S. G. S. spelling) sand is an economic designation for an oil-producing sand of Mississippian age in West Virginia and Kentucky.] Average values of the *K* factor, cementation factor "*m*," and saturation exponent "*n*" were obtained and studied with the electric logs for a determination of connate water resistivity, fluid saturation, and average porosity. The electric logging parameters were similar at the two places.—*L. C. P.*

166–168. Pryor, Wayne A. Quality of groundwater estimated from electric resistivity logs: Illinois Geol. Survey Circ., no. 215, 15 p., 1956.

The resistivity of ground water from 94 wells in sandstone of Pennsylvanian age is estimated from electric well logs by using the formula: $Rw=(Ra64''\times Rm)/Ra\ 16''$ where: Rw=resistivity of water in the bedrock, $Ra64''$=apparent resistivity of "long normal" resistivity curve (64'' or 71''), $Ra\ 16''$=apparent resistivity of "short normal" resistivity curve (16'' or 18''), and Rm=resistivity of drilling fluid; and by converting the resistivity of the formation water to a sodium-chloride (NaCl) solution equivalent in parts per million.

Comparison of chemical analyses of formation water with calculated values of NaCl-solution equivalent for 94 resistivity logs shows that the chloride content and total solids content of water in sandstone of Pennsylvanian age of the Illinois Basin can be determined within a limited range by the use of resistivity logs. However, the resistivity of the drilling fluid and the temperature of the formation must be taken into account or the conclusions may be erroneous.—*V. S. N.*

166–169. Alger, R. P. Electrical logging problems in the Eocene Wilcox: Texas Petroleum Research Comm., Bull. 44, (Proceedings of the Eighth Oil Recovery Conference), p. 79–101, 1955.

The Wilcox consists of a very thick series of shales, shaly sands and sands, and many lignite beds. The electrical logging problems are many. In the shallow Wilcox, best studied in the presently active Natchez trend, use of the induction log and MicroLog solves most of the logging problems. In the deep Wilcox, any or all logging tools that are now available will not give a high degree of resolution unless mud control is successful. If that control is successful, the use of some combination of auxiliary logs, such as MicroLog, MicroLaterolog, Laterolog, and perhaps the induction log, should provide information to give reliable interpretations.—*V. S. N.*

ELECTRICAL PROPERTIES

166–170. Evernden, J. F., and Verhoogen, J[ohn]. Electrical resistivity of meteorites: Nature, v. 178, no. 4524, p. 106–107, 1956.

The resistivities of several stony meteorites containing different amounts of metal have been measured with a 60-cycle a-c bridge. The resistivity departs by several orders of magnitude from that of the silicate phase and the departure is not proportional to the metal-phase content. On the basis of these measurements, the rapid rise in conductivity at depths of 600 to 900 km in the mantle, inferred by Lahiri and Price, could be explained by textural changes. In the lower part of the mantle, the resistivity is essentially that of the silicate phase.—*M. C. R.*

166–171. Tarkhov, A. G. Opredeleniye elektricheskikh svoystv gornykh porod po zatukhaniyu radio voln [Determination of the electrical properties of rocks by the attenuation of radio waves]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 599–608, 1956.

The electrical properties of the rocks should be determined in place because the data obtained by laboratory measurements on specimens can be different because of the presence of differently mineralized water or impurities and differences in the physical constitution of the rocks. The attenuation of radio waves is affected by the electrical properties of the surrounding formations and can thus give an indication of these properties. Different frequencies of waves are transmitted and the amplitudes are measured in different directions and at different distances from the transmitter. From the measured amplitudes the coefficient of damping can be determined. With data for two frequencies, the electrical resistivity and the dielectric constant can be readily computed.—*S. T. V.*

EXPLORATION SUMMARIES AND STATISTICS

166–172. Boaga, Giovanni. Metodi e strumenti delle moderne ricerche geofisiche [Methods and instruments of modern geophysical research]: Riv. Catasto e Servizi Tecnici Erariali, anno 10, no. 3, p. 161–173, 1955.

A review. Emphasis is placed on the gravity method and Italian practice, but magnetic, electric, seismic, and radioactive methods are included.—*M. C. R.*

166–173. Skeels, D. C. Correlation of geological and geophysical data: Canadian Oil and Gas Industries, v. 9, no. 6, p. 67–72, 1956.

Essentially the same as paper in Oil and Gas Journal (see Geophys. Abs. 162–243).—*V. S. N.*

166–174. Plichon, J. N. Application des méthodes géophysiques aux travaux de génie civil [Application of geophysical methods to civil engineering works]: Inst. tech. bâtiment et travaux publics Annales, 9me année, nos. 103–104, p. 651–670, 1956.

A review of the electrical and seismic methods and their use in civil engineering.—*M. C. R.*

166–175. Hensoldt, Ernst E. Bodenphysik im Fahrbahnbau. 5. Geophysikalische Behandlung [Physics of the ground in construction of arteries of communication. 5. Geophysical treatment]: Geologie u. Bauwesen, Jahrg. 22, Heft 1, p. 1–27, 1956.

This is part of a series on the relation of physical properties of the ground to construction of railways, highways, tunnels, bridges, and the like. The fundamental theory of geophysical methods, particularly the seismic and magnetic, is reviewed. The geological features on which the effects measured depend range from microscopic scale, such as grain size, to the order of large-scale topographic relief. Expensive methods practical in petroleum exploration may not be economical when applied to foundation-engineering problems. In general, regional gravity measurements serve as a base for more detailed surveys by the cheaper electrical or magnetic measurements, and from the combined results the physical play of forces in geological space becomes clear.—*D. B. V.*

166–176. Slichter, L. B. Geophysics applied to prospecting for ores: Econ. Geology, Fiftieth anniversary v., 1905–1955, pt. 2, p. 885–969, 1955.

The use of probability methods in prospecting for blind ore bodies is discussed and illustrated in the first part of this paper. The application of eight different types of geophysical methods is then discussed with specific examples in order from the least expensive reconnaissance to the most expensive detailed method: aeromagnetic, aeroelectromagnetic, ground-magnetic, self-potential, electromagnetic, applied potential, gravitational, and seismic. In the third part of the paper the significance of the broad field of instrumentation in geophysics is considered with a brief discussion of the desirability of better magnetometers for ordinary ground application and with a detailed consideration of sensitivity attainable in light, portable, electromagnetic systems under the restrictions imposed by natural "magnetic noise." The use of electromagnetic prospecting in mining is growing, and the development may be accelerated by use of lighter, faster equipment. Further, the basic limitation on the sensitivity of the electromagnetic systems, the natural magnetic-noise field, may find application in a new type of "sourceless" magnetic prospecting in which natural magnetic fluctuations are used as a source.—*V. S. N.*

166–177. Heinrichs, Walter E., Jr. Status of mining geophysics today: Mining Engineering, v. 8, no. 8, p. 809–811, 1956.

A brief review of the present status of each of the geophysical methods as used in mining exploration.—*L. C. P.*

166–178. Morrisey, N[orman] S. Finding oil with geophysics: Oil and Gas Jour., v. 54, no. 52, p. 123A–123L, 1956.

The important types of oil traps with an explanation of how geophysics can be used to find them.—*D. R. M.*

166–179. McCarver, H. C. Geophysics is here to stay: Oil and Gas Jour., v. 54, no. 52, p. 110–112, 1956.

The more difficult oil is to find, the more necessary geophysics should become; however, geophysics will remain necessary only if it finds oil at a price industry can afford to pay.—*D. R. M.*

166–180. Oliphant, Charles W. (editor). Symposium: Examples of geological and geophysical cooperation in petroleum exploration: Tulsa Geophys. Soc. Proc., v. 2, p. 15–54, 1954.

The advantages of close cooperation between geologist and geophysicist in the interpretation of geophysical data in the following papers:

Cram, Ira H. Geological and geophysical cooperation.—The case in general terms. The natural outgrowth of such cooperation is development of a new type of earth scientist capable of handling satisfactorily all data about the earth, however acquired.

Mossman, R. W. Interpretation of a geophysical prospect.—The history of a seismic survey in East Texas shows successive changes in interpretation as additional geologic information is introduced, ultimately reversing the original interpretation.

Maruchek, Joseph L., and Glidden, Charles H. A geological-geophysical problem in Tillman County, Oklahoma.—Close cooperation between geologist

and seismologist is illustrated by the case history of exploration of an area in southern Tillman County.

Finley, J. E., and Fenner, G. W. Cross-section interpretation in the Anadarko Basin.—Presents seismic and geologic cross sections interpreting the geologic complexities of the Wichita Mountain front and the southern limit of the Anadarko Basin; the most logical solution is obtained when all available data are coordinated, with freedom from professional prejudice.

Rupnik, John J., and Matson, Thomas E. Extension of the Central School East Field, Logan County, Oklahoma by geological and geophysical coordination.—This is a discussion of a 1-day survey in which a shallow subsurface geologic map, combined with seismic data on the Viola limestone, was used as a reference surface. By reducing the limits of error of seismic surveying, coordination of geology and geophysics makes realistic evaluation of structures of small relief.

Hamilton, R. G. Importance of geological studies in the interpretation of quantitative electric log determinations.—Illustrates the importance of using lithologic and geologic information in interpretation of electric logs. The log may indicate the presence of oil or gas, but geologic study determines the commercial value of the prospect.—*D. B. V.*

166–181. Vajk, Raoul, and Walton, George. Geophysical history of Parentis oil field, France: Geophysics, v. 21, no. 3, p. 815–827, 1956.

In 1951, the French Government granted an exclusive exploration permit to the Esso R. E. P. (a Standard Oil Company affiliate) over an area of 4,357,980 acres around Bordeaux in the northern part of the Aquitaine Basin, France. This area was investigated first by surface geology; then it was surveyed by the gravity meter. In checking the gravity anomalies by the reflection seismograph, a subsurface structure was found at Parentis in 1953, which was drilled in 1954, and was proved to be oil bearing. The Parentis oil field is the most important oil field, not only in France, but in all Europe outside the Iron Curtain.

Gravity map, seismograph map, seismic profiles, telluric map and geological contour maps, and cross sections of the Parentis structure are presented.—*Authors' abstract*

166–182. Brand, E. Ergebnisse neuer Aufschlusstätigkeit im Raum Rehden-Aldorf [Results of recent exploratory activity in the Rehden-Aldorf area]: Erdöl u. Kohle, Jahrg. 9, Heft 1, p. 2–9, 1956.

A summary of structural information on the oilfields in the Rehden-Aldorf area in Germany, obtained by various types of exploratory activity including seismic and resistivity measurements.—*D. B. V.*

GENERAL GEOPHYSICS

166–183. Dedebant, G., and Machado, E. A. M. Effectos de ciertos filtros sobre la correlación [Effects of certain filters on correlation]: Meteoros, año, 5, no. 3, p. 163–176, 1955.

The technique of instrumental measurements and methods of analysis of observations, in geophysics as in other fields of science, concerns phenomena studied by means of "filters." Giving this term the strict mathematical sense which it has in the theory of aleatory functions (Blanc-Lapierre and Fortet), the effect on operations of variation, differentiation, and mean is examined. The discussion

shows that the distortion introduced by filtering can be great enough to create veritable "mirages" against which we must always be on guard.—*Authors' summary, D. B. V.*

166–184. Due Rojo, Antonio. Actualidad geofísica de las regiones polares [Geophysics at the present time in the polar regions]: Observatorio de Cartuja (Granada), Trabajos cient., ser. B, año 9, no. 76, 10 p., 1955; reprinted from Urania, no. 240.

A review of the physical characteristics of the north and south polar regions, and geophysical activity by various countries in connection with the coming International Geophysical Year. The information which will be obtained should provide the key to many geophysical problems, but particularly meteorological and magnetic problems.—*D. B. V.*

166–185. Timofeyev, A. N. K metodu kharakternykh tochek [On the method of characteristic points]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 712–721, 1956.

In geophysical exploration many general relations can be readily established from the curve of observed data on the basis of the position of some characteristic points such as the maximums or minimums, the points of inflection, asymptotic points and so on. Several examples are discussed.—*S. T. V.*

GEODESY

166–186. Arnold, K. Über das mittlere Erdellipsoid [On the mean ellipsoid of the earth]: Gerlands Beitr. Geophysik, Band 65, Heft 2, p. 157–162, 1956.

In the Stokes formula for calculation of geoidal undulations, normal gravity enters in, as is known, because gravity anomalies are determined with it. The effects of a change of gravity flattening in the formula for normal gravity on the major axis of the spheroidal level surface, on the geoidal undulations, and absolute deflections of the vertical are given. A way to improve the dimensions of the mean ellipsoid of the earth is shown.—*Author's summary, D. B. V.*

166–187. Tardi, Pierre. Résultats définitifs de la mesure d'un arc de méridien équatorial, effectuée de 1898 à 1906 par une mission française placée sous le contrôle de l'Academie des Sciences [Definitive results of the measurement of an arc of the equatorial meridian in 1898 to 1906 by a French expedition under the authority of the Academy of Sciences]: Acad. Sci. Paris Comptes Rendus, tome 242, no. 5, p. 612–615, 1956.

The length of the arc between the extreme stations of Tulcan at the north and Payta in the south was calculated as 651,764.038 m; the astronomic amplitude of the arc was $6^G5474.69''$. Hence the average length of an arc of 1^G at the equator is 99,544.42 m, of 1° 110,604.92 m. This latter value is close to that obtained by the 18th century expedition.—*M. C. R.*

166–188. Whitten, C. A. Crustal movement in California and Nevada: Am. Geophys. Union Trans., v. 37, no. 4, p. 393–398, 1956.

Resurveys after 20 years of two small triangulation networks crossing the San Andreas fault, one near Monterey Bay and the other near San Luis Obispo, con-

firm the relative movement known to exist between the two sides of the fault zone and indicate an angular change in azimuth of about 1 second of arc every 10 years. Resurvey of an extensive network in the Imperial Valley shows that points on the west side have moved almost 4 ft relative to the east side between 1941 and 1954, and 6 ft with respect to a survey in 1935. The angular distortion is about 1 second per 10 years. Some slippage along the fault is shown. Triangulation observations before and after the earthquakes near Fallon, Nev., indicate the usual rebound effect with the west side of the fault moving northward and a total displacement of more than 8 ft. Levelling surveys indicated the floor of the valley dropped and was tilted some feet.—*M. C. R.*

166–189. Miyabe, Naomi. Vertical earth movement in Nankai District: Geog. Survey Inst. Japan Bull., v. 4, pt. 3–4, p. 1–14, 1955.

Analysis of precise levelling in the Shikoku and Kii districts indicates that the directions of earth movements at the time of the Nankai earthquake in 1946 were opposite to the chronic movement before the earthquake in the Shikoku district and the southern part of the Kii peninsula. Comparison of the preseismic earth movements with "provisional isostatic gravity anomalies" (differences between Bouguer anomalies and the relation of the anomaly to elevation if the area is in gravitational equilibrium) suggests that near the Muroto promontory and in northern Shikoku the crust was deformed to recover isostatic equilibrium.—*M. C. R.*

166–190. Japan Geographical Survey Institute. The observation of the vertical deflection in Japan: Geog. Survey Inst. Japan Bull., v. 4, pt. 3–4, p. 15–161, 1955.

A tabulation of observations from February 1952 to February 1953 and May 1953 to February 1954. A map shows the vectorial deflections for observations from 1940 to 1954.—*M. C. R.*

GEOTECTONICS

166–191. Burgers, J. M. Rotational motion of a sphere subject to visco-elastic deformation. I, II, III: K. Nederland. Akad. Wetensch. Proc., v. 58, no. 4, ser. B, p. 219–237, 1955.

The rotation of a spherical body affected by gravitational, rotational, and visco-elastic forces is considered. The effect of visco-elastic forces is treated in terms of a mechanical model with two springs and viscous damping. Small deformations are considered and the appropriate Eulerian equations of motion developed. The effect of small changes in the moments of inertia produced by causes other than centrifugal force may, in certain cases, be such as to produce large polar wandering.—*P. E. B.*

166–192. Nieuwenkamp, W. Energy in orogenesis and metamorphism: Geologie en Mijnbouw, jaarg. 18, no. 4, p. 128–130, 1956.

Some elementary physical statements are expressed in terms more easily comprehended geologically. Heat flow from the earth is enough to melt an ice sheet only 0.5 cm thick in 1 year, showing vividly how little the earth's internal heat can influence climatic conditions. Heat transfer through volcanoes is shown to be small compared to transfer by conduction; therefore, in proposing theories of volcanism special sources of heat are not necessary, merely a device to concentrate the heat of a sufficient area in the vent. Calculations of the work done in

mountain uplift result in similar conclusions. The maximum temperature rise in a layer of geosynclinal sediments 25 km thick is calculated roughly as 30° in 1 million years; a hundred million years are required to melt such a mass. With no heat loss, heat generated by radioactivity within 1 million years would be 30° for granite, 9° for basalt, 0.5° for iron meteorites; thus a granitic layer 25 km thick can furnish heat sufficient to account completely for the observed heat flow to the surface, and total radioactivity of the earth must be less than half that of iron meteorites and must be concentrated in the upper layers. Considerable amounts of heat are taken up in some geochemical reactions during metamorphism and later released either by erosion or at depth by retrograde reactions. Juvenile matter rising and entering into exothermic reactions introduces a new source of heat; the decrease of radioactivity with depth must be even steeper than calculated above to keep the total amount of radioactivity within the bounds of measured heat flow.—*D. B. V.*

166–193. Bemmelen, R. W. van. The geochemical control of tectonic activity: Geologie en Mijnbouw, jaarg. 18, no. 4, p. 131–144, 1956.

Diffusions of elements at various speeds and intensities occur in the crust and mantle, tending to establish thermodynamic equilibrium; change the chemical and mineralogical composition of rocks; and affect their physical properties, such as density, rigidity, and viscosity. Changes of mean density cause gravity (hydrostatic) imbalance and storing of potential energy which is released intermittently by mass displacements. At the surface these displacements cause differential vertical movements. The seismically and gravimetrically contrasted structure of continents and oceans need not be permanent. Geochemical processes in mantle and crust may cause the crust to grow in thickness and extent or cause continental segments to subside to oceanic depths. They may also produce instability of the earth's axis and polar wandering. As illustration, the observed gravity field of Cyprus is explained on the basis of geochemical processes.—*D. B. V.*

166–194. Eardley, Armand J. The riddle of mountain building: Utah Univ. Bull., v. 46, no. 11, 31 p., 1955.

Text of the 19th annual Frederick William Reynolds lecture.—*M. C. R.*

166–195. Harpum, J. R. Recent investigations in pre-Karroo geology in Tanganyika: Assoc. Services Géol. Africains, Réunion de Nairobi 1954, Compte Rendu et Commun., p. 165–215, 1955.

A summary of the results of recent investigations on the pre-Karroo systems of Tanganyika, including stratigraphic details and correlations. One of the most striking features is the frequent superposition or parallelism of orogenies. This tendency for structural lines to follow older trends which provide lines of least resistance, called "conservatism of tectogens," makes interpretation of the results of radioactive age determinations difficult.—*D. B. V.*

166–196. Rade, J. Notes on the geotectonics and uranium mineralization in the northern part of the Northern Territory, Australia: Econ. Geology, v. 51, no. 4, p. 354–361, 1956.

