Geophysical Abstracts 181 April-June 1960

By JAMES W. CLARKE, DOROTHY B. VITALIANO, VIRGINIA S. NEUSCHEL, *and others*

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

UNITED STATES DEPARTMENT OF THE INTERIOR

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GEOLOGICAL SURVEY

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CONTENTS

GEOPHYSICAL ABSTRACTS 181, APRIL-JUNE 1960

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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 circulations (such as dissertations, open-file reports, or memorandums) or of other papers presented orally at meetings. Abstracts of papers in Japanese and Chinese are based on abstracts or summaries in a western language accompanying the paper.

List of Journals

Lists of journals published in Geophysical Abstracts 160 (January-March 1955, Bulletin 1033-A) and subsequent issues through 175 (October-December 1958, Bulletin 1086-D) have been compiled into a single list, which may be obtained by writing to the U. S. Geological Survey, Washington 25, D. C.

Supplements to this master list have been published in each issue since Geophysical Abstracts 175. The following is an additional supplement that lists references cited in Geophysical Abstracts 181 that have not been listed previously.

Geod. Soc. [Japan] Jour. —Journal of the Geodetic Society of Japan. Chiba, Japan.
Illinois Geol. Survey Circ. —Illinois State Geological Survey Circular. Urbana, Illinois.
Inst. Mining and Metallurgy [London] Trans. —Transactions of the Institute of Mining and Metallurgy. London, England.
Mus. Royal Congo Belge Annales Sci. Géol. —Annales du Musée Royal du Congo Belge, Sciences Géologiques [Annals of the Royal Museum of the Belgian Congo, Geological Sciences]. Tervuren, Belgium.
Ohio State Univ. Inst. Geodesy, Photogrammetry and Cartography Repts. — Reports of the Institute of Geodesy, Photogrammetry and Cartography. The Ohio State University Research Foundation. Columbus, Ohio.
Phys. Rev. Letters. —Physical Review Letters, American Physical Society, Columbia University. New York, N. Y.
Royal Dublin Soc. Sci. Proc. —Royal Dublin Society Scientific Proceedings. Dublin, Ireland.
Scientia Sinica—Scientia Sinica. Academia Sinica. Peking, China.
Univ. Copenhague Mus. Minéralogie Géologie, Commun. Géol. —Muséum de Minéralogie et de Géologie de L'Universite de Copenhague, Communications Géologiques [Museum of Mineralogy and Geology of the University of Copenhagen, Geological Communications]. Copenhagen (Kϕbenhavn), Denmark.

Form of Citation

The abbreviations of journal titles used are those used in the U.S. Geological Survey publications and 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 of Geographic Names. This system of transliteration for Russian is given in Geophysical Abstracts 148 (January-March 1952, Bulletin 991-A) and in the new "List of Journals" announced above. Titles of papers in Japanese and Chinese are given in translation only.

Abstracters

Abstracts in this issue have been prepared by Wanda L. Grimes, A. J. Shneiderov, A. B. Tanner, and S. T. Vesselowsky, as well as by the principal authors. Authors' abstracts are used in many instances. The initials of an abstracter following the notation "Author's abstract" indicates a translation from the original language.

AGE DETERMINATIONS

181-1.   Kulp, J. L[aurence], Long, L[eon] E., Giffin, C. E., Mills, A. A., Lambert, R. St. J., Giletti, B[runo] J., and Webster, R. K. Potassium-argon and rubidium-strontium ages of some granites from Britain and Eire: Nature, v. 185, no. 4712, p. 495-497, 1960.

In an earlier paper (see Geophys. Abs. 179-2) it was concluded that the evidence for the greatly extended geologic time scale of Mayne, Lambert, and York (see Geophys. Abs. 176-1) rests largely with their measurements on British granites. The present paper gives some new data obtained for the same rock units by using the isotope dilution technique for potassium-argon determinations and by making independent determinations by the rubidium-strontium method. Results are tabulated.
    Apparent age values obtained by the potassium-argon method in this study are somewhat lower than those of Mayne and his associates. The rubidium-strontium results are much closer to the new values than to the latter. These measurements support suggestions for an extension of the Holmes B time scale. The discrepancy between the potassium-argon results reported here and those of Mayne and his associates poses an analytical problem, which has not yet been resolved. — D. B. V.

181-2.   Rubinshteyn, M. M. K peresmotru absolyutnoy geokhronologicheskoy shkaly [On the revision of the absolute geochronologic scale]: Akad. Nauk SSSR Doklady, v. 129, no. 5, p. 1117-1119, 1959.

The Kelasursk granitic intrusion is a marker for the Jurassic-Cretaceous boundary; its age, determined by the potassium - argon method on biotite, is $167 \pm 9 \times 10^6$ yr. As there is no reason to believe that the biotite is anomalous, the upper limit of the Jurassic (152×10^6 yr) on the Holmes B time scale is evidently too high.
    The Bakisdzhvara syenite massif, determined as post-Middle Eocene and pre-Oligocene, is dated as $40 \pm 5 \times 10^6$ yr; this fits very well with the Holmes

B scale.

An Ordovician glauconite from Estonia (Tallinn horizon) gives an argon age of 465 ± 10 × 10^6 yr. Although the question of argon retention in glauconite is still not settled, this figure merits attention in revision of this part of the Holmes scale. — D. B. V.

181-3.   Hurley, Patrick M. How old is the earth?: Garden City, N. Y.,
           Doubleday and Co., Inc. 160 p., 1959.

This book is one of the Science Study Series which offers to students and the general public the writings of distinguished authorities on fundamental topics in physics. The book has six chapters as follows: the structure of the earth, radioactivity, the radioactive earth, measurement of absolute geologic time, memorable dates in earth history, and the earth's beginnings. A brief bibliography is included. — V.S.N.

181-4.   Starik, I. Ye. Sovremennoye sostoyaniye radioaktivnykh metodov
           opredeleniya absolyutnogo vozrasta gornykh porod [The present
           status of radioactive methods of determination of the absolute age
           of rocks]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Voz-
           rasta Geol. Formatsiy, 5th sess., Trudy, p. 5-8, 1958.

The work of the Commission for the Determination of the Absolute Age of Geological Formations during the preceding 5 years is summarized and the methods of geochronology used in the U.S.S.R. are described. Instead of increasing the sensitivity of the mass spectrometers, as is the practice of geochronologists in the U.S.A., Soviet geochronologists aim at obtaining more accurate data by extracting large amounts of lead by an inexpensive method. The argon method is next after the lead method with regard to volume of use. The helium method has limited use, and the strontium method is seldom used mainly because the decay constant of rubidium-87 is not known with sufficient accuracy. — A.J.S.

181-5.   Tugarinov, A. I., Zykov, S. I., and Orlova, L. P. O formakh na-
           khozhdeniya svintsa radioaktivnykh mineralakh i metodakh opre-
           deleniya ikh vozrasta [On the forms of lead occurrence in radio-
           active minerals and methods of their age determination]: Akad.
           Nauk SSSR, Kom. Opredeleniyu Absolut. Vozrasta Geol. Format-
           siy, 5th sess., Trudy, p. 348-355, 1958.

The divergence of absolute ages of silicate minerals (allanite and thorite) determined from uranium and thorium from the same rock can be expressed in the following way: $T(Pb^{207}/Pb^{206}) \gg T(Pb^{207}/U^{235}) > T(Pb^{206}/U^{238}) \gtrless T(Pb^{208}/Th^{232})$. Theoretical considerations and experiments indicate that the lead present in radioactive minerals is able to migrate from its locus without destroying the crystal structure. This possible migration of lead and the difference in mobility of uranium and thorium in uranium-thorium miner-als are probably the causes of the divergence mentioned above. In the exper-iments described, the ratio Pb^{208}/Th^{232} was found best suited for thorite. Regional metamorphism is suggested as the process whereby lead from an-cient uranium is recrystallized. — A.J.S.

181-6.   Zhirova, V. V., and Gokhshtein, Ya. P. Kolichestvennoye opre-
           deleniye svintsa i urana v mineralakh metodom ostsillografiches-
           koy polyarografii [Quantitative determination of lead and uranium
           in minerals by the method of oscillograph polarography]: Akad.

Nauk SSSR Kom. Opredeleniyu Absolyut. Vozrasta Geol. Format-
siy, 4th sess., Trudy, p. 241-248, 1957.

It is shown that oscillograph polarography can be used for quantitative a-
nalysis of uranium and lead in monazite, pitchblende, uraninite, and allanite.
The time required to complete the analysis is generally less than two hours.
— A. J. S.

181-7.   Russell, R. D., and Farquhar, R. M. Dating galenas by means of
           their isotopic constitutions--II: Geochim. et Cosmochim. Acta,
           v. 19, no. 1, p. 41-52, 1960.

In the light of recent data there appear to be three classes of leads, each of
which has isotope ratios that vary in a remarkably simple pattern; these are
(1) meteoritic leads, (2) anomalous leads, and (3) leads from certain conform-
able lead ore deposits. The first and third appear to have developed in sur-
roundings where thorium and uranium had very similar properties, and in
both cases the thorium-uranium ratio corresponds to a present value of 3.73
± 0.03; this suggests that both classes developed under predominantly reduc-
ing conditions. The thorium - uranium ratio present during the production of
anomalous leads on the other hand is extremely variable, indicating an oxi-
dizing environment. It has been suggested that all vein leads may be anoma-
lous to some degree and should be interpreted with this possibility in mind.
    The methods for dating galenas previously proposed by Russell and others
(see Geophys. Abs. 157-134) are reexamined. It is shown that they may lead
to more explicit information on the age and history of lead ores than has usu-
ally been obtained. — D. B. V.

181-8.   Baranovskaya, N. V. K voprosu o sokhrannosti geliya v minera-
           lakh [On the problem of preservation of helium in minerals]:
           Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol.
           Formatsiy, 5th sess., Trudy, p. 313-315, 1958.

The preservation of helium in minerals and rocks during geologic time is
discussed. There are indications that finely powdered minerals lose some of
their helium in a few years. Experiments on the preservation of helium in
Ukrainian monazite powdered to the size of a few thousandths of a millimeter
were conducted in the Radium Institute of the Academy of Science of the
U.S.S.R. from 1952 to 1956. The average helium content in the monazite in-
vestigated was found to be 2.5 cm^3 per 1 gm of the mineral. — A. J. S.