The geotectonic theories of Kraus are applied to the northern part of the Northern Territory in an attempt to connect the uranium mineralization with the geotectonics. The uranium mineralization favored the structually weak

zones, the sheared anticlines and transverse faults, because of the deep-seated character of these features that were produced directly or indirectly by the bathyrheal underflow.—*V. S. N.*

166–197. Whitten, C. A. Measurements of earth movements in California: California Div. Mines Bull., no. 171, pt. 1, p. 75–80, 1955.

Resurveys by the United States Coast and Geodetic Survey across parts of the San Andreas fault are consistent in showing a slow drift to the northwest at a rate of about 2 inches per year, west of the fault. Reobservation, in 1941, of the triangulation system crossing the San Andreas fault in Imperial Valley, where the earthquake of 1940 occurred, established the fact that the area on the east side of the fault shifted to the southeast and that the area on the west shifted to the northwest. Preliminary results of repeat surveys of triangulation and level schemes in Kern County, in September 1953, suggest that the Bear Mountain block, southeast of the White Wolf fault, moved north-northeast a distance on the order of 1 to 2 feet and the valley block a similar distance in a west-southwest direction. The Bear Mountain block was also elevated, and the valley side was depressed on the order of a foot and a half near Arvin.—*Author's abstract*

166–198. Benioff, Hugo. Relation of the White Wolf fault to the regional tectonic pattern: *in* Earthquakes in Kern County, California during 1952, California Div. Mines Bull., no. 171, pt. 2, p. 203–204, 1955.

For a large and old fault system such as the San Andreas it is not safe to attempt to determine the configuration of the stress pattern now active from the geometry of the break. The easterly deviation of the fault in the vicinity of the Garlock intersection together with the left strike-slip displacements on the Garlock fault indicate that in addition to the regional movements parallel to the San Andreas fault there is a regional movement parallel to the Garlock fault. These two movements are eventually incompatible and it appears that the White Wolf fault is an expression of this incompatibility.—*Author's abstract*

166–199. Hill, Mason L. Tectonics of faulting in Southern California: California Div. Mines Bull., no. 170, p. 5–13, 1954.

The primary structural elements of southern California are two sets of major faults, ranging in length from tens to hundreds of miles, some extending to depths of at least 10 miles, and characterized by lateral slips. Northwest-trending right lateral-slip faults and east-northeast-trending left lateral-slip faults have been active since Jurassic time. Movements on these two sets of faults establish a regional strain pattern of relatively outward-moving wedges in an east-west direction and a relative shortening in a north-south direction. These currently active faults probably are genetically related as conjugate shears to establish a primary regional strain pattern of north-south shortening. This strain pattern extends over an area of more than 100,000 square miles and has been in existence for more than 100 million years. It is geotectonically important because it represents a significant size, with respect to the earth's surface, a significant period of time, with respect to the earth's history, and a significant amount of deformation with cumulative offset on some of the lateral-slip faults amounting to tens or even hundreds of miles. Subcrustal convection currents, possibly maintained by heat exchange between sub-Pacific and sub-North American geoprovinces, may be the primary cause of all tectonic deformation in southern California.—*V. S. N.*

166–200. Hill, Mason L. Nature of movements on active faults in southern California: California Div. Mines Bull., no. 171, pt. 1, 37–40, 1955.

The principal fault types of southern California are right lateral, left lateral, reverse, and thrust faults. Some of the northwest-trending right lateral and east-northeast-trending left lateral faults are known to have mainly dip-slip movement. Many of the faults are probably characterized by oblique-slip movements where both the dip-slip and strike-slip components are relatively substantial.

Most, if not all, faults in southern California are potentially active. Movements on large lateral faults, which have substantial strike-slip components of movement, are possibly responsible for much of the strong seismic activity in this region. Many of the reverse and thrust faults of outcrop, especially those associated with folded sediments, probably die out before reaching the focal depths of important southern California earthquakes.

The active White Wolf fault, being parallel to the left lateral-slip Garlock fault and conjugate to the right lateral-slip San Andreas fault and being steep and deep, is probably characterized by a substantial left lateral component of movement.—*Author's abstract*

166–201. Meshcheryakov, Yu. A. Sovremennyye tektonicheskiye dvizheniya Britanskikh Ostrovov [Present-day tectonic movements of British Isles]: Priroda, no. 2, p. 89–92, 1955.

In Great Britain observations of the variation of sea level made in numerous harbors on the coast and precise geodetic measurements at inland points show that there are continuous vertical movements of the ground upward at some places, downward in others. The upward movement of the ground in Great Britain has been attributed to readjustment after the disappearance of the glaciation over northwestern Europe. Meshcheryakov believes the present vertical movement is a continuation of a process begun before the last glaciation. The present maximum rate of upward movement is in the Scottish highlands.—*S. T. V.*

166–202. Rode, K. P. Geo-kinetic evolution of greater India: Rajputana Univ. Dept. Geology Mem., no. 4, 61 p. and 16 maps, 1954.

The sheet (geokinetic) theory proposed by Rode is that movements of enormous sheets of rock formations often of continental dimensions are brought about by subcrustal magmatic activity, so that rocks originally formed in narrow basins become dispersed over a wide area. The intervening areas are occupied by volcanic flows, deformed eruptive rocks, marine or terrestrial rocks of younger age, or older basement rocks laid bare by exposure on the removal of the overlying rock sheets. Greater India which extends from the Iranian-Afghan border on the northwest, the Pamir and Tibetan highlands on the north, to Burma including Tenasserim and Yunnan on the east and Ceylon on the south, was formed by the movement of sheets of divergent trends that radiated fan-wise from a center in the Inner Himalayas. The magma that brought about the movement first invaded the overlying sediments as extensive sills and dikes and the activity later culminated as the floods of the Deccan traps which brought about the dispersal of the sheets and packets of sediments to distant regions.—*M. C. R.*

166–203. Gnedin, K. I. K voprosu o tektonicheskom stroyenii severnoy chasti ostrova Sakhalin [On the tectonics of the northern part of Sakhalin Island]: Akad. Neftyanoy Promyshlennosti Trudy, vypusk 2, p. 138–142, 1955.

Gravity and magnetic measurements on profiles across the Tatar Strait from Sakhalin Island to the Asiatic continent show continuity, making improbable the generally accepted hypothesis that Sakhalin Island was formed by breaking away from the continent as the result of a violent earthquake. Instead it is postulated that the island was cut off from the continent by the erosive action of the great Amur River whose estuary was previously several hundred miles south of its present location. Beneath the bottom of the strait, surveying has indicated a layer of high electric resistivity proving that a great amount of sweet water is still preserved under the former bed of the river.—*S. T. V.*

GRAVITY

166–204. Yaramanci, Ali. Gravimetrik prospeksiyon metodlarina kritik bir bakiş [Critical review of the gravimetric prospecting methods (in Turkish and German)]: Türk Fiz. Derneği Bül., no. 22, 2 p., 1955.

The accuracy of modern gravimeters is now 0.01 milligal; a corresponding improvement in the precision of methods of correction has been brought about with the introduction of new charts of density, and Bouguer and terrain corrections. New developments in interpretation include methods of depth determination independent of the uncertainty arising from density estimates which are much easier to use than former methods.—*D. B. V.*

166–205. Clarkson, H. N., and LaCoste, L. J. B. An improved instrument for measurement of tidal variations in gravity: Am. Geophys. Union Trans., v. 37, no. 3, p. 266–272, 1956.

A self-reading continuous recording instrument for measuring changes in gravity as small as one microgal has been developed and employed in earth-tide studies. The basic force-measuring device is a modified LaCoste-Romberg gravity meter, altered to give the required accuracy. A servo-loop was designed to follow the change continuously and measurements of the tidal variation in gravity have been recorded for over two years with this instrument.—*Authors' abstract*

166–206. Karatayev, V. N. Obrabotka nablyudeniy s gravimetrom CH–3 [The processing of the observations made with the CH–3 gravimeter]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 30 (157), p. 250–255, 1955.

An explanation of the processing of data obtained made with the CH–3 gravimeter (the Russian equivalent of the Nørgaard).—*S. T. V.*

166–207. Wielądek, Romuald. Teoria bledow pomiarow grawimetrami statycznymi [Theory of errors of measurements made by means of static gravimeters (in Polish with English summary)]: Acta Geophys. Polonica, v. 2, no. 2, p. 73–96, 1954.

A general theory of errors of measurements with the static gravimeter based on the theory of accidental stationary processes. Numerical examples are given for measurements made with a Nørgaard gravimeter.—*M. C. R.*

166–208. Lagrula, Jean. Sur la synthèse des données gravimétriques et séismologiques concernant l'écorce terrestre [On the synthesis of gravimetric and seismologic data on the crust of the earth]: Acad. Sci. Paris Comptes Rendus, tome 242, no. 11, p. 1502–1504, 1956.

The effect of the intermediate layer of the crust on isostatic anomalies cannot be neglected in regions of strong topographic contrasts. As an extreme case, in a submarine trench 6 km deep the intermediate layer could cause a positive anomaly of more than 100 milligals.—*M. C. R.*

166–209. Malovichko, A. K. Ob interpretatsii gravimetricheskikh nablyudeniy v svyazi s poiskami struktur, perspektivnykh na neft' i gaz [The interpretation of gravimetric data in prospecting for favorable structures for oil and gas]: Prikladnaya geofiz., vypusk 13, p. 63–79, 1955.

The importance of quantitative methods of interpretation of data from a gravimetric survey is shown by several examples. The first problem discussed is the determination of the boundary between two formations of different densities. The solution of this problem leads to a nonlinear integral equation of the first kind. Malovichko resorts to "linearization of the problem," developing the integrand into two series and reducing them to the terms of the first power, and as a further simplification uses Taylor series to obtain relatively simple equations. The formulas can be conveniently used if the anomalies are recalculated to a plane parallel to and at a given height above the surface of the earth. This is done by using Poisson's integral and changing from cartesian to cylindrical coordinates. Numerical integration gives approximate but quite accurate formulas that can be used for the determination of the analytical continuation of the gravitational function. Numerical terms used in these computations are given in tables. An example with detailed calculations is included.—*S. T. V.*

166–210. Geyer, R. A., and Romberg, F. E. What is a gravity anomaly: Oil and Gas Jour., v. 54, no. 52, p. 196–200, 1956.

The Bouguer gravity anomaly results from the application of a number of corrections applied to the gravity meter reading, and some of these corrections involve personal judgment. Because the Bouguer or residual anomalies cannot be evaluated in a unique manner it is important that the interpreter be fully appraised of the geological conditions. An analog computing device is described which facilitates the determination of the relationship between a theoretical or hypothetical anomaly and an observed anomaly.—*D. R. M.*

166–211. Stackler, W. F. Gravity—an accurate exploration tool: Oil and Gas Jour., v. 54, no. 68, p. 210–214, 1956.

There are excellent possibilities for gravity methods of exploration in prospecting for faults and anticlines in the disturbed foothills belt of Alberta, northeastern British Columbia, Northwest Territories, and northern Yukon. Because of the rough terrain, special care must be exercised in computing the elevation and terrain corrections. A density map showing the distribution and densities of the surface rocks is used in correcting the data for density variations above a datum plane. The terrain effect in the immediate vicinity of the station as well as at greater distances must be considered.—*D. R. M.*

166–212. Kogbetliantz, E. G. Electronic computers aid geophysical interpreters: Oil and Gas Jour., v. 54, no. 67, p. 136–139, 1956.

Modern electronic computers facilitate and speed up the purely arithmetical work involved in the handling of geophysical data. The computers can be used to compute residuals and first and second vertical derivatives at various depths from gravity and magnetic data. The computing equipment facilitates studies of the change in a geophysical "picture" based on one set of field data in response to the variations of a geologic parameter. The elimination of the distortion of aeromagnetic anomalies due to the inclination of the earth's magnetic field can be accomplished in addition to the determination of total mass excess and center of gravity from magnetic anomalies.—*D. R. M.*

166–213. Watson, Ian J. The results of gravimeter observations between the stations on the primary gravity base-line of Great Britain: Royal Astron. Soc. Monthly Notices, Geophys. supp., v. 7, no. 2, p. 60–70, 1955.

Re-examination of gravity values relative to Cambridge at York, Newcastle-upon-Tyne, Edinburgh, and Aberdeen has shown that the errors of the pendulum observations by Browne and others (see Geophys. Abs. 146–12899) are within published standard deviations except at Newcastle where the error is just greater than twice the published standard deviation. By combining present observations with pendulum values and differences measured by Bullerwell, new gravity values have been calculated for the four stations. It is recommended that these be used in making ties to these stations from abroad though Cook's values are satisfactory for use in Great Britain.—*M. C. R.*

166–214. Lozano Calvo, Luis. Formula de la gravedad normal en España [Formula for normal gravity in Spain]: Inst. Geog. y Catastral Mem., tomo 21, no. 4, 53 p., 1951.

The formula $g=978.0223\ (1+0.0052682\ \sin^2\varphi\ -0.000008\ \sin^2 2\varphi)$ is derived for normal gravity in Spain. Theoretical values calculated from this formula are lower than those obtained using the Helmert, Bowie, Cassinis, and Heiskanen formulas. The effect of Bouguer correction varies greatly in different parts of the country. The degree of isostatic compensation is calculated for different regions and shows that there is a definite relation between large-scale negative anomalies and zones of seismicity. The small positive anomalies in some coastal seismic zones may actually be the result of incomplete isostatic reduction.—*D. B. V.*

166–215. Sutton, George H. Gravity bases in central Africa: Nature, v. 178, no. 4530, p. 435–436, 1956.

During December 1955—January 1956, 392 gravity stations were occupied in the Belgian Congo, Ruanda Urandi, Uganda, and Tanganyika Territory to delineate the gravity anomaly associated with the western Rift Valley. Several stations of the Duclaux-Martin African base network were reoccupied and the results indicate a linear relation between the corrected readings of the Sutton survey and the Duclaux-Martin values to a high degree of precision.—*M. C. R.*

166–216. Williams, L. W. Geophysical survey, Ashford Coal Fields, New South Wales: Australia Bur. Min. Resources Geology and Geophysics Rept., no. 8, pt. 2, p. 30–34, 1954.

A gravity survey of the Ashford coalfield defined the eastern and western boundaries of the coal measures and traced their extension northward under an

alluvial cover with reasonable accuracy. Further evidence was obtained that there is overthrusting of the granite in the southern part of the area.—*V. S. N.*

166–217. Thyer, R. F., and Everingham, I. B. Gravity survey of the Perth Basin, Western Australia: Australia Bur. Min. Resources Geology and Geophysics Bull., no. 33, 11 p. and 4 maps, 1956.

In 1951 and 1952 the Australian Bureau of Mineral Resources conducted a regional gravity survey of the west coast of Australia between Geraldton and Cape Leeuwin and extending inland for 100 to 150 miles. Gravity observations were made at 650 stations over an area of about 43,000 square miles, which includes the Perth Basin. A pronounced negative gravity anomaly with a minimum of more than −130 milligals was revealed. This anomaly is about 400 miles long and as much as 55 miles wide. Steep gravity gradients on the flanks of the anomaly suggest the existence of faults against which about 30,000 feet of lighter sedimentary rocks are in contact with the denser basement rocks.

The Darling and Dunsborough faults show up prominently as gravity anomalies, but other faults deduced from geologic evidence do not have strong gravity expression. Two major faults, previously unknown, were discovered during the gravity study, along with certain lesser structures. The gravity results indicate that the Perth Basin joins the Carnarvon Basin to the north.—*L. C. P.*

166–218. Knapman, W. H. A gravity survey in the Peake and Denison ranges *in* The geology of the Peake and Denison region: South Australia Dept. Mines and Geol. Survey Rept. Inv., no. 6, p. 17–23, 1955.

A gravity survey was undertaken to determine the structural relationship between the Precambrian rocks of the ranges and the adjacent Mesozoic beds of the Great Artesian Basin and to find possible limits of the artesian waters. East of the main range the survey indicated a gradual shelving of bedrock, deepening eastward. West of the range, however, there was a sudden decrease in gravity; it is believed that this subsurface discontinuity represents the western edge of a shallow bedrock ridge. It is likely that artesian water is present in most of the area east of the range but west of the range the line of subsurface discontinuity would probably be the eastern limit of artesian water.—*V. S. N.*

166–219. Allen, William, Jr. The gravity meter in underground prospecting: Mining Engineering, v. 8, no. 3, p. 293–295, 1956.

Gravity surveys underground have been used for 6 years in the copper mines at Bisbee, Ariz. A Worden gravity meter with a tall tripod is used. Stations along crosscuts are usually located at 100-ft intervals, and at 25- or 50-ft intervals in anomalous areas. About 70 to 90 gravity stations can be run in a 6-hour day, by a 2-man crew. Field data are reduced in the usual way, except that it is necessary to correct for topography above the underground gravity stations. An extended version of Hammer's tables is used for this purpose. Mine openings, such as stopes and raises, affect the gravity and are taken into account in interpretation. Gravity contours at an interval of 0.1 milligal can be presented on either a horizontal or vertical plane. A gravity high can be caused by either a dense mass below the level of observation or a mass deficiency above. The reverse is true for a gravity low.—*L. C. P.*

166–220. Mabey, Don R. Geophysical studies in the intermontane basins in southern California: Geophysics, v. 21, no. 3, p. 839–853, 1956.

Geophysical surveys were made by the U. S. Geological Survey in Searles Lake basin and in the Mojave Desert near Barstow, California to test the application of geophysical exploration to the study of the geologic problems associated with the intermontane basins of southern California. In Searles Lake basin a coordinated gravity and seismic reflection and refraction survey indicated that the fill in the basin is about 3,300 feet thick with the greatest thickness occurring east of the center of the basin. The regional gravity data from the area near Barstow can be used to estimate the thickness and extent of the Tertiary and Quaternary deposits.—*Author's abstract*

166–221. Thyssen-Bornemisza, Stephan von [Thyssen, Stephan von], and Stackler, W. F. Observation of the vertical gradient of gravity in the field: Geophysics, v. 21, no. 3, p. 771–779, 1956.

Experimental measurements of the vertical gradient of gravity were made over the Turner Valley structure near Calgary, Alberta, Canada. A Worden gravimeter was read in its normal position and on an elevated tripod 12.542 feet higher. The results were affected by vibrations generated by wind gusts and transport of the instrument up and down the tripod. The results are inconclusive, but they suggest improvements in the free-air correction.—*R. G. H.*

166–222. Matsuda, Takeo. Gravity survey at Yokote District, Akita Prefecture: Geol. Survey Japan Bull., v. 6, no. 9, p. 47–52, 1955.

A gravity survey of the "Yokote Basin," Akita Prefecture, indicates that the basin may be divided into two basinlike structures by an east-west line through Kanazawa town.—*V. S. N.*

166–223. Ogawa, Kenzō. Gravity survey at Ibaraki District: Geol. Survey Japan Bull., v. 6, no. 8, p. 47–52, 1955.