181-9.   Herzog, Leonard F., Pinson, William H., Jr., and Hurley, Patrick
           M. Rb-Sr analyses and age determinations of certain lepidolites,
           including an international interlaboratory comparison suite: Am.
           Jour. Sci., v. 258, no. 3, p. 191-208, 1960.

Rubidium, strontium, and radiogenic strontium-87 concentrations, and ra-
dioactivity "ages" have been determined by stable isotope dilution for lepido-
lite samples from eight pegmatite occurrences.
    Five of the samples analyzed comprise an "Intercomparison Suite" ranging
in age from 100×10^6 to $2,600 \times 10^6$ yr. Portions of these samples were sent
by us to several other laboratories for analysis, as a test of the interlabora-
tory reproducibility of stable isotope dilution analysis. In this paper analyti-
cal data for this suite from four laboratories are compared. Interlaboratory
reproducibility and intralaboratory reproducibility are essentially identical
for the age determinations; it is apparent that age ratios for lepidolite can be

measured routinely with analytical accuracy better than ± 4 percent (standard deviation).

Rubidium was determined with a precision of 1 - 2 percent, and strontium-87 with a precision of 1 - 3 percent within individual laboratories; difference between results obtained at the several laboratories may be due in part to small differences in rubidium and strontium standard solution calibrations and in part to sample inhomogeneities; the good interlaboratory agreement in age determinations favors the latter interpretation.

A comparison of stable isotope dilution, optical spectrographic, and neutron activation rubidium-strontium data for sets of independently collected and analyzed samples from six localities is also given. For each pegmatite, there is good agreement (a range of a few percent) in the ages determined by isotope dilution and neutron activation, although rubidium concentrations have ranges up to 30 percent.

The study gives insight into the sources of error in the optical spectrographic technique and provides standards which may make possible the improvement of this method of analysis. — Authors' abstract

181-10.   Crocket, J., Winchester, J. W., and Gowen, K. Deuteron reaction with Sr and Rb isotopes, in Variations in isotopic abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U. S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 70-71, 1958.

This is a report on studies to test the feasibility of determining the relative amounts of rubidium, normal strontium, and radiogenic strontium-87 in silicate minerals (for use in rubidium-strontium age determination) by means of 15-Mev deuteron bombardment. — V.S.N.

181-11.   Goldstein, M. I., Winchester, J. W., and Anderson, D. Determination of K in common rocks and minerals by neutron activation, in Variations in isotopic abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U.S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 72-74, 1958.

The results of potassium analysis of 12 different silicate rock and mineral samples are reported. The analysis was made by thermal neutron irradiation followed by counting the gamma and beta activity in an end window proportional counter. — V.S.N.

181-12.   Hurley, Patrick M. Progress report on argon analysis, in Variations in isotopic abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U.S..Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 17-25, 1958.

The progress to date in the technique of analysis of argon for argon-potassium age determinations is discussed. A system of analysis is used that includes two mass spectrometers--a cycloidal-focusing mass spectrometer for monitoring outgassing, determining the time at which hydrogen is reduced to zero in the purified gas, and finally in measuring the Ar^{38}/Ar^{40} ratio; and a mass spectrometer directly coupled to the gas system and under vacuum at all times, into which purified argon is fed for Ar^{36}/Ar^{38} ratio measurements. The principal error, ± 10 million years, occurs in the air contamination correction on younger age determinations; the error is insignificant in older age determinations. Errors in potassium determination are considerably greater

and are believed to dominate the error in the final age.

Details of the instrumental procedures are given, and a comparison of argon measurements with those of other laboratories is presented in a table. — V. S. N.

181-13.   Murina, G. A.   Opredeleniye absolyutnogo vozrasta argonovym metodom [Absolute age determination by the argon method]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy, 5th sess., Trudy, p. 331-335, 1958.

Absolute age determinations of Precambrian and younger rocks by the argon method from feldspar and mica are reported and presented in two tables. The first table gives ages from 130 to 2,060 million years; the divergence between ages determined from mica and from feldspar is not more than ±7 percent. The second table gives ages from 250 to 2,300 million years where the divergence is from 7.5 to 40 percent. Murina opposes the elimination of feldspar from experimental samples but suggests a thorough study of the causes of this divergence. — A. J. S.

181-14.   Sardarov, S. S.   Usovershenstvovannyy metod izotopnogo razbavleniya dlya opredeleniya soderzhaniya radiogennogo argona v geologicheskikh obrazovaniyakh [An improved method of isotopic dilution for determination of the content of radiogenic argon in geological formations]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy, 5th sess., Trudy, p. 278-288, 1958.

Experiments on the effect of atmospheric argon present in the apparatus used in the isotopic dilution method are reported, and a steel device for extraction and purification of radiogenic argon is described. The absolute ages determined for micas and microclines confirm earlier observations that the microcline age is 10-85 percent lower than the mica age for the same rock. The argon age of sedimentary glauconite is in good agreement with its geologic age. — A. J. S.

181-15.   Shukolyukov, Yu. A.   Novaya ustanovka dlya opredeleniya argona v porodakh [A new apparatus for argon determination in rocks]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy, 5th sess., Trudy, p. 289-296, 1958.

An apparatus for determination of small amounts of argon in rocks and minerals was tested for age determination of granites and porphyries from the Ukraine, Czechoslovakia, Kazakhstan, central Asia, and the Trans-Baikal region. A thermistor-operated resistance manometer was used in the apparatus. A specimen of a few tenths of a gram is sufficient for determination of the argon content in Precambrian rocks, and 3-3.5 g for Paleozoic rocks. The average difference in ages determined by the old and the new methods does not exceed ±4 percent. — A. J. S.

181-16.   Delaney, C. F. G., and McAulay, I. R.   A radiocarbon dating system using scintillation techniques: Royal Dublin Soc. Sci. Proc., ser. A, v. 1, no. 1, p. 1-20, 1959.

The development of a radiocarbon dating system using scintillation techniques is described. The sample to be dated is converted to methyl alcohol and mixed with a liquid scintillator. The scintillator cell is of fused silica, in the form of a cylinder of volume 50 ml, 10 ml of methanol being added to 40 ml

of liquid scintillator. The scintillator cell is viewed by two photomultipliers operating in coincidence. The background counting rate is reduced by massive screening and by pulse height selection. The net contemporary carbon count- ing rate is 20.6 counts per min above a background counting rate of 13.6 counts per min. Using a 17-hour counting period, this system will give results of significance to 30,000 years, which is adequate for all samples of Irish inter- est.

A discussion of the chemical synthesis is given, and some results are pre- sented. — Authors' abstract

181-17.   Vinogradov, A. P., Devirts, A. L., Dobkina, E. I., Markova, N. G., and Martishchenko, L. G. Opredeleniye absolyutnogo voz- rasta po C^{14} [Determination of absolute age according to carbon- 14]: Geokhimiya, no. 8, p. 663-668, 1959.

Results of carbon-14 age determinations on a number of wood and peat sam- ples from the Waldai glacial period of Eastern Europe and the contemporan- eous Zyriansk glaciation of eastern Siberia, on charcoals from archeological excavations by the Kharesm expedition, and on a tree scorched by volcanic action in Kamchatka are tabulated. The procedure and apparatus are describ- ed briefly and illustrated with photographs. Both ethane and carbon dioxide counting methods were used. Improvements in the apparatus resulted in con- siderable reduction in background count. — D. B. V.

Plesset, Milton S., and Latter, Albert L. Transient effects in the distribu- tion of carbon-14 in nature. See Geophys. Abs. 181-415.

Latter, Albert L., and Plesset, Milton S. Carbon-14 production from nuclear explosions. See Geophys. Abs. 181-416.

181-18.   Baranov, V[ladimir] I., and Kuz'mina, L. A. Opredeleniye skor- osti otlozheniya donnykh osadkov v okrainnoy chasti Tikhogo oke- ana radioaktivnymi metodami [Determination of the rate of depo- sition of sediments in the marginal part of the Pacific Ocean by the radioactive method]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy, 5th sess., Trudy, p. 321- 330, 1958.

The use of the ionium method for determination of the rate of sedimentation on the ocean floor is discussed, and a formula is derived for such determina- tions. Twenty ocean-floor samples were taken from depths ranging from 76 to 6,187 m in the region of the Kurile-Kamchatka trough and tested for thor- ium, uranium, and ionium. The tests indicate an average rate of sedimenta- tion on the ocean floor of 1 cm per 600-700 years. — A. J. S.

181-19.   Deutsch, S[arah], and Janssens, P. Coloration of biotites in pleo- chroic haloes--II: Nuovo Cimento, v. 11, no. 4, p. 473-483, 1959.

Determination of the relation between color of pleochroic haloes and the doses of alpha - radiation is of interest both for understanding of coloration phenomena and in the application of haloes to estimating the age of rocks. A quantitative law governing the coloration of biotite as a function of the number of ions formed is established in this paper on the basis of microphotometric study of haloes in biotite and the measurement of the activity of the inclusions in rocks of known age.

The curve of optical density increase ΔD has three parts, an increasing

part, a saturated part, and a decreasing part. Coloration begins after formation of about 10^{18} ions per mm^3; saturation is reached for doses of 2×10^{20} - 2.4×10^{21} ions per mm^3 and coloration diminished for doses of 2.4×10^{21} - 7×10^{22} ions per mm^3. The inversion cannot be explained as metamictization of the biotite, as inversion is almost complete when only about 10 percent of the lattice atoms have been displaced (see also Geophys. Abs. 171-35). — D.B.V.

181-20.   Komovskiy, G. F., and Lozhnikova, O. N. Opyt opredeleniya otnositel'nogo vozrasta granitov termolyuminestsentnym metodom [Attempt at determination of the relative age of granites by the thermoluminescence method]: Akad. Nauk SSSR Izv. Ser. Geol., no. 11, p. 101-104, 1959.