A gravity survey in the northeastern part of the Kwantō Plain located a high gravity zone from the north to the south mountain range between Ibaraki and Tochigi Prefectures and a low gravity area centered at Sugayamachi.—*V. S. N.*

166–224. Coron, Suzanne, and Gloden, Albert. Anomalies isostatiques du Luxembourg [Isostatic anomalies of Luxembourg]: Acad. Sci. Paris Comptes Rendus, tome 242, no. 1, p. 157–159, 1956.

Isostatic anomalies have been computed on the basis of the Airy hypothesis for a crustal thickness of 30 km. The average Bouguer anomaly is −7 milligals and the average isostatic anomaly, 25 milligals. The latter indicates an overcompensation corresponding to about 200 m mass above the geoid. Recent leveling shows the northern and western parts of Luxembourg to be rising. The axis of the gravity maximum in the north follows the Belgian Ardenne. Undulation in the anomalies in the southern part may be caused by density contrasts at the surface; the general trend is that of the Hercynian folding.—*M. C. R.*

166–225. Pohly, Richard A. Reefs are hard to find: World Oil, v. 143, no. 1 p. 75–78, 1956.

Under favorable circumstances, reef-type structures can sometimes be found by gravity surveys. In Indiana, Illinois, Michigan, and Ontario, approximately 40 reefs have been found by drilling on gravity anomalies in recent years.—*L. C. P.*

166–226. Thiel, Edward. Correlation of gravity anomalies with the Keweenawan geology of Wisconsin and Minnesota: Geol. Soc. America Bull., v. 67, no. 8, p. 1079–1100, 1956.

Gravitational mapping by the University of Wisconsin has delineated what appears to be the largest positive-anomaly feature on the North American continent, extending from the Lake Superior region southwest into Kansas. For the greater part of its length this "midcontinent gravity high" is flanked on both sides by gravity lows. Because the southern part of the anomalous area is blanketed by Paleozoic sediments, the cause of the anomaly was sought first at its northern end, around Lake Superior, where Precambrian rocks crop out to facilitate a correlation of gravity and geology.

Around western Lake Superior the positive anomalies correlate with Keweenawan lava and gabbro. The negative anomaly on the Bayfield Peninsula reflects a thick accumulation of sandstone and shale which was deposited in the subsiding Lake Superior syncline during Upper Keweenawa time. A second thick accumulation of sedimentary rocks may underlie the gravity low at Cumberland. Steep gravity gradients indicate the Douglas fault. A second major fault symmetric to the Douglas fault is mapped in northwestern Wisconsin on the opposite side of the Lake Superior syncline. The center of the syncline has been thrust upward between the two faults as a horst. A traverse along the spit at Duluth fails to detect the North Shore fault as it is usually mapped; if the fault exists, no great amount of sandstone is placed in juxtaposition to basaltic lava. Detailed correlation of gravity and geology is presented on maps and structure sections along lines of gravity traverse.

The usual isostatic correction cannot reduce the gravity differentials around western Lake Superior. A geological correction which allows for the effects of near-surface geology does account for most of the anomalies. Any attempt to compute the extent of crustal warping at depth without allowing for the near-surface geology would have led to considerable error.—*Author's abstract*

166–227. Tsimel'zon, I. O. O prirode lokal'nykh anomaliy sily tyazhesti Apsheronskogo poluostrova [The nature of the local gravitational anomalies on the Apsheron Peninsula]: Prikladnaya geofiz., vypusk 14, p. 14–22, 1956.

In nine gravimetric profiles near Baku and the Apsheron Peninsula, the most important source of petroleum in the U. S. S. R., it was found that even the secondary gravitational minimums as a rule correspond to either discovered or inferred salt domes.—*S. T. V.*

HEAT AND HEAT FLOW

166–228. Clark, Sydney P., Jr. Effect of radiative transfer on temperatures in the earth: Geol. Soc. America Bull., v. 67, no. 8, p. 1123–1124, 1956.

The assumption that material in the mantle is opaque to electromagnetic radiation is implausible if the mantle is composed of silicates or oxides. The importance of the contribution of radiation to heat transfer in nonopaque media has been demonstrated by recent work with glasses and ceramics. Temperatures at different radii in the earth have been calculated for extinction coefficients of ∞, 100 cm^{-1}, and 10 cm^{-1}. A detailed analysis of the magnitude of the extinction coefficient and its dependence on temperature, pressure, and wavelength for materials likely to exist in the mantle must be made before the importance of radiative transfer in the earth can be determined. Preliminary results indicate

the extinction coefficients of mafic rocks are between 20 and 40 cm^{-1} at wavelength of about 0.8 microns at room temperature. Calculations in this paper show that if the extinction coefficient is as low as 100 cm^{-1}, radiative transfer will drastically modify the temperature at depth.—*M. C. R.*

166–229. Jaeger, J. C. Conduction of heat in an infinite region bounded internally by a circular cylinder of a perfect conductor: Australian Jour. Physics, v. 9, no. 2, p. 167–179, 1956.

Numerical information is given for radial flow of heat in an infinite region bounded internally by a circular cylinder of radius a containing a perfect conductor, there being contact resistance $1/H$ per unit area across the cylinder. Problems considered are: (i) the perfect conductor and the surrounding region initially at different temperatures; (ii) heat supply to the perfect conductor. Results are expressed in terms of the dimensionless parameters $\tau=\nu t/a^2$, $h=K/aH$, $\alpha=2\pi a^2\rho c/S$, where K, ρ, c, ν are the thermal conductivity, density, specific heat, and diffusivity in the region outside the cylinder, S is the thermal capacity of the perfect conductor per unit length of the cylinder, and t is the time. Tables and graphs of the temperature of the perfect conductor are given for $0.2<\tau<20$; $h=0$, 0.5, 1, 2, 3, 4, 5, 7, 10, 20; and $\alpha=0.5$, 1, 1.5, 2. The temperature outside the cylinder, a problem involving fluid motion within the cylinder, and the heating of a buried cable carrying electric current are also discussed.—*Author's summary*

166–230. Lyubimova, Ye. A. O termicheskoy istorii zemli i eye geofizicheskikh posledstviyakh [The thermal history of the earth and its geophysical aftereffects]: Akad. Nauk SSSR Doklady, tom 107, no. 1, p. 55–58, 1956.

Lyubimova has previously evaluated the temperature variation in the earth on the basis of its formation by coalescence of cold particles of interstellar dust [see Geophys. Abs. 152–14352, 156–150, 164–180]. Heat within the nascent earth was produced by the impact of the particles, by the compression of the initial cluster due to the ever-increasing pressure of its outer layers, and by the radioactive disintegration of uranium, thorium, and potassium in the earth. The initial conditions of heat production were changed as soon as the temperature within the earth made its mass plastic, bringing about gravitational differentiation and a concentration of radioactive substances in the outer layers of the earth. The equation derived for the initial period of the earth's thermal history is no longer applicable. Results given by R. J. Uffen [see Geophys. Abs. 151–14070] were used to compute the probable temperature in different layers of the earth at various periods of its history. The results show that, at least for a certain period, the maximum temperature was not in the center of the globe but at the lower surface of the mantle.

Comparison of the computed temperatures in different layers and temperatures of fusion at the corresponding depth indicates possible existence of fused layers between solid ones. Owing to the heterogeneity of the earth, the fused layer does not form a complete shell, but pockets, which are the probable cause of deep-focus earthquakes. The present depth of such a partially fused layer is about 700 km.—*S. T. V.*

166–231. Carte, A. E. Thermal constants of pyrophyllite and their change on heating: British Jour. Applied Physics, v. 6, no. 9, p. 326–328, 1955.

The thermal conductivity, thermal diffusivity, and specific heat of a rock, composed almost entirely of pyrophyllite from the Lichtenburg district of the

Transvaal, were determined before and after heating to 1,200°C. Before heating, the conductivity was about 0.01 cal cm per cm² sec °C in directions parallel to the bedding planes, and half that in directions at right angles to the bedding planes. As the temperature is increased, the two conductivities decrease and converge, so that after heating to 1,200°C the material is thermally isotropic with a conductivity of about 0.003 cal cm per cm² sec °C.—*M. C. R.*

166–232. Garvitch, Z. S., and Probine, M. C. Soil thermometers: Nature, v. 177, no. 4522, p. 1245–1246, 1956

Calibration of thermometers used in measuring soil temperature indicated errors at temperatures of 40° F or less (as much as 6° or 8° at 20° F). The errors are attributed to pressures developed on the bulbs by thermal contraction of the wax placed around the bulb to give it a high lag coefficient.—*M. C. R.*

166–233. Beck, A., Jaeger, J. C., and Newstead, G. The measurement of the thermal conductivities of rocks by observations in boreholes: Australian Jour. Physics, v. 9, no. 2, p. 286–296, 1956.

Three experimental measuring devices for determining thermal conductivity in boreholes have been constructed and found satisfactory. One consists of a brass rod 1¼ in. in diameter and 3 ft long with the heating wire wound on the outer surface and temperature measured by a thermistor inside the rod. Measurement is by an a-c bridge connected to the thermistor by a coaxial cable. Seals at the ends of the tube are composed of a large number of thin rubber sheets cut radially to form a "bottle brush" attached to a poorly conducting "Perspex" cylinder. The second apparatus is similar except in length (5 ft) and in that the seals are pneumatic. The third head consists of a rubber tube on which the heater wires are laid longitudinally, covered with thin sheet rubber, and the whole vulcanized. There are 50 wires around the circumference; the thermistor is attached to the inside of the tube. The method of reducing observations is based on the theory given by Jaeger [see Geophys. Abs. 166–229]. Two methods of determining conductivity are considered: the measurement of the variation with time of the temperature of water in a drill hole, and the measurement of temperatures at various depths after heating a considerable length of borehole. A byproduct of the investigation has been the discovery of movement of water in boreholes.—*M. C. R.*

166–234. Beck, A. The stability of thermistors: Jour. Sci. Instruments, v. 33, no. 1, p. 16–18, 1956.

Experiences with use and calibration of thermistors in the laboratory and field indicate they sometimes undergo sudden arbitrary changes. Adverse heat treatment is one possible cause; thermistors should not be subjected to temperatures outside the range of those to be measured. It is unwise to use two or more different thermistors to measure temperature differences in one experiment unless each one is carefully calibrated before and after the experiment. If one thermistor is used, and if the error in absolute temperature is less than 1.5° C and the thermistor constants are stable over the period of measurement, relative temperatures may be relied on to an accuracy of 0.02° C over a range of 10° C. In general, the thermistor constants change slowly enough that the thermistors can be used with this order of accuracy in experiments of 24 hours' duration; for longer periods frequent checking of stability is desirable.—*M. C. R.*

166–235. Pihlainen, J. A., Brown, R. J. E., and Legget, R. F. Pingo in the Mackenzie Delta, Northwest Territories, Canada: Geol. Soc. America Bull., v. 67, no. 8, p. 1119–1122, 1956.

Pingoes are conical hills peculiar to arctic regions. Temperatures were measured in drill holes in one pingo in the lower Mackenzie Valley; 13 days after drilling, temperatures decreased from 28.3° F at 2 ft 6 in. to minimums of 22.4° F at 12 ft 6 in. and 15 ft and increased to 23.6° F at 25 ft. Two months later, the temperatures were higher and decreased from 33.4° F at 2 ft 6 in. to 24.6° F at 25 ft. Similar temperatures were recorded 1 year later.—*M. C. R.*

166–236. Chadwick, Peter. Heat flow from the earth at Cambridge: Nature, v. 178, no. 4524, p. 105–106, 1956.

Measurements of temperature in an experimental borehole at Cambridge and of the thermal conductivity at 16 levels in the Paleozoic rocks are used to calculate a heat flow of $(1.28\pm0.12)\times10^{-6}$ cal cm^{-2} sec^{-1}. A heat flow of $(1.34\pm0.02)\times10^{-6}$ cal cm^{-2} sec^{-1} is obtained from the observed temperatures and the thermal conductivity of samples of the Oxford clay in East Anglia. With the correction for recent climatic changes, the equilibrium heat flow is 1.48×10^{-6} cal cm^{-2} sec^{-1}.—*M. C. R.*

166–237. Bullerwell, W. Temperature surveys in the [Stowell Park] borehole: Great Britain Geol. Survey Bull., no. 11, p. 65–66, 1956.

Two temperature surveys were made of the Stowell Park borehole. The first readings ranged from 50.4° F at 195 ft to 72.1° F at 1,492 ft and the second from 48.7° F at 495 ft to 109.0° F at 3,835 ft. In the depth interval over which the two surveys can be compared, the readings from the second survey are approximately 4° F cooler at a given depth. The temperature readings are accurate to 0.2° F and the discrepancy between surveys may be attributed to the shorter shutdown period prior to the second survey and disturbance from equilibrium associated with loss of fluid. Both surveys were made too soon after drilling for accurate estimation of the geothermal gradient.—*V. S. N.*

166–238. Boldizsár, T. Terrestrial heat flow in Hungary: Nature, v. 178, no. 4523, p. 35, 1956.

Temperatures have been measured in four recently sunk shafts in the Liassic coal basin of South Transdanubia and conductivities determined by a method similar to that of Benfield and Bullard. The calculated heat flow is $(3.035\pm0.010)\times10^{-6}$ cal cm^{-2} sec^{-1}.—*M. C. R.*

166–239. Birch, Francis. Heat flow at Eniwetok Atoll: Geol. Soc. America Bull., v. 67, no. 7, p. 941–942, 1956.

Temperatures in drill holes on Parry and Ellugelab Islands indicate the upper part of the atoll is permeated with sea water. A "normal" trend of the temperatures at the greatest depths indicates a gradient of 20.5° C per km; for an effective conductivity of 0.004 to 0.006 cal per cm sec deg, the heat flow by conduction is between 0.8 and 1.2 microcal per cm^2 sec. With corrections for the effect of topography, the heat flow is between 0.9 and 1.4 microcal per cm^2 sec.—*M. C. R.*

INTERNAL CONSTITUTION

166–240. Shima, Michiyasu. Elastic theory and elastic properties of the Earth's interior (II) [in Japanese with English summary]: Zisin, v. 8, no. 1, p. 38–44, 1955.

The distribution of the ratio of the bulk modulus to density and pressure is investigated by means of atomic theory on the assumption that the mantle is composed of ionic crystals. If the change between layers B (33 km—413 km) and D (1,000 km—2,898 km) were a polymorphic transition from the low-pressure phase to a high-pressure phase, there would be a decrease of the gradient of k/ρ between B and D. The change may be of the chemical composition; if so, the dissociation energy and the reduced increase of density and the inverse power of the potential between the atoms do not change markedly.—*V. S. N.*

166–241. Magnitskiy, V. A. O prirode perekhodnogo sloya v obolochke zemle na glubine 400–900 km [The nature of the intermediate layer in the earth's mantle at depths of 400 to 900 km]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 700–703, 1956.

The layer between about 400 and 900 km in the mantle is characterized by a sharp increase in the velocities of both longitudinal and transverse waves. The change in the ratio of Young's modulus and rigidity to density thus indicated may be due simply to the increase in pressure with depth. From the developments of theoretical physics on the structure of solid bodies, based on the relations between atomic repulsions and valence attraction, it is concluded that the increase in the ratio $k/\rho : \Delta(k/\rho)$ is 1.9 (km per sec)^2, whereas from seismological evidence it is about 1.5 (km per sec)^2, a good agreement in view of the approximations in volume in the assumptions.—*S. T. V.*

166–242. Vening Meinesz, F. A. A phase-transition layer between 200 and 900 km depth in the earth?: K. Nederland. Akad. Wetensch. Proc., ser. B, v. 59, no. 1, p. 1–10, 1956.

Seismic data indicate the presence of a transition layer in the earth between depths of 200 and 900 km. Evidence supporting Vening Meinesz' hypothesis that this layer is one of phase transition between a denser phase of olivine in the lower mantle and the orthorhombic phase below the crust is based in part on the probability of convection currents over the whole depth of the mantle, which could not occur if there were also a chemical difference between the upper and lower layers, but to which phase transition is no impediment. The temperature-depth curve for the upper 1,200 km of the earth and the theoretical phase equilibrium curve coincide between 200 and 900 km, therefore the concept of a transition layer is completely acceptable. The hypothesis of a denser phase in the lower mantle leads unavoidably to the presence of a transition layer between the two phases which, owing to the cooling of the earth, is slowly travelling upwards; it is difficult to see how a difference of chemical composition could lead to this same result. Loading or unloading of the crust would cause pressure changes disturbing the phase equilibrium in the transition layer; the theoretical effect of removal of the Pleistocene ice load explains satisfactorily why the rising velocity computed for the first one or two thousand years for Fennoscandia is less than what has actually occurred and why later rising was delayed. Finally, the effect of the transition layer on a convection current breaking through it is shown to

406832—56——5

explain why the temperature gradient under the oceans is about the same as that in the continents even though the continental crust is richer in radioactive constituents.—*D. B. V.*

166–243. Press, Frank, Ewing, Maurice, and Oliver, Jack. Crustal structure and surface-wave dispersion in Africa: Seismol. Soc. America Bull., v. 46, no. 2, p. 97–103, 1956.

Records at the University of Natal at Pietermaritzburg of the earthquake of September 9, 1954, and aftershock of September 10 provide data on Rayleigh wave dispersion over a 7,890-km continental path. The dispersion curve extends from periods of 10 sec to at least 70 sec; between 18 and 31 sec the group velocity is within 0.1 kmps of that given for North America by Brilliant and Ewing. For periods greater than 38 sec, the observed points fall below the theoretical dispersion curve, indicating a change of properties with depth in the mantle. Between 18 and 30 sec, the observed points lie as much as 0.2 kmps above the theoretical curve, and the observed minimum of group velocity is at 17 sec (instead of 22 sec on the theoretical curve). These differences may be the effect of an increase in velocity with depth in the crust.—*M. C. R.*

166–244. Nagamune, T. On the travel time and the dispersion of surface waves (II): Geophys. Mag., v. 27, no. 1, p. 93–104, 1956.

Dispersion of surface waves observed at the Matsushiro observatory indicates the crust in southeastern Asia consists of two layers, as suggested by Akima, each 19 km thick and with shear-wave velocities of 3.3 and 3.9 kmps, overlying a 4.3-kmps medium. In the western Pacific two layers, 7.2 and 28.8 km thick, with the shear-wave velocities of 3.9 and 4.1 kmps, and in the central Pacific a single layer 33 km thick in which the velocity is 4.1 kmps overlie a 4.8-kmps medium.—*M. C. R.*

166–245. Adlung, A. Seismische Beobechtungen bei Kammersprengungen [Seismic observations of chamber blasts]: Gerlands Beitr. Geophysik, Band 65, Heft, p. 1–10, 1955.

Seismic records from 23 chamber blasts in Saxony, Thuringia, and northern Czechoslovakia in 1951–1954 are analyzed. Although the times of origin are not precisely known, travel time curves can be established for four profiles. The velocities thus obtained fall within the range determined by other methods, except for that of the "gabbro" layer which is higher. A slight transfer of energy away from the Harz and a decrease in travel time to the right of the Elbe were noted. The necessity for a plan of systematic observations of chamber blasts is indicated.—*D. B. V.*

166–246. Tamaki, Ituo. The crustal structure derived from the traveltime of shallow earthquakes (continued) [in Japanese with English summary]: Zisin, v. 7, no. 4, p. 226–232, 1955.