The ages of seven granitic rocks of different ages from the Caucasus determined on the basis of their thermoluminescence glow curves correspond within $\pm 50 \times 10^6$ yr with their ages determined by absolute dating methods. It is concluded that the thermoluminescence method, if developed and refined, can be used for rapid determination of the relative ages of unfossiliferous rocks. — D.B.V.

181-21.   Maksimov, S. P., Yeremenko, N. A., Zhukhovitskiy, A. A., Turkel'taub', N. M., Botneba, T. A., and Pankina, R. G. Zakonomernosti izmeneniya sostav popytnykh gazov po stratigraficheskomu razrezu [Regularities of change of the composition of casing head gas along the stratigraphic section]: Geologiya Nefti i Gaza, no. 1, p. 55-63, 1959.

The change of the ratio of He/Ar on the absolute geochronometric scale is not a straight line as previously proposed by Mavritskiy (see Geophys. Abs. 180-21) and by Kortsenshteyn (see Geophys. Abs. 180-22). It may be better to determine the age of oil by using the ratio of isomers of butane or pentane to their normal compounds in casing head gas. These ratios, as shown by the data presented in the article, seem to bear a more stable and linear character on the geochronometric scale. — J.W.C.

181-22.   Hurley, Patrick M., and others. Collection of glauconite from known stratigraphic horizons for the dating of the geologic time scale, in Variations in isotope abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U.S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 132-166, 1958.

A catalogue of stratigraphically well-dated glauconite samples compiled by the Ad Hoc Committee on the Measurement of Geologic Time, Division of Earth Sciences, National Research Council, is presented. The collection is housed at the Department of Geology and Geophysics at the Massachusetts Institute of Technology and may be used by anyone who wishes to carry out age measurements on it. — V.S.N.

181-23.   Gheith, Mohamed A. Tabulated index and bibliography of published age measurements of North America, in Variations in isotope abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U.S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 167-228, 1958.

Part 1 of this paper lists age measurements of rocks and minerals from North American localities. Part 2 is a bibliography dealing with actual age measurements; it is worldwide in scope but does not include papers dealing with meteorites. — V. S. N.

181-24.   Fairbairn, H[arold] W., Pinson, W[illiam] H., [Jr.], Hurley, P[atrick] M., and Cormier, R. F. A comparison of the ages of coexisting biotite and muscovite in some Paleozoic granite rocks: Geochim. et Cosmochim. Acta, v. 19, no. 1, p. 7-9, 1960.

Available rubidium-strontium age data on muscovite and biotite from the same rock are compiled and evaluated. Of the 11 samples involved, 10 are Paleozoic granitic rocks from Nova Scotia, New Hampshire, and Georgia and 1 is a mica schist from Connecticut. Six potassium-argon ages are included for comparison. The age differences in the members of a pair range from 0 to 12.5 percent. Six biotites are "older" than the associated muscovite, 4 are "younger," and 1 pair shows agreement.
It is concluded that within the limits of analytical precision obtainable the muscovite and biotite of each pair have been equally affected by a thermal event at a particular time; in this limited sense they are cogenetic, regardless of absolute age. — D. B. V.

181-25.   Hurley, Patrick M., and others. Age measurement program in the northern Appalachian Province, in Variations in isotopic abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U. S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 61-68, 1958.

Results of age determinations by the strontium-rubidium and (or) the argon-potassium methods on micas and feldspars from various localities in the northern Appalachians are reported in tables. In Maine, northern New Hampshire, and eastern Quebec ages are rather uniformly of the Acadian type, that is, close to 350 million years. In Connecticut, Rhode Island, and eastern Massachusetts, a mixed age area, relics of the Acadian orogeny are evident with a second period of deformation and granite emplacement between 260 and 220 million years. A third and younger period of batholithic granite emplacement at 175 million years is exemplified by the Conway granite in New Hampshire. An argon age of 145 million years was found for alkaline intrusives at Mount Royal and Oka, Quebec; previously these were thought to be related in time to the Conway granite, but more probably they coincide in time with the Triassic flows and sills of New Jersey, Connecticut, and other states. — V. S. N.

181-26.   Hurley, P[atrick] M., Fairbairn, H[arold] W., Pinson, W[illiam] H. [Jr.], and Faure, G. K-A and Rb-Sr minimum ages for the Pennsylvanian section in the Narragansett Basin: Geochim. et Cosmochim. Acta, v. 18, no. 3/4, p. 247-258, 1960.

Potassium-argon and rubidium-strontium age measurements on metamorphic minerals in the Rhode Island and Wamsutta formations of Pennsylvanian (Allegheny) age in the Narragansett Basin, Rhode Island, indicate that the minimum age of these formations is 255 million years. Intrusive granites cutting the Wamsutta formation show a minimum age of 235 million years. The fairly widespread orogenic event in the Appalachians that caused metamorphism and igneous rock emplacement showing ages in this range is therefore post Lower Pennsylvanian, and should be referred to as Appalachian rather than Acadian. The concordant lead ages in the pegmatites of Middletown,

Conn., are of this age; and as these were used as the basis of a Devonian age point in the present time scale of Holmes, it is clear that the scale must be lengthened. These results are in accordance with a new value of 360 million years for the minimum age of the Lower Devonian, reported earlier. — Authors' abstract

181-27.   Hurley, Patrick M., and others. Age study of some crystalline rocks of the Georgia Piedmont, in Variations in isotopic abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U. S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 58-60, 1958.