Several additional crustal-structure sections have been determined in northeastern Japan; from all these sections horizontal structures at the surface and at depths of 10, 20, 30, and 40 km have been calculated. The lateral structure so determined is consistent with the gravity anomalies, and observed deviations of arrival times of *P* waves from deep earthquakes can be explained in terms of these structures.—*M. C. R.*

166–247. Research Group for Explosion Seismology. Observations of seismic waves from the second Kamaisi explosion [in Japanese with English summary]: Zisin, v. 7, no. 4, p. 209–215, 1955.

An explosion of nearly 42 tons of explosives at the Kamaisi mine, Iwate-ken, on September 13, 1953, was observed at 15 temporary stations set up on a north-south line. The *P*-wave velocity in the uppermost layer in this area is 6.05 kmps; in the underlying layer, 7.27 or 7.55 kmps. Corresponding *S*-wave velocities are 3.46 kmps and 4.57 or 4.75 kmps. The thickness of the upper layer is 22.2 or 25.6 km from *P*-wave curves, 32.4 or 35.8 km from *S*-wave data, and 22.13 km from data on reflected waves.—*M. C. R.*

166–248. Berckhemer, Hans. Rayleigh-wave dispersion and crustal structure in the east Atlantic Ocean basin: Seismol. Soc. America Bull., v. 46, no. 2, p. 83–86, 1956.

The dispersion of Rayleigh waves generated by several earthquakes in the Mid-Atlantic Ridge and observed at stations close to shore does not indicate continental-type crustal structure under the eastern part of the Atlantic Ocean. Observed data are fitted by the assumption of a layer 5 km thick in which the compressional wave velocity is 6.9 kmps overlying elastic half-space in which the velocity is 8.1 kmps. The thickness of unconsolidated sediments ranges from 0.55 to 1.2 km.—*M. C. R.*

166–249. Wiese H[orst]. Tiefentellurik. Enforschung der grossräumigen elektrischen Leitfahigkeitsstruktur des tiefen Untergrundes durch geomagnetische Variationen [Deep tellurics. Investigation of the regional electrical conductivity structure of the deep underground through geomagnetic variations]: Zeitschr. Geophysik, Jahrg. 21, Heft 2, p. 7–80, 1955.

Geomagnetic Z-variations of less than 2 hours duration are sometimes similar at far distant observatories in Europe but opposite at observatories near each other, the effect of a zone of high electrical conductivity in the deeper part of the crust extending from Spain over North Germany to the Bosporus and North Africa. Similar phenomena have been observed in Japan, South Africa, China, and North America. See also Geophys. Abs. 164–93.—*M. C. R.*

ISOSTASY

166–250. Sauramo, Matti. Land uplift with hinge-lines in Fennoscandia: Acad. Sci. Fenn. Annales, Ser. A–III, Geol.–Geog. 44, 25 p., 1955.

Uplift of Fennoscandia during the last 8,000 years has been regular and dome-like, at a slowly decreasing rate. Earlier deformation, studied in detail, is more complex; deformation of the shorelines along different hinge lines in the center of the upwarped area, dating approximately from the time of the removal of the ice load, can be shown. Conclusions as to the crustal recoil inside the inner hinge-line agree with Daly's concept of elastic followed by plastic response. The amount of elastic rise is nearly half the total uplift of 280 m in the center. Oscillation in the southeastern marginal belt is explained as a wandering plastic peripheral bulge. In considering the role of eustasy, the question arises whether these general oscillations can be explained by glacial control only. Comparative studies show that recent vertical movements of the crust are of greater magnitude than the average value for such movements in the past.—*D. B. V.*

ISOTOPE GEOLOGY

166–251. Gerling, E. K. Nakhozhdeniye v meteoritakh inertnykh gazov i ikh izotopnyy sostav [The presence of inert gases in meteorites and their [isotopic] composition]: Akad. Nauk SSSR Komiss. opredel. absolyut. vozrasta geol. formatsiy Byull., vypusk 1, p. 57–60, 1955.

Similar to paper in Akademii Nauk SSSR Doklady [see Geophys. Abs. 165–16].—*S. T. V.*

166–252. Lounsbury, M. The natural abundances of the uranium isotopes: Canadian Jour. Chemistry, v. 34, no. 3, p. 259–264, 1956.

Using a surface-ionization mass spectrometer, the natural U^{238}/U^{235} abundance ratio in uranium obtained from Great Bear Lake Pitchblende has been measured to be 137.80 ± 0.14. From a survey of results reported in the literature on U^{234} a best value of $17{,}325 \pm 550$ was estimated for the U^{238}/U^{234} abundance ratio. The corresponding isotopic abundances are 0.7204 ± 0.0007 atom percent and 0.00573 ± 0.00018 atom percent for U^{235} and U^{234}, respectively.—*Author's abstract*

166–253. Phair, George, and Mela, Henry, Jr. The isotopic variation of common lead in galena from the Front Range and its geological significance: Am. Jour. Sci., v. 254, no. 7, p. 420–428, 1956.

Mass spectrometric analyses of lead from 13 samples of galena from the Colorado Front Range show that galena from the southwestern half of the Laramide mineral belt in comparison with that from the northeastern half is enriched in Pb^{206}, Pb^{207}, and Pb^{208} relative to Pb^{204}; the isotopic composition of galena from deposits in outlying parts of the Front Range is typical of older Precambrian common lead; and galena from the pegmatite of Stove Mountain is intermediate between the Laramide and the Precambrian lead.

Regional averages of Pb^{206} and Pb^{207} in the Front Range along the Laramide mineral belt increase from east to west as in the samples from Colorado Plateau studied by Stieff and Stern. However, Pb^{208} also increases with the Pb^{206} and Pb^{207}. No Pb^{206} enrichment was noted in galena from nonuraniferous veins in and around centers of intrusion of uranium-rich late-stage Tertiary intrusive rocks or in uraniferous mining districts.—*V. S. N.*

166–254. Fireman, E. L., and Schwarzer, D. Measurement of the tritium concentration in natural waters by a diffusion cloud chamber: Phys. Rev., v. 94, no. 2, p. 385–388, 1954.

The tritium concentration (T/H ratio), measured for surface water from Long Island Sound, New Jersey well water, and a number of rain and atmospheric water samples, was found to range from 10^{-15} to 3×10^{-18}. Water from the Mendenhall glacier was the only water in which tritium could not be detected with a factor of 40 electrolytic enrichment, indicating a concentration of less than 5×10^{-19}.—*D. B. V.*

MAGNETIC FIELD OF THE EARTH

166–255. Chatterjee, J. S. The crust as the possible seat of earth's magnetism: Jour. Atmos. Terrest. Physics, v. 8, no. 4/5, p. 233–239, 1956.

The temperature and pressure conditions in the crust of the earth make its magnetic mineral content highly permeable. The shell can thus be magnetically saturated by a field of very low intensity of the order of 0.1 gauss. The magne-

tizing field may be provided by the external current system formed in space (at a distance of 5 to 10 earth radii from the center of the earth) during worldwide magnetic storms. A ring current is formed when the solar neutral corpuscular beams associated with these storms enter the magnetic field of the earth. An initially existing field even one-hundredth of the present field is enough to build up the magnetization of the crust to saturation. Secular variation may be the result of the tendency of the ring current to follow, but with a lag, the wobbling motion of the magnetic axis around the geographic axis.—*M. C. R.*

166–256. Rikitake, Tsuneji. Growth of the magnetic field of the self-exciting dynamo in the earth's core: Tokyo Univ. Earthquake Research Inst. Bull., v. 33, pt. 4, p. 571–582, 1955.

An investigation is attempted in order to see whether or not the earth's dynamo can grow from a state of zero field. The dynamo considered by E. C. Bullard and H. Gellman seems likely to grow, the rate of growth being also obtained. A period of about 10^4 years is required in order to have a field e times the initial one.—*Author's summary*

166–257. Jacobs. J. A. Effect of altitude on the position of the magnetic pole: Nature, v. 178, no. 4523, p. 35–36, 1956.

Using the 48 coefficients in the spherical harmonic expansion of the magnetic potential evaluated by Jones and Melotte, the northerly and easterly components of the earth's magnetic field were calculated for heights of 100 and 250 km above the surface. A gradual shift in the position of the pole with increasing altitude is indicated; at 250 km the pole has moved northward 1° but with no measurable change in longitude.—*M. C. R.*

166–258. Nagata, Takesi; Oguti, Takasi; and Maekawa, Hideo. Model experiments of electromagnetic induction within the earth: Tokyo Univ. Earthquake Research Inst. Bull., v. 33, pt. 4, p. 561–569, 1955.

Problems in electromagnetic induction in the earth can be solved by model experiments in which the electrically conductive earth is represented by a metallic sphere or spherical shell, and changes in the magnetic field owing to the presence of the sphere are estimated by measuring the time derivative of the radial component of the field over the spherical surface by means of a search coil. By means of such experiments, the anomalous distribution of induced subterranean electric currents in the vicinity of Japan suggested by Rikitake and Yokoyama [see Geophys. Abs. 162–39 to 43, 166–36] can be shown to be caused by a considerable distribution of high electrical conductivity either as an upheaved zigzag circuit or an upheaved loop; the general westward-induced currents may be forced to pass through the branch circuit, and the currents passing through the branch in the opposite direction may have a predominant effect on the observed geomagnetic field because of its shorter distance from the earth's surface.—*M. C. R.*

166–259. Zmuda, Alfred J. Note on the components of magnetic intensity at inverse points relative to a spherical boundary: Am. Geophys. Union Trans., v. 37, no. 3, p. 273–274, 1956.

Equations are derived which govern the relation between the values of a field component at points that are inverse relative to a spherical boundary carrying the distribution of sources. Inversions are made for surface and double layer distributions. The existence of simple relations of this character accompanies the existence of continuity of the component at the boundary.—*Author's abstract*

166–260. Yokouchi, Yukio. Principal magnetic disturbances at Kakioka, 1924–1951: Kakioka Magnetic Observatory Mem., v. 6, no. 2, p. 204–248, 1953.

Characteristics of some principal magnetic disturbances recorded at Kakioka from February 1924 to December 1951 are tabulated, giving times of beginning and ending, times of beginning of main and last phases, times of minimum H, maximum ranges of D, H, and Z, and classification; and for sudden commencements, amplitudes and ranges of D, H, and Z and duration of H. Sudden commencements with preliminary movement in the opposite direction are listed in a separate table. Results of statistical analysis of these data are given in 24 tables and 13 graphs.—*D. B. V.*

166–261. Yokouchi, Yukio. Solar-flare effects in geomagnetic field at Kakioka, 1924–1951: Kakioka Magnetic Observatory Mem., v. 6, no. 2, p. 191–203, 1953.

Solar-flare effects on the geomagnetic field observed at Kakioka from February 1924 to December 1951 are tabulated, giving times of beginning and ending and maximum ΔD, ΔH, ΔZ, ΔX, ΔZ, and ΔF. Results of statistical analysis of the data are given in graphs of annual variation of solar-flare effect and relative sunspot numbers; of seasonal variation of solar-flare effect; and of diurnal variation of ΔX, ΔY, ΔZ, and ΔF of solar-flare effects and of calm days.—*D. B. V.*

166–262. Yumura, Tetsuo. On the results [of] geomagnetic observation at the solar eclipse, Sept. 12th, 1950: Kakioka Magnetic Observatory Mem., v. 6, no. 2, p. 168–173, 1953.

Analysis of data from the Memambetsu, Kakioka, and Aso observatories shows that the solar eclipse of September 12, 1950, had a distinct effect on declination. More data are needed before conclusions can be drawn.—*D. B. V.*

166–263. Johnston, H. Freeborn. List of geomagnetic observatories and thesaurus of values: Jour. Geophys. Research, v. 61, no. 2, p. 273–282, 1956.

Geomagnetic observatories throughout the world, their geographic positions, and annual values of declination, horizontal intensity, and vertical intensity for 1 or more years (nearly all since 1946) are tabulated.—*M. C. R.*

166–264. San Roman, J. Sancho de. Geomagnetismo, año 1947 [Geomagnetism, 1947]: Inst. Geog. y Catastral Mem., tomo 21, no. 8, 43 p., 1951.

A description of the physical plant and instruments of the geomagnetic section of the Observatorio Central Geofísico at Toledo, Spain, and tables of the results obtained during 1947 including absolute values of D, H, and I; comparison of absolute values with values based on magnetograms; mean diurnal values of D, H, and Z; and diurnal variation of D, H, and Z for all days and for calm days.—*D. B. V.*

166–265. McGregor, P. M. Magnetic results from Macquarie Island, 1952: Australia Bur. Min. Resorces Geology and Geophysics Rept., no., 27, 9 p., 1956.

A description of the Macquarie Island Magnetic Observatory giving details of the observatory site, buildings, and the instruments used. Magnetic observations made at Macquarie Island during the period April to December 1952 are presented in tabular form.—*V. S. N.*

166–266. Princep Curto, José M. Distribución diurna de los tipos fundamentales de bahías geomagnéticas en Tortosa, Cheltenham, Tucson y San Juan [Diurnal distribution of the basic types of geomagnetic bays in Tortosa, Cheltenham, Tucson, and San Juan]: Rev. Geofísica, año 13, no. 51–52, p. 217–231, 1954.

The law for the appearance of different types of bays in Tortosa is essentially the same in Cheltenham, Tucson, and San Juan. The number of bays in declination at Cheltenham is much greater than that of bays in the horizontal component.—*M. C. R.*

166–267. Slaucitajs, Léonidas. Sobre el uso de los magnetómetros QHM y BMZ en la campaña y en el observatorio magnético [On the use of the QHM and BMZ magnetometers in the field and in the magnetic observatory]: Meteoros, año 5, no. 3, p. 155–162, 1955.

After discussion of the accuracy and care necessary in the classic method of determining the absolute values of MH and M/H, Slaucitajs considers the QHM horizontal quartz magnetometer and the BMZ vertical balance from the standpoint of their suitability for use in the field and observatory. Both are recommended for use in South America and Antarctica.—*D. B. V.*

166–268. Thiesen, K. On the determination of D by means of QHM: Geophysica, v. 5, no. 2, p. 63–69, 1955.

In using the QGM magnetometer to determine declination, the correction $\psi = c - \alpha$ must be applied to the readings, where c is the collimation angle between the magnetic axis of the magnet and the perpendicular on the mirror, and α is the deflection of the magnet from magnetic meridian when the telescope is in the zero position (no torsion on the quartz fiber). The values of c are shown to differ systematically according to whether the readings are made in a clockwise or counterclockwise direction. Two sets of readings therefore should be combined, taken in the opposite order; this requires seven settings instead of six in the standard method, but eliminates the elastic aftereffect in the quartz fiber and yields the true value of collimation.—*D. B. V.*

166–269. Blum, Pierre-Antoine, and Lebeau, André. Sur une méthode d'élimiation des variations lentes dans l'enregistrement des pulsations du champ magnétique terrestre [On a method of eliminating slow variations in recording pulsations of the geomagnetic field]: Acad. Sci. Paris Comptes Rendus, tome 241, no. 24, p. 1807–1809, 1955.

A compensating device to oppose a variation of a given component of the magnetic field may be used with a magnetic variometer; the variation of the component and the compensating device act as signal and response of an apparatus that follows the equation for a long-period, strongly damped pendulum.—*M. C. R.*

MAGNETIC PROPERTIES

166–270. Grabovskiy, M. A. Magnitnaya anisotropiya gornykh porod [The magnetic anisotropy of the rocks]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 4, p. 479–482, 1956.

Magnetic anisotropy in ferromagnetic metals can be of two kinds: one caused by crystallographic structure of the metal and especially noticeable on monocrystals; the other, often omitted in interpretations of magnetic anomalies, is caused by the form of the specimen or by the composition of the disturbing ore

body. Experiments are described showing magnetic anisotropy in long prisms placed in different directions with reference to the magnetic field or in quartzites containing magnetite in various distributions along the axis of the specimens.—*S. T. V.*

166–271. Roy, Supriya. Thermal experiments with the vanadium-bearing titaniferous magnetites of Mayurbhanj—A study of the different types of crystallographic intergrowths: Natl. Inst. Sci. India Proc., Pt. B, v. 21, nos. 5–6, p. 222–226, 1955.

The author has subjected crystallographic intergrowths of four pairs of minerals in the titaniferous magnetite ores of Mayurbhanj to thermal experiments by heating them in vacuum at varying temperatures from 500°C to 1,200°C for 24 hours and has come to the following conclusions: The intergrowths of magnetite-ilmenite, magnetite-ulvöspinel, ilmenite-hematite and ilmenite-ulvöspinel have originated by unmixing in decreasing temperature condition. The intergrowth of magnetite-ulvöspinel and ilmenite-ulvöspinel formed first at a temperature lying between 850°C and 900°C. The magnetite-ilmenite intergrowth formed after it between 750°C and 800°C only to be followed by ilmenite-hematite intergrowth between 550°C and 600°C.—*Author's summary*

166–272. Petrova, G. N. Tri vida namagnichivaniya gornykh porod: [Three kinds of magnetization in rocks]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 4, p. 431–436, 1956.

There are three possible methods of magnetizing a ferromagnetic body: "normal" magnetization in a constant magnetic field, "ideal," using in addition an alternating magnetic field, and thermomagnetization. Experiments on samples of magnetite, nickel, and pyrrhotite indicate that it is possible to obtain three equal states of magnetization by these procedures but three different energy contents. With remanent magnetizations of the same intensity, that is with $I_{rt}=I_{ri}=I_{rn}$, different coercive forces, H_c, are experimentally obtained and $H_{cn}<H_{ci}<H_{ct}$, where the second indices denote normal, ideal, and thermomagnetic magnetization, respectively.—*S. T. V.*

166–273. Grabovskiy, M. A., and Petrova, G. N. Termokoertsitivnaya sila gornykh porod pri vysokikh temperaturakh [The thermocoercive force of rock at high temperatures]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 519–524, 1956.

To study the effect of repeated heating on the magnetic state of different bodies, specimens of nickel and magnetite from different ore deposits of the U. S. S. R. were heated to temperatures slightly below their Curie points. Heating to temperatures some 50°–100° below their Curie points does not change appreciably the thermoremanent magnetization once acquired by the rock after cooling because the intensity of the thermocoercive force is several times greater than the intensity of the surrounding geomagnetic field. Thus the initial intensity and the direction of the magnetism of the rocks is characteristic of the initial geomagnetic field.—*S. T. V.*

166–274. Rimbert, Francine. Sur la desaimantation, par action de champs magnétiques alternatifs, de la magnétite et du sesquioxyde de fer α [On the demagnetization by an alternating magnetic field of magnetite and $\alpha-Fe_2O_3$]: Acad. Sci. Paris Comptes Rendus, tome 242, no. 7, p. 890–893, 1956.

Both thermoremanent and isothermal remanent magnetization have been induced in a cylinder of synthetic rock containing 1 percent magnetite in different fields. The rock was demagnetized by heating to the Curie point between experiments. The induced magnetizations were then attacked by alternating fields of increasing intensity. If the isothermal remanent magnetization was weak, the alternating field necessary to destroy it was equal to the field which created it, but for greater isothermal remanent magnetizations, approaching saturation, the alternating field increased more slowly and tended toward a maximum of 700 oersted. On the contrary, for thermoremanent magnetization, the necessary alternating field was very high (about 1,200 oersted) for weak magnetizations, and tended toward 700 for strong magnetizations. It was not possible to obtain measurements at saturation magnetization for $\alpha-Fe_2O_3$ but the effects were similar to those for magnetite in the range of the experiments. These results apply only to fresh isothermal remanent magnetization and cannot be applied directly to rocks.—*M. C. R.*

166–275. Rimbert, Francine. Sur l'action de champs alternatifs sur des roches portant une aimantation rémanente isotherme de viscosité [On the effect of alternating fields on rocks with a viscous isothermal remanent magnetization]: Acad. Sci. Paris Comptes Rendus, tome 242, no. 21, p. 2536–2538, 1956.

Samples of rocks were placed in fields of 2 to 100 oersteds for times ranging from a few seconds to 2 months, the magnetization measured, and then opposed by alternating fields of increasing intensity until destroyed. For a given magnetizing field, and for times of application of more than 1 minute, the strength of the demagnetizing field varied linearly as a function of the logarithm of the time of application. If this relation is valid for very long times and weak fields (which are significant in paleomagnetic studies) it indicates that remanence acquired by "creep" has an especially strong resistance to alternating fields. It may be possible to take account of the effect of this magnetic viscosity and determine better the other types of magnetizations in rocks.—*M. C. R.*

166–276. Irving, E. Palaeomagnetic and palaeoclimatological aspects of polar wandering: Geofisica Pura e Appl., v. 33, p. 23–41, 1956.

This paper contains a summary of all the published palaeomagnetic observations from rocks of pre-Tertiary age. Evidence is produced which shows that the ancient latitude deduced from the palaeomagnetic observations in several regions of the world is similar to the latitude indicated for these same regions by palaeoclimatology. Thus it is reasonable to suppose that the magnetic and rotational axes of the Earth have approximately coincided since the Palaeozoic, as they are known to have done during the past 20 million years. On the basis of this assumption two further points are made: In pre-Tertiary times the pole was a great distance away from the present position, but the pole positions given by data from pre-Tertiary rocks from four continents do not agree one with another. Although the palaeomagnetic and palaeoclimatic observations from the same regions agree, this is not so when palaeomagnetic observations from one region are compared

against palaeoclimatic evidence from a distant region. Both these results suggest that prior to Tertiary times the pole has not only shifted its position with respect to certain land masses, but also that these land masses have moved relative to one another.—*Author's abstract*

166–277. Verhoogen, J[ohn]. Ionic ordering and self-reversal of magnetization in impure magnetites: Jour. Geophys. Research, v. 61, no. 2, pt. 1, p. 201–210, 1956.

Impure magnetites, containing an appropriate amount of aluminum or other elements with an average charge of about 3 (for example, titanium plus magnesium, titanium plus vacancies), may undergo a reversal in their direction of magnetization as a result of an ionic ordering process during and after cooling. Gorter has shown that this phenomenon occurs in the compound $NiFeA1O_4$. Some natural magnetites have compositions which suggest that they would be self-reversing. It is unlikely that reversals could occur in less than 10^5 or 10^6 years; on the other hand, ordering may be so slow that an igneous rock may be eroded away, and its magnetic constituents redeposited in sediments before they undergo inversion; some sediments may thus have an inherent self-reversing property. When this suggested mechanism is added to other possible mechanisms (two-constituent mechanism, or phase changes), it may significantly reduce the number of instances in which reversal must be explained as a result of a reversal of the earth's field.—*J. R. B.*

166–278. King, R. F. The remanent magnetism of artificially deposited sediments: Royal Astron. Soc. Monthly Notices, Geophys. supp., v. 7, no. 3, p. 115–134, 1955.

Experiments are described in which samples of unconsolidated glacial deposits from Sweden were redispersed and allowed to settle in a tank. The direction and intensity of the resultant magnetic field were varied and currents were created in the tank in an attempt to discover what factors, other than the magnetic field, control the alinement of the permanently magnetized particles that give the sediment its remanent magnetic moment.

It was found that sediments artificially deposited on a horizontal surface with no current were magnetized at an inclination lower than that of the magnetic field, and that in a deposit on a tilted surface the magnetic inclination is close to that which would be observed if the sediments had been deposited on a tilted surface and tipped into their present position. If sediments are deposited where currents flow in the water immediately above the bed, the magnetic inclination is increased in the direction of the current. These results can be explained by assuming a model consisting of spherical and platelike particles of magnetic material; when the spheres settle on a layer of already deposited spheres they roll into the interstitial hollows, randomly on a horizontal surface and under the influence of the inclination or bottom current if these conditions exist. This tentative theory quantitatively explains the experimental results of the effect of the slope and qualitatively explains most of the measurements of natural remanence of the same materials.—*J. R. B.*

166–279. Opdyke, N. D., and Runcorn, S. K. Remanent magnetization of lava flows in northern Arizona: Plateau, v. 29, no. 1, p. 1–5, 1956.

Field measurements by Brunton compass on samples of lava flows in the San Francisco Mountain, Verde Valley, and Mormon Mountain volcanic fields in northern Arizona show that lavas younger than about 60,000 years have normal

magnetization and older, but post-Pliocene flows show both normal and reversed magnetization. In three cases, baked clay horizons found beneath lava flows are magnetized accordingly with the overlying lavas. Opdyke and Runcorn conclude that this evidence lends support to the hypothesis that the geomagnetic field can reverse.—*J. R. B.*

166–280. Irving, E. The magnetization of the Mesozoic dolerites of Tasmania: Royal Soc. Tasmania Papers and Proc., v. 90, p. 157–168, 1956.

The magnetization in the Mesozoic dolerites of Tasmania is almost vertical. The magnetic pole consistent with this magnetization is 10° S. E. of Tasmania. The stratigraphic record of Australia at this time suggests climatic conditions indicating a high geographical latitude agreeing with the high geomagnetic latitude, and this provides qualitative evidence in support of the supposition that some time in the later Mesozoic the geomagnetic field, when averaged out over several thousand years, was approximately coincident with the axis of rotation. The upper half of a 1,050-ft diamond drill core of the dolerite showed reverse magnetizations, but because no reversals were found in the surface sampling it is assumed that the reversal in the core is due to some special effect by means of which the rock became magnetized during cooling in the opposite direction to the Earth's magnetic field.—*J. R. B.*

166–281. Clegg, J. A., Deutsch, E. R., and Griffiths, D. H. Rock magnetism in India: Philos. Mag. v. 1, no. 5, p. 419–431, 1956.

Measurements have been made of the magnetic polarization of 450 specimens of basaltic lavas of the Deccan Trap taken from two sites about 500 miles apart. With the exception of some nearly randomly magnetized specimens, the main direction of magnetization is N. 155° E. and the dip is 53° downwards. The most plausible interpretation of this result is that India has drifted north from a position about 34° south of the equator when the rocks were formed some 70 million years ago and has rotated anti-clockwise through 25°, and that either the earth's field was reversed when the rocks were formed or that the rocks became magnetized in the opposite direction to the field by some physico-chemical mechanism.

The pole position corresponding to these results does not agree with that found by other workers for British and American rocks of the same period. This suggests that a movement of India, relative to North America and Europe, has taken place at some time during the past 70 million years.—*Authors' abstract*

166–282. Asami, Eizo. Reverse and normal magnetism of the basaltic lavas at Kawajiri-Misaki, Japan: Jour. Geomagnetism and Geoelectricity, v. 6, no. 3, p. 145–152, 1954.

The natural magnetization has been measured of 119 specimens of early Pleistocene basalt from Cape Kawajiri, Japan; 41 specimens have shown that 2 main belts of the basalt are reversely magnetized but 74 specimens from a central belt have normal and reverse remanent magnetization intermixed, even in the same block of rock (see also Geophys. Abs. 159–41). It is concluded that it is not likely that the reverse magnetization of these rocks has been caused by a reverse geomagnetic field, but may be related to the self-reversal of magnetization of rocks that may occur by a solid-phase transformation in ferromagnetic minerals in the rocks. (See Geophys. Abs. 160–36 and 161–41).—*J. R. B.*

166–283. Griffiths, D. H. The remanent magnetism of varved clays from Sweden: Royal Astron. Soc. Monthly Notices, Geophys. supp., v. 7, no. 3, p. 103–114, 1955.

The directions of remanent magnetization of samples taken from a number of varved clay series from Sweden have been measured in an attempt to obtain information about the direction of the Earth's field in past times. Two sets of samples were taken from a Kullenberg core sampler from cores of recent varves obtained from a river delta. It was possible therefore to compare the magnetization directions of these samples with observatory records of the Earth's field direction at the time of deposition of the clay. The results indicate that the magnetizations were acquired on deposition and have remained stable in direction since. Their directions are shown to have been controlled not only by the Earth's field but by the slope of the bed on which deposition took place and very probably by bottom currents flowing in the river or lake during sedimentation. Thus no information about the past direction of the Earth's field can be obtained from the data unless corrections can be applied to allow for these factors. A method of correcting approximately for the change of magnetization direction due to deposition on a slope is explained. No way of allowing for the effects of bottom currents has yet been discovered, though there is evidence that in some instances these effects are small. Where this is so the magnetization direction may perhaps prove a reliable indicator of the field direction at the time of deposition.—*Author's abstract*

166–284. Martinez, Joseph D., and Howell, Lynn G. Palaeomagnetism of chemical sediments: Nature, v. 178, no. 4526, p. 204-205, 1956.

Statistical evaluation of the magnetic polarization of samples of large syngenetic ellipsoidal calcareous concretions in the Barnett shale of Mississippian age from the Llano uplift of central Texas indicates that the south magnetic pole was at 39° N. lat, 124° E. long. Eight measurements of reversely magnetized limestone indicate that the north pole was at 42° N. lat, 142° E. long. Stability of magnetization in Barnett time is indicated by the agreement in samples of different lithology from widely separated areas of a direction drastically different from that of the present earth's field. Thin-section study indicates that hematite formed by oxidation of syngenetic pyrite is the most likely ferromagnetic mineral present.—*M. C. R.*

MAGNETIC SURVEYS

166–285. Logachev, A. A. Kurs magnitorazvedki [Textbook of magnetic exploration]: 302, p., Moscow, Gosgeoltekhizdat, 1955.

A revised edition of Logachev's textbook [see Geophys. Abs. 113–6959]. The physical principles of the magnetic method; instruments used in magnetic measurements, including instruments for airborne surveying; field methods; and analysis and processing of data are covered.—*S. T. V.*

166–286. Zietz, Isidore, and Henderson, Roland G. A preliminary report on model studies of magnetic anomalies of three-dimensional bodies: Geophysics, v. 21, no. 3, p. 794–814, 1956.

Model experiments were made to devise a rapid method for calculating magnetic anomalies of three-dimensional structures. The magnetic fields of the models were determined using the equipment at the Naval Ordnance Laboratory, White Oaks, Md. An irregularly shaped mass was approximated by an array of prismatic rectangular slabs of constant thickness and varying horizontal dimensions.

Contoured maps are being prepared for these magnetic models at different depths and for several magnetic inclinations. The fields of these three-dimensional structures are obtained by superimposing the appropriate contoured maps and adding numerically the effects at each point. The equipment and laboratory methods are described. Theoretical and practical examples are given.—*Authors' abstract*

166–287. Simonenko, T. N. O vychislenii znacheniy Z_a po izmerennym znacheniyam ΔT [Computation of the Z_a values from measured values of ΔT]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 704–707, 1956.

The solution to the problem of computing the intensity of the vertical component Z_a of the anomalous field from the measured increases ΔT of the total intensity of the geomagnetic field is known in the general form but one difficult to use in practical field work. Simonenko reduces the problem to two dimensions, applicable also as an approximation to elongated bodies, and gives the solution in finite and relatively simple form. The solution was applied to practical cases and the agreement between the theoretical solution and the results of extensive geophysical measurements was found to be fully satisfactory.—*S. T. V.*

166–288. Du Vernet, J. P. An airborne magnetometer survey in the Arctic Islands: Canadian Min. Jour., v. 77, no. 3, p. 57–59, 1956.

A discussion of the equipment and problems in an exploratory airborne magnetometer and scintillation counter survey of the Arctic Islands made by the Geological Survey of Canada during the field season of 1955.—*V. S. N.*

166–289. King, A. J. Preliminary magnetometric survey of Mwinditi Hill, near Itiso, Dodoma District: Tanganyika Geol. Survey Rec., v. 4, p. 70–73, 1954.

A preliminary magnetic survey of Mwinditi Hill detected two local intense anomalies that were interpreted as the result of magnetite concentrations in a dunite intrusion. Further work is required to determine the economic importance of the deposit.—*V. S. N.*

166–290. Hernández, Roberto P. J., and Besada, Eduardo M. Mediciones geomagnéticas en la Isla Decepción [Magnetic measurements on Deception Island]: Meteoros, año 5, no. 1–2, p. 55–86, 1955.

Magnetic observations during April to December 1951 in different parts of Deception Island and at the geomagnetic station at the Argentine naval base are tabulated, with no attempt at exhaustive analysis. On the basis of these measurements the area is unsuitable for installation of a permanent magnetic observatory, because of the presence of a natural local anomaly.—*D. B. V.*

166–291. Yumura, Tetsuo. Magnetic anomaly due to serpentine rocks (Magnetic survey of the Hizume district): Kakioka Magnetic Observatory Mem., v. 6, no. 2, p. 174–190, 1953.

A detailed magnetic survey was made in 1942 in the vicinity of the Hizume anomaly in Iwate Prefecture, Japan. Vertical and horizontal intensity and declination were measured at 129 stations. The cause of the anomaly is almost certainly the serpentine which crops out over most of the area, but its magnitude is greater than that expected from estimates based on the ferromagnesian content

of about 10 percent. An isogonic and five isodynamic maps (horizontal and vertical components and *X*-, *Y*-, and *Z*- anomalies) and tables of survey data are included.—*D. B. V.*

166–292. Rodríguez-Navarro de Fuentes, José. Proyecto de mapa magnético de la Península Ibérica [Proposed magnetic map of the Iberian Peninsula]: Inst. Geog. y Catastral Mem., tomo 21, no. 7, 32 p., 1951.

After brief comparison of existing maps of Spain and Portugal with those of other European countries, plans are outlined for a new magnetic survey of the Iberian peninsula, to be undertaken jointly by the Instituto Geográfico y Catastral in Spain and the Servicio Meteorológico Nacional in Portugal. The spacing of stations in the permanent and first-, second-, and third-order networks is discussed, and plan of work outlined. The survey should be completed in 5 years.—*D. B. V.*

MICROSEISMS

166–293. Monakhov, F. I. Kharakteristika istochnikov shtormovykh mikroseysm [The character of the sources of microseisms related to cyclones] Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 634–643, 1956.

From records of the most important microseismic disturbances observed between 1950 and 1955 at seven Russian and eight Japanese stations analysed in relation to cyclonic storms and their paths over different parts of the northwestern Pacific Ocean, it is concluded that the full development of the microseismic disturbance is always delayed with reference to the appearance of the cyclone or typhoon by about 10 hours. This causes a lag in the position of the microseismic center with reference to the center of the moving cyclone, estimated as equal to $10v$ km, where v is the velocity of the displacement of the cyclone. Because of this lag, the center of the microseism storm is never in contact with the cold front.—*S. T. V.*

166–294. Monakhov, F. I., and Baryshnikov, V. B. K voprosu ob istochnikakh mikroseysmicheskikh kolebaniy [On the sources of microseisms]: Meteorologiya i gidrologiya, no. 4, p. 31–34, 1956.

Those who do not accept as the cause of microseisms barometric disturbances created by cyclones passing over extended ocean areas point to the retardation of the maxima of microseisms compared with the position of the cyclones. Observations by Russian seismological observatories in the northern Pacific region confirm this lagging of microseismic maxima with reference to the position of the moving cyclone; however, the retardation can be explained as the timelag necessary to overcome inertia and the friction of terrestrial masses in starting to vibrate.—*S. T. V.*

166–295. Gutenberg, B[eno]. Untersuchungen zur Bodenunruhe in Südkalifornien [Investigations of microseisms in southern California]: Zeitschr. Geophysik, Jahrg. 21, Heft 4/5, p. 177–189, 1955.

Apparent differences in opinion concerning microseisms are sometimes a consequence of the fact that a few authors still confuse the various types. In southern California, somewhat irregular microseisms with periods of 1–4 sec usually increase with increasing turbulence of the air, especially after passage of cold fronts. These waves seem to arrive from the coast and show great attenuation. They have the character of *SV* waves with prevailing vertical component. According to Ewing, Jardetzki and Press such motion is to be expected in surface waves of second and higher modes.

Regular microseisms with periods of 4–9 sec show prevailingly properties of Rayleigh waves, but surface shear waves occur, too. At Palomar, all such waves

arrive from the direction of the coast. Contrasting with the microseisms with periods of 1–4 sec, they travel with little loss of energy across continental regions which are tectonically undisturbed. However, they decrease rapidly in crossing some mountain chains with deep roots; e. g., the Sierra Nevada in California. These waves seem to travel in the same low-velocity layer as *Lg* and *Rg*. Near the coast of California their amplitudes show better correlation with heights of ocean waves than with meteorological conditions; however, the corresponding periods may change in opposite sense.—*Author's abstract*

166–296. Strobach, Klaus. Zum Studium der mikroseismischen Bodenunruhe in Hamburg [Studies of microseisms in Hamburg]: Zeitschr. Geiophysik, Jahrg. 21, Heft 4/5, p. 190–214, 1955.

A special method is given to investigate the microseismic disturbances under the fact that microseismic motion is of statistical appearance, but caused by series of physical occurrences. The attempt is made of a statistical theory of superposed oscillations caused by waves travelling from different directions and with varying amplitudes. In this way it is shown that the problems of character of waves and the direction of approach can be studied by means of a statistical investigation of the horizontal directions of oscillations. A vector seismograph is described, by means of which the horizontal movements of particles (Lissajous figures) are recorded. The method of treating the records is characterized by forming the sums of amplitudes corresponding to the horizontal directions of ground oscillations. Comparisons of some results with the weather conditions show that the ground particles are chiefly moving parallel to the direction of approach of waves. Till now a noticeable rate of Love waves was not observed.—*Author's abstract*

RADIOACTIVITY

166–297. Picciotto, E. [E.] Les phénomènes nucléaires en géologie et géophysique [Nuclear phenomena in geology and geophysics]: Univ. Bruxelles Rev., tome 8, no. 5, p. 436–440, 1956.

A review of the application of radioactivity in studies of the thermal development of the earth and age determinations.—*M. C. R.*

166–298. Aswathanarayana, U. Applications of nuclear physics in the economic aspects of geology: Natl. Inst. Sci. India Bull., no. 5, p. 4–9, 1955.