Strontium-rubidium and argon-potassium ages for micas from granite and gneiss specimens of the Georgia Piedmont are given in a table. Except for the Carolina gneiss and the Elberton granite, which are demonstratively older and younger respectively than the granites, the average strontium-rubidium age is 288 million years suggesting a Devonian origin. The ratios of rubidium in biotite to rubidium in muscovite are constant at 1.7 in these granites, whereas this ratio is 0.9 in the Lithonia gneiss micas. This ratio may be useful in distinguishing between metamorphic and intrusive rocks in a petrographic province. — V. S. N.

181-28.   Cobb, J[ames] C., and Kulp, J. L[aurence]. U-Pb age of the Chattanooga shale: Geol. Soc. America Bull., v. 71, no. 2, p. 223-224, 1960.

Three samples of the 4.9-foot upper black unit of the Gassaway member of the Chattanooga shale, which carries an average uranium content of 0.80 ppm, were analyzed by isotopic dilution techniques, and the apparent U^{238}/Pb^{206} ages were calculated. The results agree within the limits of experimental error and average $350\pm10 \times 10^6$ yr. "Hot spots" (centers of uranium concentration) do not appear in the shale, and the radium present is in equilibrium with the uranium in the sample; therefore, it is quite possible that the true age of the Chattanooga shale is about 350×10^6 yr. The true age of the Mississippian-Devonian boundary cannot be much greater. — D. B. V.

181-29.   Giffin, C. E., and Kulp, J. L[aurence]. Potassium-argon ages in the Precambrian basement of Colorado: Geol. Soc. America Bull., v. 71, no. 2, p. 219-222, 1960.

The potassium-argon ages of 23 mica-bearing Precambrian rocks from four areas in Colorado were determined in an attempt to find possible occurrences of the 2,600-million-year-old basement and to delimit the areas affected by the 1,000- and 1,400-million-year events. The data, which are tabulated, give no evidence of a basement older than $1,500 \times 10^6$ yr; if an older basement did exist in these areas, the micas have been sufficiently reheated about 1,300 to 1,500 million years ago to have lost all their inherited argon. The less intense metamorphic-igneous event about 1,000 million years ago is also reflected in the data.

The data do not preclude additional thermal pulses between 1,000 and 1,500 million years ago. The rocks do not seem to have been subjected to any significant metamorphism since 1,000 million years ago. — D. B. V.

181-30.   Frye, John C., and Willman, H. B. Classification of the Wisconsinan stage in the Lake Michigan glacial lobe: Illinois Geol. Survey Circ. 285, 16 p., 1960.

The revised time-stratigraphic classification of the Wisconsinan stage of the Lake Michigan lobe as used by the Illinois State Geological Survey consists of the following substages in order of increasing age: Valderan, Two-creekan, Woodfordian, Farmdalian, and Altonian. Extrapolation from presently available radiocarbon dates suggests that Wisconsinan time started 50,000-70,000 years ago and terminated approximately 5,000 years ago. More than half of this time falls within the Altonian. — J. W. C.

181-31. Howard, Hildegarde. Significance of carbon-14 dates for Rancho La Brea: Science, v. 131, no. 3402, p. 712-714, 1960.

Carbon-14 dates have been determined for documented samples from the Rancho La Brea tar pits at Los Angeles. A tree from pit 3 was found to be about 14,500 years old, and an artifact from pit 61-67 about 4,450 years old. The latter substantiates the contention that artifacts and fossils from pit 61-67 are not contemporaneous. — D. B. V.

181-32. Hurley, Patrick M., and others. Argon ages in the Canadian shield area, in Variations in isotopic abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U.S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 99-102, 1958.

Argon ages of rock samples collected in 1957 in various parts of the Canadian shield are reported in a table. Results to date indicate a major boundary between the 1,700 million year province in northern Manitoba and the 2,600 million year province in western Ontario. This boundary extends along a break from York Factory on Hudson Bay southwest across Manitoba into Saskatchewan south of Flin Flon. The Mystery-Moak Lake area nickel occurrences lie on this boundary, and the highly mineralized belt between Flin Flon and Snow Lake in Manitoba is close to it. Further, this boundary may cut across the northern tip of Labrador to include the nickel-bearing peridotites of that region. — V. S. N.

181-33. Kupsch, W. O. Radiocarbon-dated organic sediment near Herbert, Saskatchewan: Am. Jour. Sci., v. 258, no. 4, p. 282-292, 1960.

Willow wood from organic sediments at a depth of 11 feet near Herbert, Saskatchewan, has a carbon-14 date of 10,050 ± 300 yr. Other plant fragments and fauna (predominantly snails and ostracodes) in the sediments indicate a period of sedimentation in a quiet pond in a spruce-pine parkland with a few broadleaved trees such as birch, willow, and aspen. A similar environment exists today in the forest belt 200 miles north of Herbert. The change from forest to grassland now prevailing near Herbert is reflected by the pollen in the sediments overlying the radiocarbon-dated wood. — V. S. N.