Geologic applications of nuclear physics include radiometric surveys, radioactivity logging, radioactive tracer and sorting techniques in mineral dressing, studies of mineral paragenesis by autoradiography, and isotope abundances.—*M. C. R.*

166–299. Zadorozhnyy, I. K., and Zykov, S. I. O postoyannykh raspada radioaktivnykh elementov, uspol'zyyemykh pri opredelenii geologicheskogo vozrasta [The disintegration constants of radioactive elements used in the determinations of geologic age]: Akad. Nauk SSSR Komiss. opredel. absolyut. vozrasta geol. formatsiy Byull., vypusk 1, p. 67–76, 1955.

A review of the most important determinations of the half lives of U^{235}, U^{238}, Th^{232}, R^{87}, K^{40}, and C^{14}.—*S. T. V.*

166–300. Baranov, V. I. O vliyanii vneshnikh usloviy na radioaktivnyy raspad [The effect of external conditions on radioactive disintegration]: Akad. Nauk SSSR Komiss. opredel. absolyut. vozrasta geol. formatsiy Byull., vypusk 1, p. 77–79, 1955.

Results of experiments by different scientists to determine the effect of various external factors on the process of radioactive disintegration show that temperature, pressure, or the magnetic field affect the decay constants to only a small fraction of a percent, if at all, and certainly less than the unavoidable errors of the measurements. The process considered is atomic fission producing radioactive disintegration combined with an enormous release of energy. External radiation of the element under observation can perhaps produce capture of the outer electron (K capture). This effect can be pronounced in the disintegration of K^{40}, but in others it is practically insignificant.—*S. T. V.*

166–301. Geese-Bähnisch, Ingeborg, and Huster, E. Neubestimmung der Halbwertszeit des ^{87}Rb [New determination of the half-life of Rb^{87}]: Naturw. Jahrg. 41, Heft 24, p. 495–496, 1954.

The beta activity of Rb^{87} was determined by extrapolating to zero thickness the effect of thin layers of RbCl on lacquer emulsions; from this value, corrected for mass absorption and other errors, a half life of 4.3×10^{10} years within +7 and −4 percent was obtained.—*D. B. V.*

166–302. Flinta, J., and Eklund, S. On the radioactivity of Rb^{87}: Arkiv fysik, Band 7, Häfte 32, p. 401–411, 1954.

The radioactive radiation from Rb^{87} has been investigated, and the maximum energy of the β-spectrum found to be 250 ± 25 *keV*, by means of absorption in aluminium. The absorption curve shows an excess of low-energy β-particles, in agreement with the assumption that the β-decay is triply forbidden. No γ or X radiations were found. The mean value found for the total β-radiation from rubidium was 42.2 ± 0.7 β-decays per min per mg Rb, corresponding to a half-life of $(6.1 \pm 0.2) \times 10^{10}$ years for Rb^{87}.—*Authors' summary*

166–303. Geslin, Marcel. Radioactivité des eaux, des roches et des sédiments naturels [Radioactivity of natural waters, rocks, and sediments]: Cahiers Naturalistes, nouv. sér., tome 10, supp. for 1954, p. 3–8, 1955.

A review of the radioactivity of natural waters, rocks, sediments, and the atmosphere, its origin, and units and methods of measurement, particularly for springs. Spring waters have a "permanent radioactivity" due to the presence of radium or thorium, and a "temporary radioactivity" due mainly to dissolved radon. The total hourly and daily contribution of radon to the atmosphere by springs is considerable.—*D. B. V.*

166–304. Hess, V. F., Kisselbach, V. J., and Miranda, H. A., Jr. Determination of the alpha-ray emission of materials constituting the earth's surface: Jour. Geophys. Research, v. 61, no. 2, p. 265–271, 1956.

Alpha particles from surface materials were measured with a scintillation counter. The surface emissivities, given in terms of alphas per cm^2 per min range from 0.00105 to 0.00350 for vegetation, and averaged 0.060 for "acid" igneous rocks, 0.027 for basic igneous rocks, and 0.033 for soils. A correction for exhalation of radon from rocks was determined by heating the rocks to high temperatures and "de-emanating" them completely and then determining the

buildup of radon after de-emanation. The values determined indicate that alpha-particle emission does not play a very important part in the ionization balance of the lower atmosphere.—*M. C. R.*

166–305. Ponsford, D. R. A. Radioactivity of the rocks of the [Stowell Park] borehole: Great Britain Geol. Survey Bull. no. 11, p. 62–64, 1956.

An account of the interpretation of a gamma-ray log taken down to 3,200 feet below the surface in the Stowell Park borehole which was drilled to prove the sequence and thickness of the Mesozoic rocks and the nature of the sub-Mesozoic floor. The gamma-ray log detected the misplacement of one complete draw of core by the driller.—*V. S. N.*

166–306. McCallum, G. J. Correction for the effect of cosmic radiation on the field measurements of the radioactivity of soils: New Zealand Jour. Sci. Technology, sec. B, v. 37, no. 2, p. 172–178, 1955.

Apparatus for field measurements of the radioactivity of soil designed by Fergusson, Belin, and Bargh has a statistical accuracy of the order of 2 percent. For wide use changes in cosmic ray background must be known as accurately. This background was experimentally determined by suspending the probe from the end of a wharf over sea water, and components of cosmic radiation were determined in the laboratory by placing the probe inside a ring of Geiger-Müller counters surrounded by a shield of iron 7 in thick. Relative contributions of each component were (in counts per minute): shield contamination, 5; mesons and hard electrons, 436; cosmic ray gammas, 109; and internal contamination, 20. With the pressure coefficients considered, the laboratory and wharf values are in good agreement. Absorption coefficients have been determined as 0.0019 cm^2 per g for the ionizing component and 0.025 cm^2 per degree for cosmic ray gammas. The formula for background rate N at a depth x cm in soil of density ρ and barometric pressure P cm Hg is $N(x, \rho, P) = 424(1-0.026(P-76))e^{-0.0019\rho x} + 106\ (1-0.03(P-76))e^{-0.025\rho x} + 20$. The count rate to be expected from the most common radioactive minerals uniformly distributed throughout soil has been determined in counts per minute as: potassium, 1.7×10^2 per percent K_2O; uranium in equilibrium with daughter products; 7.5×10^5 per percent U_3O_8; thorium in equilibrium with daughter products, 4.0×10^5 per percent ThO_2.—*M. C. R.*

166–307. Krumbein, W. C., and Slack, H. A. Statistical analysis of low-level radioactivity of Pennsylvanian black fissile shale in Illinois: Geol. Soc. America Bull., v. 67, no. 6, p. 739–762, 1956.

Black fissile shale in Pennsylvanian cyclothems in the western part of the Illinois Basin shows low-level radioactivity as measured by alpha-particle emission. Preliminary analysis showed a ten-fold variability in radioactivity among closely spaced samples, with no apparent concentration in particular zones of the thin shale units. These relations favored design of a sampling experiment for evaluation of average radioactivity of the shale and for detection of regional radioactivity gradients.

Interlocked regional and local sampling designs were set up and provided 176 samples for a regional study and 32 samples for a local study, including evaluation of the experimental error. The interlocked designs furnished data for estimating stratigraphic variability of samples spaced from about 1 foot to 18 miles apart.

Strip mines, mine dumps, and some well cores provided regional samples of the 3-foot black fissile shale bed overlying Coal No. 6 in an area about 200 miles long and 20 miles wide. The local samples were collected from four localities within a single mine. In both sampling designs the maximum variability occurred at the lowest sampling level, indicative of a "spotty" distribution of radioactivity in the black shale. Neither the geological evidence nor the statistical analysis suggested any strong regional gradient in radioactivity over the area studied. Both the geological and statistical data support the inference that the radioactive material was associated with the depositional environment, rather than introduced by wholly diagenetic processes.—*Authors' abstract*

166–308. Garrigue, Hubert, and Perrin, Albert. Trou soufflant radioactif au sommet du Puy-de-Dôme [Radioactive blowhole at the summit of Puy-de-Dôme]: Acad. Sci. Paris Comptes Rendus, tome 242, no. 10, p. 1345–1346, 1956.

On February 10, 1956, a circular hole about 10 cm in diameter was observed in the snow, which was 20 to 30 cm thick, near the summit of Puy-de-Dôme. The air temperature in this hole was about 3° C and the radioactivity 400 to 800 $\times 10^{-16}$ curies per cm^3 (in contrast to the "normal" 300 $\times 10^{-16}$ curies per cm^3), indicating anomalies in the radon content of the underground.—*M. C. R.*

166–309. Aswathanarayana, U., and Mahadevan, C. The potentialities of deep sea sediments as source of radioactive elements: Natl. Inst. Sci. India Bull., no. 5, p. 22–27, 1955.

Because of the extensive occurrence of deep-sea sediments and their high radioactivity when compared with terrestrial rocks, they form a valuable source of radioactive elements and their exploitation becomes an economic proposition. In India a zonal pattern has been observed in sediments off the Visakhapatnam Coast: high radioactivity in an inshore zone, low radioactivity offshore, and high radioactivity in the deep-sea sediment zone beyond a depth of 100 fathoms. Exploitation requires a thorough knowledge of the mode of concentration. (See also Geophys. Abs. 164–257.)—*M. C. R.*

166–310. Blifford, I[rving] H., Jr., Friedman, H., Lockhart, L[uther] B., Jr., and Baus, R. A. Geographical and time distribution of radioactivity in the air: Jour. Atmos. Terrest. Physics, v. 9, no. 1, p. 1–17, 1956.

Both natural and fission-product radioactivity of the air at ground level have been measured in identical filter-type air-sampling units at naval installations during a 5-year period. Average atmospheric radon and thoron concentrations have been determined for several places in the United States, Puerto Rico, Panama, the Pacific Islands, North Africa, and Alaska; diurnal and seasonal variations have been determined at some places by continuous measurements. These range from 0.09×10^{-18} curies per cc of air in Puerto Rico to 47×10^{-18} at Washington, D. C., for radon; and 0.03 (at Puerto Rico) to 2.69 (at Chicago) $\times 10^{-18}$ curies per cc of air for thoron. At Washington, D. C., fission-product activity from atomic bombs has been detected in the air for more than 70 percent of the days since January 1950, and similar results have been observed at other places. Except for short periods, the fission-product beta activity has been lower than the natural background. There is evidence that fission products put into the air from ordinary atomic bomb explosions are removed within a few months, but that thermonuclear explosions cause a reservoir of radioactivity to be formed in the stratosphere and that this radioactivity appears at ground level at a much later and for a considerably longer time after the explosion.—*M. C. R.*

166–311. Anderson, W., and Turner, R. C. Radon content of the atmosphere: Nature, v. 178, no. 4526, p. 203–204, 1956.

The radium contents of a series of representative samples of coal used in Great Britain range from 0.50 to 3.25 $g \times 10^{-13}$ per g coal. These figures suggest that the contribution of radon from burning coal does not represent a significant addition to the total atmospheric level. Raised levels of atmospheric radon during smoky or foggy conditions are probably best explained in terms of special meteorological conditions.—*M. C. R.*

RADIOACTIVITY LOGGING AND SURVEYING

166–312 Zeschke, Günter. Prospektion und Nachweis radioaktiver Minerale und Erze [Prospecting and detection of radioactive minerals and ores]: Zeitschr. Erzbergbau u. Metallhüttenwesen, Band 9, Heft 2, p. 49–56, 1956.

This review of prospecting for radioactive ores includes discussion of geochemical and geological processes involved in the formation of such deposits; methods of exploration, including airborne, car-borne, and ground methods; use of Geiger counters and scintillation counters; characteristic uranium mineral associations; and field and laboratory methods of determination and analysis of radioactive minerals.—*D. B. V.*

166–313. Melkov, V. G. Methods of uranium prospecting: Soviet Jour. Atomic Energy, no. 1, p. 85–91, 1956.

In prospecting for uranium, a geological survey is made to distinguish favorable districts and the degree of likelihood of uranium deposits so that the order in which reconnaissance should be carried out is determined. In large new areas prospecting usually begins with airborne radioactivity surveys, and car-borne radiometric and radiohydrogeological reconnaissance. In regions in which radioactivity anomalies are found and in adjacent areas detailed prospecting is then carried on. For efficient detailed prospecting and evaluation of anomalies, the geologic laws of uranium distribution, characteristics of uranium deposits, and behavior of uranium in weathering must be considered. Detailed work also includes emanation (radon and thoron), determination of uranium in samples, luminescence surveys, and geobotanical surveys.—*M. C. R.*

166–314. Satō, Kōnosuke. Some problems of prospecting for radioactive minerals [in Japanese with English summary]: Butsuri-Tankō, v. 9, no. 1, p. 1–4, 1956.

A review of methods and techniques of prospecting and the geologic interpretation of radioactivity anomalies.—*M. C. R.*

166–315. Russell, William L. The use of gamma-ray measurements in prospecting: Econ. Geology, Fiftieth anniversary v., 1905–1955, pt. 2, p. 835–866, 1955.

A comprehensive review of the use of gamma-ray measurements in prospecting for radioactive minerals, and in gamma-ray and neutron logging of oil wells. Instruments, methods, interpretation, and the uses of radioactivity logs are discussed.—*M. C. R.*

166–316. Sano, Shun'ichi. Portable instruments for measurement of radioactivity: Geol. Survey Japan Bull., v. 6, no. 12, p. 15–24, 1955.

A discussion of the conditions for design of a portable radiation counter (scaler) and a comparison with the ratemeter.—*V. S. N.*

166–317. Sano, Shun'ichi. On the measurement of radioactive intensity in the field measured by gamma ray G. M. counter (1): Geol. Survey Japan Bull., v. 6, no. 11, p. 31–40, 1955.

A discussion of the relations between the radioactive intensity measured by a Geiger-Müller counter and the distribution of radioactive sources.—*V. S. N.*

166–318. Sano, Syun'iti [Shun'ichi]. On the scintillation counters for geophysical use [in Japanese with English summary]: Butsuri-Tankō, v. 9, no. 1, p. 5–12, 1956.

A review of scintillation counters using thallium-activated sodium iodide crystals and their use in geologic work. Circuit diagrams are given for instruments developed by the U. S. Geological Survey [see Geophys. Abs. 159–174] and the United Kingdom Atomic Energy Research Establishment [see Geophys. Abs. 165–320]. The Geological Survey of Japan uses a special transportable recording ratemeter system developed by Scientific Research Institute, Ltd., in aerial prospecting.—*M. C. R.*

166–319. Obolenskaya, A. M. Primeneniye radioaktivnykh isotopov dlya issledovaniya skvashin [Use of radioactive isotopes in drill-hole exploration]: Prikladnaya geofiz., vypusk 14, p. 189–200, 1956.

A description of the use of γ-ray logging in oil wells for such purposes as the determination of the depth where mud is escaping or where water is coming into the well and the determination of the height of the cement lining around the tubing. Logs obtained in exploration of wells in the different oilfields of the U.S.S.R. illustrate the text.—*S. T. V.*

166–320. Kukharenko, N. K., Shimelevich, Yu. S., Bespalov, D. F., and Odinokov, V. A. Novyy geofizicheskiy metod vyyavleniya neftenosnykh i vodonosnykh plastov i opredeleniya vodoneftyanogo kontakta v obsazhennykh skvazhinakh [A new geophysical method of locating oil-bearing and water-bearing strata and of determining the contact between water and oil in cased oil wells]: Neftyanoye Khozyaystvo, no. 3, p. 43–49, 1956.

Description of a radioactive well-logging method, using fast neutrons and Na^{24}. The method has been used in the oilfields of the Tatar S.S.R. In many cases, but not always, a sharp delineation of the boundary between water and oil can be obtained.—*S. T. V.*

166–321. Dakhnov, V. N., Kholin, A. I., and Barsukov, O. A. Raschleneniye kollectorov po neftevodonasyshcheniyu v obsazhennykh skvazhinakh neytronnym gamma-metodom [The separation of strata on the basis of their saturation with oil or water in cased wells by the neutron gamma method]: Neftyanoye Khozyaystvo, no. 8, p. 50–56, 1955.

Analysis of the spectrum of neutron gamma radiation or the measurement of the density of thermal neutrons provides a method of distinguishing oil- and water-saturated rocks. The presence of hydrogen is the factor determining the intensity of the gamma radiation, but the hydrogen content of water and oil is almost the same and therefore other indicators, such as copper, magnesium, sodium, chlorine, iodine, and bromine, which are present in much greater proportion in water than in oil, must be used. Chlorine is the best because its con-

tent in water is usually high—as much as 150 g per liter in some oilfields—and it absorbs slow neutrons much better than other elements, radiating as much as three or even more gamma quanta for every absorbed neutron.

The diameter of the apparatus must be as great as possible to decrease the effect of mud (for a 6-in pipe a 130-mm implement is used); the distance from the source of the radiation to the indicator must be not less than 40–50 cm; the working surface of the counter must be not greater than 10–15 cm, and boron screening is recommended (a hollow cylindrical box surrounding the instrument and filled with boron carbide, placed below the counter and preventing the radiation from the primary substance reaching the counter directly). In field operation a measurement is first made with static level oil-water; then the mud is bailed out and the well "radioactivated," and the measurements are repeated.—*S. T. V.*

166–322. Lundberg, Hans. What causes low radiation anomalies over oil fields: Oil and Gas Jour., v. 54, no. 52, p. 192–195, 1956.

The existence of low-radiation anomalies over accumulations of oil is explained by the upward migration of water. The water will be diverted by various stratigraphic conditions and no water will reach the surface directly above the oil accumulations. Water that has been in the presence of hydrocarbons will be relatively sulfate-free and may dissolve radium and other metals and carry them to the surface where they will be precipitated in a pattern that will reflect the conditions below.—*D. R. M.*

166–323. Vybornykh, S. F. Metod mechenykh atomov dlya issledovaniy i kontrolya tekhnicheskogo sostoyaniya neftyanykh i gazovykh skvazhin [The method of marked atoms in investigations of the technical condition of oil and gas wells]: Neftyanoye Khozyaystvo, no. 7, p. 61–64, 1955.

A brief report on the procedure and results of well logging by the "induced" radioactive method. This consists in adding to the mud of the well any radioactive salt (for example, salts of cobalt or zinc); the activated solution penetrates the cracks of the surrounding formations, thus making it possible to determine the levels of leakage of the mud, or of the influx of external water. The level of cementing around the pipe can also be determined by using activated cement.—*S. T. V.*

166–324. Sarrot-Reynauld [de Cresseneuil] Jean. Nouveaux essais de corrélation stratigraphique dans le Bassin Houiller de La Mure par mesures de radioactivité [New attempts at stratigraphic correlation in the La Mure coal basin by radioactivity measurements]: Grenoble Univ. Lab. géologie Travaux, tome 32, p. 195–213, 1954–1955 (1956).

Radioactivity ($\beta+\lambda$) measurements are used as a basis of stratigraphic correlation in working out the Carboniferous paleogeography of the La Mure coal basin in France. The results, presented in detail, justify the basic hypothesis of the method that the radioactivity of the sediments enclosing the coal veins is constant laterally. This constancy is attributed to the presence of "microcyclothems." See also Geophys. Abs. 159–183.—*D. B. V.*

166–325. Rizzi, Ted M. Airborne geophysics in the search for uranium in the Black Hills: Mining Engineering, v. 8, no. 3, p. 284–287, 1956.