181-34. Moore, J. M., Jr., Hart, S. R., Barnett, C. C., and Hurley, P[atrick] M. Potassium-argon ages in northern Manitoba: Geol. Soc. America Bull., v. 71, no. 2, p. 225-230, 1960.

Potassium-argon ages were determined for 10 micas from 5 different areas in northern Manitoba in order to help locate the boundary between the Churchill (Athabasca) and Superior geologic provinces. The results from Lynn Lake, Northern Indian Lake, Miller Lake, and Partridge Crop Lake range from 1,640 to 1,810 $\times 10^6$ yr and suggest that the Churchill province is homogeneous in northern Manitoba.

The ages from the Oxford Lake-Knee Lake area are typical of "mixed age" areas, which result from the complete or partial recrystallization of older rocks in the vicinity of a younger orogenic belt. Similar inhomogeneities are observable in the Superior province where it is bordered by the Grenville province. A sample showing an age of 2, 200 $\times$ 10^6 yr is interpreted as indicating that the normal host rock in this area should be included in the Superior province, although it does not show the usual age of 2, 400-2, 600 $\times$ 10^6 yr. — D. B. V.

181-35.   Aldrich, L. T., and Wetherill, G[eorge] W. Rb-Sr and K-A ages of rocks in Ontario and northern Minnesota: Jour. Geophys. Research, v. 65, no. 1, p. 337-340, 1960.

The results of analyses for potassium-40, radiogenic argon-40, rubidium-87, and radiogenic strontium-87 in seven biotites from samples collected in central Ontario are presented. The argon and strontium ages for these and for two lepidolites previously analyzed (see Geophys. Abs. 175-14) range from 2, 500 to 2, 650 million years. These data help define the boundaries of the oldest rocks in the Canadian Shield. — D. B. V.

181-36.   Mair, J. A., Maynes, A. D., Patchett, J. E., and Russell, R. D. Isotopic evidence on the origin and age of the Blind River uranium deposits: Jour. Geophys. Research, v. 65, no. 1, p. 341-348, 1960.

Isotopic analyses of lead from a variety of minerals from Blind River, Ontario, are reported. Detrital monazite and zircon both give lead-ratio ages of 2, 500 $\times$ 10^6 yr and uraninite ore of 1, 700 $\times$ 10^6 yr. Other isotopic evidence suggests that the age of the uranium-bearing sediment may be about 1, 700 $\times$ 10^6 yr or older. The lead in pyrite, pyrrhotite, sericite, and feldspar has anomalous isotopic ratios; this may be explained by the hypothesis that they received additions of radiogenic lead from the uraninites 1, 200 to 1, 300 $\times$ 10^6 yr ago. In any case the time of last chemical alteration of these minerals is not more than 1, 450 $\times$ 10^6 yr ago. The evidence does not require a major period of mineralization more recent than 1, 000 $\times$ 10^6 yr ago, but the possibility is not ruled out. — D. B. V.

181-37.   Hurley, Patrick M., and others. Sudbury, Ontario, age program, in Variations in isotopic abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U. S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 51-57, 1958.

This is primarily a listing of age determinations made on biotite and potassium feldspars from Sudbury, Ontario, since those reported in the 4th annual report, March 1, 1957. Apart from the general Precambrian age of all specimens, the most important feature of these dates is the discrepancy, far in excess of experimental error, in results between argon-potassium and strontium-rubidium data. This discrepancy is believed to be geological rather than an analytical problem because the strontium-rubidium ages from specimens collected on the north side of the Sudbury basin agree much more closely with the argon-potassium ages than do those from the tectonically disturbed belt on the south side of the basin. The concordant ages obtained by this (and other) laboratories for the Grenville rocks south of the Sudbury basin, on the other hand, may be an expression of overall equilibrium in a metamorphic terrane that developed somewhat later than the rock assemblages at Sudbury. — V. S. N.

181-38. Fairbairn, H[arold] W., Hurley, P[atrick] M., Pinson, W[illiam] H., Jr., and Cormier, R. F. Age of the granitic rocks of Nova Scotia: Geol. Soc. America Bull., v. 71, no. 4, p. 399-414, 1960.

The ages of biotite, muscovite, and potassium feldspar in granitic rocks from 27 localities in Nova Scotia, determined by the potassium-argon and rubidium-strontium methods, are between 300 and 400 $\times 10^6$ yr. At two places where nearby intrusive contacts with upper Lower Devonian fossiliferous sedimentary rocks are established the best estimate of the age of the intrusives is 365 ± 20 $\times 10^6$ yr. Granite associated with Middle Cambrian rocks is about 500 ± 20 $\times 10^6$ yr.

The age data suggest a protracted period of intrusion in the Devonian, with the upper Lower Devonian older than 365 million years. Middle Cambrian is tentatively believed to be older than 500 million years. Holmes' B time scale would require an extension of 10-25 percent to meet the Nova Scotia data. — D. B. V.

181-39. Fairbairn, Harold W. Nova Scotia age program, in Variations in isotopic abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U. S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 4-7, 1958.