A review of airborne radioactivity surveying in the search for uranium ore, with particular reference to the prospecting of the Homestake Mining Co. in the Black

Hills, S. Dak. Homestake uses rim flying with a Super-Cub type aircraft and a Model 118 Royal Scintillator. Several small commercial deposits of uranium have been found.—*L. C. P.*

166–326. Sano, Shun'ichi, and Hatase, Yasuhiko. Radioactive prospecting in the Naegi Region, Gifu Prefecture: Geol. Survey Japan Bull., v. 7, no. 1, p. 33–40, 1956.

A radioactive survey was made in the Naegi region to investigate the applicability of the radioactive method in the search for place deposits of rare minerals and to collect data on fundamental problems of radioactive prospecting.—*V. S. N.*

SEISMIC EXPLORATION

166–327. Brinckmeier, G. Team work in seismic prospecting: Geophys. Prosp., v. 4, no. 2, p. 105–111, 1956.

Successful seismic prospecting requires an increasing degree of cooperation among many people of different skills and duties. Present operations and requirements are contrasted with those of the past.—*W. H. D.*

166–328. Nature. Improvements in seismic prospecting: Nature, v. 177, no. 4522, p. 1209–1210, 1956.

A report of a Geophysical Discussion of the Royal Astronomical Society. The development and applications of continuous-velocity logging were described by F. W. Hales. R. J. Raitt described seismic refraction work in the equatorial Pacific Ocean. S. Wyrobek described refraction methods used to delineate layers where the velocity contrast is less than 2,000 fps.—*M. C. R.*

166–329. Van Nostrand, Robert G. Enregistrement continu de vitesse [Continuous velocity logging]: Rev. Inst. Français du Pétrole, v. 11, no. 6, p. 743–756, 1956.

Continuous velocity logging is one of a variety of methods designed to obtain information in a bore-hole by physical measurements. Velocity logs were originally devised to get seismic velocity information more conveniently and more economically than can be done by conventional well geophone surveys. However, continued experience with velocity logs has shown that they have many other uses, some of which appear to be of even greater importance than that for which the tool was originally designed. For example, stratigraphic correlation over a line fifty kilometers long, by means of velocity logs, is very well illustrated by an example near Midland, Texas. Many times, the determination of formation boundaries is possible on velocity logs when not on other types of logs; examples are shown from Gonzales County, Texas, and from the Paris Basin, France.

A second purpose of velocity logs is to help us understand the origin of signals on reflection seismograms. This understanding is best accomplished through the preparation of synthetic seismograms. A comparison of synthetic seismograms with real seismograms illustrates the principles involved and shows that the idea of a synthetic seismogram is valid. A further use of velocity logs lies in the direct detection of gas and oil in bore-holes. It has been found that in hydrocarbon saturated sands the seismic velocity decreases whereas the restivity increases. On the contrary, when the sands are of low porosity or are water saturated, the velocity increases. Several examples of off-shore wells in Louisiana illustrate this principle and the presence of oil and gas was correctly predicted on the basis of this principle.—*Author's abstract*

166–330. Hicks, Warren G., and Berry, James E. Application of continuous velocity logs to determination of fluid saturation of reservoir rocks: Geophysics, v. 21, no. 3, p. 739–754, 1956.

Theoretical studies show that the variation in velocity of sound waves in a formation may be as much as 15 to 20 percent from compressibility changes in the saturating fluid; 20 to 30 percent from changes in overburden and hydrostatic pressures; and 60 percent from porosity changes of 3 to 30 percent. Specific examples show how the comparison of velocity, self-potential, and resistivity logs facilitate differentiation between oil- or gas-bearing sands and water-saturated sands. The interpretation of velocity logs in shaly sands is less difficult than that of electric logs. In low-porosity formations the velocity log is helpful in distinguishing between extremely compact formations and those containing fluid.—*R. G. H.*

166–331. Denton, Eric R. Formation porosity and fluid content from velocity logs: Canadian Oil and Gas Industries, v. 9, no. 6, p. 53–60, 1956.

A velocity log may be interpreted to advantage by considering it as a formation elasticity log. Load, matrix composition, porosity and fluid content are discussed in relation to formation elasticity. An empirical relationship between velocity and porosity has been determined for a limestone and a method is shown whereby porosity, expressed as a percentage, may be read directly from a velocity log.

The detection of hydrocarbons is facilitated by comparing the velocity of a formation with its resistivity. In general, low velocity accompanied by high resistivity indicates the presence of hydrocarbons. The velocity contrast between oil, gas and water sands is such that fluid contacts may often be located.—*Author's abstract*

166–332. Yurchenko, B. I. K metodike seysmicheskikh nablyudeniy v burovykh skvazhinakh [On the methods of seismic observations in drill holes]: Akad. Neftyanoy Promyshlennosti Trudy, vypusk 2, p. 149–154, 1955.

For detailed exploration in drill holes and reliable determination of relatively thin strata in the oilfields of Northern Caucasus, a probe consisting of two identical geophones connected by a cable about 20 m long was used with a third geophone placed on the ground near the opening of the hole. It was possible to measure accurately the times of arrival of waves from the shot to all three geophones and to locate the strata only 20 to 40 m thick. In determining the time of the arrival of the waves it was necessary to correlate the waves carefully, to avoid the loss of a half wavelength in the case of opposite phase.—*S. T. V.*

166–333. Kokesh, F. P. The long interval method of measuring seismic velocity: Geophysics, v. 21, no. 3, p. 724–738, 1956.

The reverse method of seismic velocity determination, wherein the shot is detonated in the borehole, has been extended to operate in deep wells. This has been accomplished by the use of a long interval arrangement of a multi-shot selective firing sound source gun and one or more geophones separated vertically by a cable several hundred feet long. A series of a relatively few such intervals can "strap" a borehole travel-time-wise with good accuracy. Travel time measurements over the cased portion of the hole can generally be accomplished by means of geophones placed at or near the surface. Velocity surveys con-

ducted in this manner become a routine well logging service, in conjunction with other services such as electrical logs. The paper describes in a general way the necessary field equipment, and field examples of surveys are presented.—*Author's abstract*

166–334. Nagumo, Shozaburo; Mori, Kiyoshi; and Hayakawa, Masami. Experimental studies on seismic disturbances and reflection waves [in Japanese with English summary]: Geol. Survey Japan Rept. no. 164, 33 p., 1955.

Owing to the complex geologic structure, the major problem of reflection seismology in Japan is distinguishing reflected waves on seismograms. After preliminary tests on the effect of topography, experiments were made, involving three shotholes averaging 20 m deep, 800 m apart, with geophones at 80 m intervals and charges of 1.125 kg, to test the effect of distance and time on amplitudes. The distance at which maximum signal-to-noise ratio occurred was found to differ for each shot point. It is concluded that for best results most suitable shot-detector distances should be checked before setting each spread.—*D. B. V.*

166–335. Chujo, Junske. On an analysis of the off set spread: Butsuri-Tankō, v. 8, no. 2, p. 55–58, 1955.

A procedure, in routine analysis, for determining the reflecting point when the shot point is off the spread line.—*M. C. R.*

166–336. Sojka, Krzysztof. Zagadnienie oscylacji energii przy badaniach sejsmicznych [The problem of oscillation of energy in seismic investigations]: Przegald geol., zeszyt 3, p. 94–98, 1954.

Conditions leading to the appearance of multiple reflections of seismic waves, and the relations between velocities in two adjacent strata, their densities, and seismic wave energy are analyzed, and the equation $T_{wt}=2T_n(\sqrt{(x/4)+h^2}/\sqrt{(x/2)+h^2})$ is derived, where T_{wt} is the arrival time of a multiple reflected wave, T_n the arrival time of a normal reflected wave, h is depth, and x is shothole distance. Calculated times of multiple reflection arrivals are compared with observed arrival times and with the doubled value of normal reflections for an actual example in Poland.—*D. B. V.*

166–337. Kołtoński, Wacław. O możliwościach zastosowanie fal ultradźwiękowych w geologii i górnictwie [On the possibilities of application of ultrasonic waves in geology and mining]: Przeglad geol., zeszyt 7, p. 327–334, 1955.

Experimental studies have been made of the use of ultrasonic waves in geologic and mining exploration. The velocity of propagation was measured on core samples, on layers of natural rock salt, anhydrite, and wet and dry sand, and in quarries. It is concluded that for a range of 10 to 30 m the method gives good results, and could be used to advantage in tracing veins and planning mine development. It may supplement or even replace present geophysical methods for limited areas of homogeneous material. Measurements should be made in two directions perpendicular to each other, at several points. Certain modifications of existing apparatus will be required, and further work should be undertaken to improve and develop the method.—*D. B. V.*

166–338. Berzon, I. S., Pariyskaya, G. N., and Starodubrovskaya, S. P. O registratsii vysokochastotnykh otrazhennykh voln na Russkoy platforme [On recording high-frequency reflected waves on the Russian Platform]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 644–656, 1956.

During 1953–54 several geophysical surveys were made of different regions in the Bashkir A.S.S.R. to investigate gently dipping structures in Devonian formations as possible sources of oil and gas. High-frequency seismic waves provided better resolving power and made it possible to obtain clear reflections from depths of 1.5 to 2.0 km. Frequencies of 70 cycles per sec or more were used, and waves of lower frequencies were filtered out. In some places multiple detectors or overlapping seismometer output were also used to obtain more detail.—*S. T. V.*

166–339. Richard, Henri, and Pieuchot, Maurice. Seismic efficiency of explosives: Geophys. Prosp., v. 4, no. 2, p. 167–184, 1956.

Parameters commonly used to characterize explosives are derived from laboratory tests and are not directly applicable to seismic purposes. A coefficient of seismic efficiency based on galvanometer deflections is presented. It allows the comparison of different explosives under field conditions. The efficiencies of several types of explosives were determined from both buried and surface charges. Precautions concerning experimental design and analysis are discussed. Preliminary results indicate that the coefficient of seismic efficiency depends on the type of explosive only and not on the size of the charge or experimental conditions. Economic aspects are stressed, and data are presented on the cost of various explosives required to attain the same seismic efficiency.—*W. H. D.*

166–340. Gaskell, T. F. The relation between size of charge and amplitude of refracted wave: Geophys. Prosp., v. 4, no. 2, p. 185–193, 1956.

Experiments carried out using charges of up to 200 lbs at a distance of about 20,000 ft from the geophones suggest that the amplitude of the refracted wave ground motion is roughly proportional to the weight of charge. Simple energy considerations lead one to expect a relation of a form in which velocity amplitude is proportional to $\sqrt{W}$.

An explanation of the observed relation may be based on a theory according to which the efficiency of the explosion increases with the source size, that is the distance from the source at which the pressure wave of the explosion ceases to cause permanent deformation of the surrounding medium.

The above theory was further confirmed by measurements of the radius of the cavity produced by explosions of charges of different size in clay. Also, explosion of charges in artificial water-filled cavities were found to give seismic wave amplitudes three or four times greater than those produced by the same charge in a narrow hole. It is possible that these observations explain in part why the charges required in marine refraction experiments are very much smaller than those needed in refraction work on land, but additional reasons for this difference are also discussed.—*Author's abstract*

406832—56——7

166–341. Nikolayevskiy, A. A. K voprosu o prichinakh izmeneniya kharaktera seysmicheskoy zapisi [On the factors changing the character of seismic records]: Akad. Neftyanoy Promyshlennosti Trudy, vypusk 2, p. 154–166, 1955.

The character of a seismogram and its legibility are determined by several factors, but primarily by the relations among the elastic properties and thicknesses of the strata forming the upper part of the profile. Conditions are most favorable for the separation of reflected waves from the multitude of disturbing effects when the elastic properties change slowly. The change in the coefficients of diffraction on the first rigid boundary determines the ratio of the energy of the reflected useful wave to the energy spent on surface disturbances. Placing the explosive charge below the first rigid boundary increases the intensity of the useful reflected wave, but for a formation of great rigidity this can increase the frequency of the wave and cause problems in recording. Directed shots are also recommended; these can be achieved by simultaneous explosion of several charges, thus affecting the direction of the impulse.—*S. T. V.*

166–342. Petrov, L. V. Iskazheniya v fazosdvigayushchikh tsepyakh [Distortions in phase displacement circuits]: Prikladnaya geofiz., vypusk 12, p. 182–209, 1955.

A theoretical study of processes in the circuits of electronic amplifiers and filters, especially those for frequency selection, used in eliminating interference in seismic prospecting. The mathematical treatment is based on the theory of the complex variable and presumes some familiarity with electronic processes.—*S. T. V.*

166–343. Gal'perin, Ye. I. Resheniye pryamykh prostranstvennykh zadach geometricheskoy seysmiki dlya mnogosloynykh sred s granitsami rardela proizvol'noy formy [The method of solving direct three-dimensional problems of geometric seismology in stratified media with boundary surfaces of any form]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 4, p. 391–403, 1956.

A graphical method for the solution of three-dimensional direct problems of geometric seismology in stratified media is described and illustrated by several examples. The method is based on the use of a stereographic projection with Wulf's net and makes it possible to arrive at the solution without the cumbersome procedures of analytic geometry. It is applicable in the determinations of the traveltime curves, of the angles of the arrival of seismic waves, and so on, and can be used for any boundary surfaces between formations.—*S. T. V.*

166–344. Berckhemer, Hans, and Oliver, Jack. Zur Deutung seismischer Einsätze mit parallelen Laufzeitkurven [On the significance of seismic impulses with parallel traveltime curves]: Zeitschr. Geophysik, Jahrg. 21, Heft 3, p. 152–164, 1955.

By means of model experiments in which the model, simulating conditions in the Ries, southwest Germany, consisted of a high-velocity layer overlying a much thicker layer of lower velocity, the parallel arrivals ovserved in seismic refraction studies are attributed to critical or near-critical reflections within the upper layer. The process may be called internal refraction as both the generating wave and the generated head wave travel in the same layer. The large amplitudes of the waves in comparison with those of the direct P wave are explained by the fact that the

observed surface motion of the direct *P* wave is also a second-order effect and by the superposition of different internal reflections of identical traveltime (*PS* and *SP; SPS, SSP,* and *PSS*). The process may take place in each layer of a multilayered medium if there is a sufficient contrast in velocity and density. Observations on glaciers show that these internal refractions may be used to determine layer thickness.—*M. C. R.*

166–345. Berzon, I. S. Priblizhennyye metody kolichestvennoy interpretatsii kart isokhron otrazhennykh voln [Approximate methods of quantitative interpretation of the maps of equal arrival of reflected waves]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 3, p. 252–262, 1956.

From maps of the isochrones of reflected waves for a given area, using always the same shot point, it is possible to construct the corresponding depth contours; that is, a map of isobaths. These methods are applicable in the case of plane boundary surfaces deviating only slightly from the horizontal plane. Two cases are discussed in detail: homogeneous layers characterized by a constant velocity, and a refracting boundary over the upper reflecting boundary. In the latter case the map of the isochrones of reflected waves can be interpreted only after the map of isochrones of the refracted waves corresponding to the upper layer has been constructed.—*S. T. V.*

166–346. Yepinat'yeva, A. M. Kinematicheskiye osobennosti prelomlennykh voln v sredakh s klinoobraznym zaleganiyem sloyev [Kinematic peculiarities of refracted waves in media containing wedge-shaped strata]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 3, p. 263–276, 1956.

In a medium composed of a wedge-shaped layer between two plane parallel strata, in which the wedge is under about half of the profile, depending on the position of the shot point, which can be either over the part of the profile containing the intermediate layer or over the two-plane parallel strata, there are seven possible paths by which refracted waves can reach the surface of the earth. The paths are different for waves propagating updip or downdip. Some of the determined rays were checked experimentally and the seismograms are reproduced. In most cases the agreement between the observed rays and those analytically determined is satisfactory.—*S. T. V.*

166–347. Domzalski, W. Some problems of shallow refraction investigations: Geophys. Prosp., v. 4, no. 2, p. 140–166, 1956.

Problems related to shallow refraction work (less than about 300 ft) are illustrated and discussed. Among the problems considered are the location of the geophone spread with respect to topography, the influence of local ground conditions on the recorded times, velocity reversal, velocity anisotropy, lateral changes in velocity, time delays caused by repeated use of the same shothole, and ill-definied bedrock surfaces. Errors are analyzed and the limits of the practical capabilities of the method are stressed.—*W. H. D.*

166–348. Masuda, Hideo, and Kitano, Akihiko. On the direction of initial motion observed in seismic prospecting; Butsuri-Tankō, v. 8, no. 2, p. 59–62, 1955.

Rarefactions have been observed in seismic prospecting on gravel.—*M. C. R.*

166–349. Tatsugami, Masao. Refraction computing set square: Butsuri-Tankō, v. 8, no. 2, p. 52–54, 1955.

A method for the graphical solution of the refracted ray path and the traveltime where the incident ray to an interface and the velocities of the media on either side are known.—*M. C. R.*

166–350. Tarrant, L. H. A rapid method of determining the form of a seismic refractor from line profile results: Geophys. Prosp., v. 4, no. 2, p. 131–139, 1956.

A set of refraction line arrival times can be readily converted into a set of dealy-times providing the refractor velocity is known. If we then subtract the delay-time at the shot-point end, we arrive at a set of delay-times representing the refractor depths at the receiving end. This paper is concerned with the conversion of such a set of delay-times into a profile of the refractor.

The method is semi-graphical and very easy to apply. For each geophone station an arc of a circle is constructed, such that the envelope of the series of arcs represents the surface of the refractor. While the method is not quite exact, especially when the dips are large, it is of particular value in allowing for the effects of varying dips upon the offset distance. The method treats the overburden above the refractor as if it were of uniform velocity.—*Author's abstract*

166–351. Wyrobek, S. M. Application of delay and intercept times in the interpretation of multilayer refraction time distance curves: Geophys. Prosp., v. 4, no. 2, p. 112–130, 1956.

The well known quantities, delay and intercept times, can be made fully useful in the interpretation of multilayer refraction problems dealing with small undulating dips.

The identification of the individual refractors is made by the use of reciprocal and intercept times and by applying an additional and useful relationship, namely that the delay time profile between two shot-points should match the half-intercept time profile when calculated using the true velocity of the refractor.

With a suitable arrangement of shot-points this relation permits us to obtain the true horizontal velocity of a refractor from one direction of shooting only.

Presentation of the refraction results in the form of time sections, similar to those used in reflection surveys, is often desirable. These sections can be converted easily into depth sections, once the overburden velocities are defined.

The use of the method is limited not only by the dip, but also by the depth of the refractor. Deep refractors can be, however, worked out by this method, by reducing a multilayer problem to that of two layers, using again the delay times.—*Author's abstract*

166–352. Rische, H. Ein erweitertes Auswerteverfahren für refraktionsseismische Übersichtsvermessungen [An expanded evaluation procedure for seismic refraction survey measurements]: Gerlands Beitr. Geophysik, Band 65, Heft 2, p. 163–167, 1956.

Statistical treatment of velocity distribution in scattered seismic measurements is used to aid interpretation of isochrone planes, and illustrated by an example from northeastern Mecklenburg, Germany.—*D. B. V.*

166–353. Puzyrev, N. N. O putyakh utochneniya metodo v interpretatsii dannykh seysmorazvedki [On ways of making more precise the methods of interpreting seismic prospecting data]: Prikladnaya geofiz., vypusk 12, p. 107–126, 1955.

A critical analysis of different approximate methods used in seismic exploration, especially the determination of ray diagrams, the position of reflecting boundaries, and variation of velocity.—*S. T. V.*

166–354. Litvinenko, I. V. Nomogrammy dlya postroyeniya seysmicheskikh razrezov priblizhennymi sposobami [Nomograms for the construction of approximate seismic profiles]: Prikladnaya geofiz., vypusk 13, p. 41–52, 1955.

Approximate methods of computing seismic profiles are very useful for interpretation of seismic data and are now currently employed in seismic surveys but require a great amount of calculation. Nomograms may be used in many cases; their construction is shown and their use explained by several practical examples. —*S. T. V.*

166–355. Ellis, L. G., and Winterhalter, A. C. Unusual reflection events in offshore seismic work: Geophysics, v. 21, no. 3, p. 755–764, 1956.

A number of unusual reflections were recorded during a reflection seismograph survey by the Sun Oil Co. in the Gulf of Mexico. These reflections are such as to indicate horizontal travel paths. A limited amount of work was done to try to determine the nature of the reflecting sources. Although conclusive evidence as to their exact nature was not obtained, this work indicates the sources are associated with rather small areas of the Gulf floor. Sonic depth finder recordings over some of these areas can be interpreted as indicating they are small silt filled depressions.—*Authors' abstract*

166–356. Burling, Richard L. Some unusual reflections of sound in the ocean: Geophysics, v. 21, no. 3, p. 765–770, 1956.

In seismic exploration for submarine structures, occasionally energy of uncertain origin arrives before that reflected from the ocean bottom. The center of the disturbance, whether a diffracting point or real or virtual image from a convex or concave reflector, can be determined from the move-out time, the short-time position and the geometry of the detector cable. It is concluded that the phenomena are due to animate diffractors, probably whales, large fish, or schools of fish.—*R. G. H.*

166–357. Williams, L. W. Seismic reflection survey at Roma, Queensland, 1952–53: Australia Bur. Min. Resources Geology and Geophysics Rept., no. 23, 8 p., 1955.

The seismic reflection survey made in an area north and northwest of Roma produced no evidence of domal structure at Hospital Hill or Block 16 where oil and gas previously have been found. No sites for drilling were found, and further seismic work is not recommended.—*V. S. N.*

166–358. Soske, Joshua L. Seismic prospecting for petroleum and natural gas in the Great Valley of California: California Div. Mines Bull., no. 171, pt. I, p. 107–127, 1955.

The seismic refraction method was used to investigate geologic structures in the Great Valley of California from 1926 to 1929 but was found to be inadequate. The reflection method, introduced in the Delano-Bakersfield area in 1928, became the accepted method for oil and gas prospecting in areas where there were no rock outcrops. The limited applicability of correlation methods of reflection study led to the development and wide use of the dip method of analysis and the construction of maps of phantom horizons to represent buried geologic structure. The success of the reflection seismograph in the Great Valley is indicated by the discovery of 34 oil and gas pools where the method contributed essential technical information in advance of drilling.—*V. S. N.*

166–359. Gutenberg, Beno, Buwalda, John P., and Sharp, Robert P. Seismic explorations on the floor of Yosemite Valley, California: Geol. Soc. America Bull., v. 67, no. 8, p. 1051–1078, 1956.

The depth and configuration of the bedrock floor beneath Yosemite Valley were determined by seismic surveys in 1935 and 1937. Seismic velocities of roughly 1.7, 2.5, 3.0, and 5.2 km per sec and good to excellent reflections delineate at least three distinct layers within the valley fill resting on granitic bedrock.

The upper layer with a maximum thickness of about 150 m extends from Mirror Lake to the Wisconsin end moraines near Bridalveil Meadow. It is thought to be primarily deltaic lake deposits of Wisconsin age. The intermediate and basal layers have maximum thicknesses of 220 and 300 m respectively, and the intermediate layer lies in a U-shaped trough seemingly gouged out of the basal layer. Both layers are thought to be remnants of earlier lake fillings, and at least the basal layer is pre-Wisconsin. The greatest thickness of fill, about 600 m, is near the head of the valley between Ahwahnee Hotel and Camp Curry.

The bedrock floor of Yosemite Valley is an undulating surface with three separate basins and a total bedrock closure of at least 400 m, possibly approaching 500 m. The bedrock floor slopes steeply from the head of the valley to its deepest point, 600 m above sea level, between Ahwahnee Hotel and Camp Curry. Down-valley, it rises rapidly about 300 m across a broad sill opposite Rocky Point. The second basin, 800 m above sea level, is opposite Cathedral Spires. From here the floor rises gradually down-valley to at least 1,000 m above sea level opposite Artist Creek. It may rise another 100 m before the drop into a small basin more than 100 m deep at the Cascades. The amount of glacial excavation on the bedrock floor, essentially double the 450 m previously estimated, is attributed wholly to pre-Wisconsin glaciation. The greatest depth of excavation is in massive granitic rocks, and it is suggested that thick ice, exfoliation sheeting developed by pressure relief, and compressive flow in the glacier combined at this point to produce exceptionally effective erosion.—*Authors' abstract*

166–360. Blundun, G. J. The refraction seismograph in the Alberta foothills: Geophysics, v. 21, no. 3, p. 828–838, 1956.

In the Alberta foothills the most valuable use of the refraction seismograph is for the definition of overthrust faulting in the Mississippian limestone which is overlain by a faulted, overthrust, and overturned Cretaceous section. Normally, two refracted arrivals are recorded with characteristic interval velocities of 14,000 ft per sec, and 21,000 ft per sec, the former arising from an unknown Cretaceous marker, and the latter from the Mississippian. In contrast to a shot-range of

65,000 ft required to record the refracted arrival from the Mississippian at a depth of 10,000 ft as the first event, a range of 20,000 ft permits recording it as the later event, with consequent improvement in the quality and reliability of the data, reduces the amount of surveying required together with smaller dynamite charges, and improves radio communication. A geophone spread of 6,300 ft, with single geophones at 300 ft intervals recorded on 22 traces is recommended.

Both in-line and broadside refraction with the Mississippian arrival recorded as the later event have been used successfully with certain advantages to each method. The former permits continuous determination of the interval velocity of the refracted events as well as providing two-way control; the latter is considerably faster, and often faulting may be observed directly on the seismograms without reduction of the data. Specimen seismograms are included to illustrate the two methods.

Field operating conditions pertaining to survey tolerances, shot formation, size of dynamite charges, the weathering shot as a polarity check, filtering, geophone frequency, and costs are discussed.—*Author's abstract*

166–361. John, H. Das Geschwindigkeitsproblem in Bereich der Schwäbischen Vorlandsmolasse [The problem of velocity in the area of the Swabian foreland Molasse]: Erdöl u. Kohle, Jahrg. 9, Heft, 5, p. 290–299, 1956.

Detailed analysis of the horizontal and vertical variations of velocity in the Molasse sediments of the Swabian foreland, Germany, based on measurements in 11 available boreholes, shows that there is a southward increase in velocity (down the dip) in addition to an eastward increase due to lithologic factors (mainly, carbonate content and grain size). Toward the southeast, therefore, there is an increase not only of velocity but of the gradient of velocity. As the eastern part of the Molasse is essentially homogeneous from the standpoint of velocity, the relation between velocity and depth is logarithmic, and that between velocity gradient and depth is hyperbolic. The "dip pressure" (Hangendruck) and lithologic ("normal") components of velocity can be separated by graphic subtraction. Identification of Molasse formations on the basis of characteristic velocities is not possible.—*D. B. V.*

166–362. Jankowsky, W. Zur Tektonik des Gebietes zwischen Bremen und Cuxhaven [On the structure of the area between Bremen and Cuxhaven]: Erdöl u. Kohle, Jahrg. 9, Heft 5, p. 283–289, 1956.

This interpretation of the structure of the salt-dome area between Bremen and Cuxhaven, Germany, is based on seismic reflection and deep borehole data. The stratigraphic interpretation of the strongly reflecting horizon *B* as representing about the base of the Tertiary and of *C* as approximately the base of the Upper Cretaceous to Albian is confirmed by a combination of well shooting in deep boreholes and almost uninterrupted seismic correlation. Lower reflecting horizons (Jurassic to Zechstein) are interpreted mostly on the basis of combined seismic and geologic considerations. Insufficient data on layer velocities and therefore of true depths to reflecting horizons are a source of great difficulty in construction of profiles.

The results are presented in 3 sketch maps and 10 cross sections.—*D. B. V*

166–363. Tazime, Kyozi. Dispersion by a small explosion: Butsuri-Tankō, v. 8, no. 3, p. 127–132, 1955.

Records were made of the waves from the explosion of a cap at a depth of 0.75 m, at geophones set every 0.25 m on a straight line from 0.25 m to 11.50 m. The dispersion observed was qualitatively the same as that observed on large-scale exploration.—*M. C. R.*

166–364. Gálfi, János, and Stegena, Lajos. Nagymélységú reflexiók Hajdúszoboszló vidékén [Deep reflections in the vicinity of Hajdúszoboszló]: Magyar Allami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 4, szám 2, p. 37–40, 1955.

Deep structure in the Great Hungarian Plain was investigated by means of reflection measurements near Hajdúszoboszló, 20 km southwest of Debrecen. A charge of 437 kg of dynamite was exploded at a depth of 42 m; in the resulting seismogram a strong reflection appeared 8.6 sec after the reflection from the basement at 1.2 sec. Using a European mean velocity of 5.8 kmps, taking into account the surface correction, the depth of the reflecting surface was calculated to be 22.7 km.—*D. B. V.*

166–365. Gaskell, T. F. Seismic prospecting in the Middle East: Oil Forum, v. 10, no. 7, p. 242–243, 254, 1956.

The reflection seismic method is used to locate the large, gently curved structures in the country of Kuwait. Good results have been obtained by firing a pattern of five small shots at 50 ft depth. The reflection method is also used for exploration off the Trucial Coast; the detectors are contained in a long hose that is towed behind the ship, and 200 to 300 shots a day are possible. The refraction method is often used for detecting the massive anticlinal structures in northern Iraq.—*V. S. N.*

STRENGTH AND PLASTICITY

166–366. Shamina, O. G. Uprugiye impulsy pri razrushenii obraztsov gornykh porod [Elastic impulses produced by the destruction of specimens of rocks]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 5, p. 513–518, 1956.

In experimental investigations of the behavior of specimens of dolomite, limestone, sandstone, granite, and different coals in the process of destruction, two kinds of cracks were observed: fissures that formed an opening in the material and those formed by slipping of one part of the material over the other. Records of the resulting shocks in the material were very different; the first consisted of many slowly dying waves, the second often of just one wave, owing to great friction between the opposite sides of the crack. The frequency and amplitudes of the impulses increase as the limiting strength of the material is approached. These features can probably be used as the warning of the approaching rock bursts or mine-wall collapse.—*S. T. V.*

SUBMARINE GEOLOGY

166–367. Due Rojo, Antonio. Geología submarina [Submarine geology]: Inst. geol. min. España notas y comunicaciones, no. 41, p. 47–66, 1956.

A review of some aspects of our knowledge of the ocean floor, including topography of the ocean basins, faults in the Pacific floor, the continental shelves, and the paleontological significance of estuaries.—*D. B. V.*

166–368. Die Umschau. Das Profil des Meeresbodens in nördlichen Eismeer [The profile of the sea floor in the northern Arctic Sea]: Umschau, Jahrg. 56, Heft 9, p. 261–262, 1956.

A summary of the results of the Soviet polar expedition's soundings of the Arctic Sea floor. Sketch maps compare the earlier concept of a simple large basin with the more complex new findings involving three distinct basins delimited by ridges and plateaus.—*D. B. V.*

VOLCANOLOGY

166–369. Guest, N. J. The volcanic activity of Oldonyo L'Engai, 1954: Tanganyika Geol. Survey Rec., v. 4, p. 56–59, 1954.

A small, explosive eruption of Oldonyo L'Engai, a volcano in the Rift Valley south of Lake Natron, occurred in August 1954. Except for a temporary increase in activity in January 1955, activity gradually diminished after the initial eruption and the volcano has now returned to the dormant stage. The rocks of this volcano belong to the soda-alkaline suite and although lavas have flowed in historic time, the ejected ash, tuff and laval blocks suggest that it has been built up largely by a series of explosive actions.—*V. S. N.*

166–370. Cucuzza Silvestri, S[alvatore]. La recente attività dello Stromboli (febbraio-marzo 1954) [The recent activity of Stromboli (February-March, 1954)]: Accad. Gioenia Boll., ser. 4, v. 3, fasc. 1, p. 26–31, 1955.

The eruption of Stromboli which began on February 1, 1954, and lasted 41 days was the longest period of lava effusion in the recorded history of the volcano. It was exceptional also in the lack of premonitory or accompanying seismic phenomena; in the absence of explosive activity in the first phases of lava effusion; in the rapid changes of position of the lava ducts in the late stages; and in the unusual basicity of the products.—*D. B. V.*

166–371. Parascandola, Antonio. Notizia sul soffione di recente apparso alla Solfatara di Pozzuoli [Note on the recent steam eruption at the Sofatara di Pozzuoli]: La Ricerca Sci., anno 25, no. 11, p. 3113, 1955.

This is a brief note describing the recent "soffione," or strong sudden jet of steam mixed with minute sandy lapilli, that burst forth at the Solfatara di Pozzuoli on September 19, 1955.—*D. B. V.*

166–372. Udintsev, G. B. O rel'yefe Kurilo-Kamchatskoy vpadiny [On the topograph of the Kurile-Kamchatka graben]: Akad. Nauk SSSR Sovet seysmologii Bull., no. 2, p. 35–42, 1956.

Investigations by Japanese and Russian geophysicists indicate existence of a close correlation between the volcanic activity of the Kurile-Kamchatka regions and the generation of tsunami spreading southward from there. Additional studies of the seismic and volcanic activity of the Kurile-Kamchatka depression are imperative.—*S. T. V.*

166–373. Tsuya, Hiromichi. Geological and petrological studies of Volcano Fuji, V. 5. On the 1707 eruption of Volcano Fuji: Tokyo Univ. Earthquake Research Inst. Bull., v. 33, pt. 3, p. 341–383, 14 photos and 16 microphotos, 1955.

The last eruption of Fuji began on December 16, 1707, and virtually stopped on the last day of the year. The eruption occurred halfway down the southeastern flank of the mountain, and incandescent fragmentary material was ejected from three new craters. The total volumes of ejecta accumulated within 25 and 100 km of the craters were 015 km^3 and 0.8 km^3. The eruption is classed as grade VI of a 10-grade intensity scale. The mineralogical and chemical composition of the ejecta are discussed in some detail.—*M. C. R.*

166–374. Suwa, Akira. The eruption of Sakura-Jima in 1955: Geol. Soc. Japan Jour., v. 62, no. 725, p. 115–116, 1956.

An eruption of Minami-dake, southern peak on Sakura-jima, occurred on October 13, 1955, with activity lasting until the end of the month. No conspicuous volcanic earthquakes other than those accompanying the explosion were recorded before or after the eruption; no primary debris was found among the ejecta; and no unusual phenomena, such as changes in springs, topography, and so on were observed. Thus it is assumed that the source of the eruption was very shallow.—*V. S. N.*

166–375. Suwa, A[kira], Takeyama, I., and Kato, Y. The viscosity of fresh lava and the distribution of earth-current potential difference at the atrio, during the 1950–51 eruptions of Miharayama [in Japanese with English summary]: Quart. Jour. Seismology, v. 19, no. 3–4, p. 19–22, 1955.

The coefficient of viscosity of fresh lava was calculated from measurements of temperature made with an optical pyrometer and of the velocity, slope, and dimensions of lava flows during the 1950–51 eruptions of Mihara volcano, as ranging from 1.6×10^4 to 2.6×10^5 poises(cgs). Earth-current potential differences were measured at 17 stations in the atrio on October 13–14, 1940, and the results shown on a map of equipotential lines with 50 mv contour interval.—*D. B. V.*

166–376. Gorshkov, G. S. Khronologiya izverzheniy vulkanov. Kuril'skoy gryady [The chronology of the volcanic eruptions of the Kuril Ridge]: Akad. Nauk SSSR Lab. vulkanol. Trudy, vypusk 8, p. 58–99, 1954.

The Kurile Islands (the name in Russian means the smoking islands) are the continuation of the line of volcanoes of the Kamchatka Peninsula and stretching from the tip of Kamchatka to Hokkaido. More than 80 volcanoes of the Kurile Islands have been investigated, most only superficially; many more volcanoes have not yet been visited by volcanologists. At least 37 volcanoes are active, and three submerged volcanoes were located here during their eruptions.

A list of known eruptions since 1713 is given with critical analysis of the available information and short descriptions of some of the eruptions. Chemical analyses are given for two samples of lava from newly erupted volcanoes.—*S. T. V.*

166–377. Menyaylov, A. A. Osnovnyye etapy razvitiya vulkana Shevelucha [The main stages of the evolution of Sheveluch Volcano]: Akad. Nauk SSSR Lab. vulkanol. Trudy, vypusk 8, p. 115–125, 1954.

Sheveluch volcano was first considered to be of monogenic origin; that is, produced by one, probably quite prolonged, eruption. Extensive investigations now indicate that Sheveluch is of polygenic origin, has gone through all the usual stages of development, and is approaching extinction. The sequence is as follows: initial cone formed by alternating lava streams and layers of tuffs; the appearance of parasitic cones and maars; the formation of a caldera as the initial opening is destroyed by the following eruptions; and finally the appearance of smaller cones within the caldera. Mineralogical analyses of numerous specimens of lava and tuffs taken from different parts of the volcano are also given.—*S. T. V.*

166–378. Gerth, Heinrich. Der geologische Bau der südamerikanischen Kordillere [The geological structure of the South American cordillera]: 264 p., Berlin-Nikolassee, Gebrüder Borntraeger, 1955.

This is the second volume of "Geologie von Südamerika." Chapter 5 is on the distribution of recent volcanoes in the cordillera and their relations to the geologic structure and the major grabens. Chapter 6 is on the sedimentation, mountain building, and magmatic processes that have shaped the cordillera.—*D. B. V.*

166–379. Vlodavec [Vlodavets], V. I. Die Vulkane der Sowjetunion [Volcanoes of the U. S. S. R.]: 136 p., Gotha, VEB Geographisch-Kartographische Anstalt, 1954.

A translation by H. Täubert. See Geophys Abs. 141–11977.—*M. C. R.*

166–380. Vlodavets, V. I. O tsunami, svyazannykh s vulkanicheskimi izverzheniyami [On tsunami related to volcanic eruptions]: Byull. Soveta po seysmologii, no. 2, p. 27–30, 1956.

Tsunami can be produced by volcanic eruptions. The eruption of a volcano near the ocean shore or on an island can cause variations in the volume of the submarine part of several cubic kilometers, sufficient to cause quite violent tsunami. One such example was the Krakatau eruption of 1883 and accompanying violent tsunami.—*S. T. V.*

INDEX