The results of 27 age determinations on Nova Scotia granites are reported in tables; these list the analytical data for strontium-rubidium ages of biotite, muscovite, and potassium-feldspar with the exact locality for each specimen; the strontium-rubidium ages of coexisting mineral pairs with the corresponding argon-potassium ages; the final estimates of ages; and, for comparison, accessory data on radiation damage ratios for zircon at nine localities for which absolute age estimates are available. Comparison of a histogram of age distribution with the geographical distribution of the specimens shows a low-age and a high-age group with a small but definite break. All four localities in the southwest part of the province are in the low-age group; none from Cape Breton Island are, however. The high-age group is scattered throughout the entire length of the province with a tendency for adjacent localities to be almost identical in age. The age spread of between 300 and 400 million years is suggestive of a prolonged period of intrusion and cooling in the Early Paleozoic. Culminations at 325 and 365 million years then represent periods when igneous activity was maximal, dropping off but not ceasing between periods. — V. S. N.

181-40. Tupper, W. M. Relative abundance of rubidium and strontium in vitrain ashes from Nova Scotia, in Variations in isotopic abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U. S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 123-126, 1958.

The rubidium and strontium content of vitrain ashes prepared from vitrain from the Sydney coal field, Nova Scotia, were determined by stable isotope dilution and by spectrochemical analysis. The high strontium-rubidium ratios (25-10:1) found, although of geochemical interest, appear unuseable for age determinations. This ratio should not exceed 2:1 for age determinations on samples from the Late Paleozoic. — V. S. N.

181-41. Fairbairn, H[arold] W. Age data from Newfoundland, in Variations in isotopic abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and

Geophysics, U.S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 69, 1958.

A strontium-rubidium age of 340 million years, comparable to Nova Scotia Devonian granites, is reported for a St. Lawrence, Newfoundland, locality; and a strontium-rubidium age of 910 million years, comparable to the Grenville of Ontario and Quebec, is reported for a quartz monzonite at Duffs. — V. S. N.

181-42.   Hurley, Patrick M., and others.   Program of age measurements in the Brazilian shield--II, in Variations in isotopic abundances of strontium, calcium and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U.S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 77-81, 1958.

Uncorrected argon ages are presented for a group of samples from formations in a block of quadrangles (Quadrilatero Ferrifero) in the Precambrian shield area of Minas Gerais, Brazil. From the great range in age measurements (2,500 to 495 million years in this relatively small area) it is believed likely that the area is a "mixed age region" similar to that near Sudbury, Ontario (see Geophys. Abs. 181-37).   The scatter of ages is a result of recrystallization during a strong orogeny at approximately 500 million years ago in a belt relatively close to very old blocks of gneiss.   Thus, these blocks of ancient Precambrian gneiss can be outlined by age determinations. —V. S. N.

181-43.   Gigout, Marcel. Âges, par radiocarbone, de deux formations des environs de Rabat (Maroc) [Ages, by radiocarbon, of two formations from the vicinity of Rabat (Morocco)]: Acad. Sci. [Paris] Comptes Rendus, v. 249, no. 25, p. 2802-2803, 1959.

Shells from the +2 m beach near Rabat, Morocco, have been dated as 5,970 ± 130 yr old, confirming the correlation of this shoreline with the European climatic optimum of about 4,000 B. C.   Pottery and charcoal from the alluvium of the lower Bou-Regreg are 800 ± 200 yr old, showing that deposition was still taking place in the 12th century; subsequent erosion can be explained by human activity (overgrazing and deforestation) rather than by climatic change. — D. B. V.

181-44.   Hurley, Patrick M., and Schürmann, H. M. E.   Preliminary age of the Dara granite, older Gattarian plutonics, east of the Nile in Egypt, in Variations in isotopic abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U.S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 97-98, 1958.

The preliminary results of age determinations on biotite from the Dara granite, Wadi Hawashia, Eastern Desert of Egypt, are reported as 620 and 630 million years. — V. S. N.

181-45.   Rubinshteyn, M. M. Novyye dannyye ob absolyutnom vozraste magmaticheskikh obrazovaniy Gruzii [New data on the absolute age of magmatic formations in the Georgian SSR]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy, 5th sess., Trudy, p. 27-43, 1958.

The potassium-argon ages have been determined for 17 samples of igneous rocks and minerals from the Georgian S. S. R. Most of the samples were mus-

covite and biotite. The results are tabulated and compared with geological ages according to Marble's scale. The ages for the biotite are 258 million years, and for muscovite 278 million years. — A. J. S.

181-46. Polevaya, N. I., Murina, G. A., Sprintsson, V. D., and Shukol-yukov, Yu. A. Vozrast porod ukrainskogo kristallicheskogo massiva po dannym argonovogo metoda [The age of rocks of the U-kraine crystalline massif according to data of the argon method]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy, 5th sess., Trudy, p. 146-158, 1958.

Age determinations ranging from 1.10 to 3.35 billion years have been made on minerals and rocks from the Precambrian of the Ukraine using the argon method. A great difference was found between geologic ages and argon ages. Furthermore, the argon ages of mica and feldspar differ in some rocks by 50 percent. The feldspar possibly formed later in most of these rocks. — A. J. S.

181-47. Vinogradov, A. P., Tugarinov, A. I., Zykov, S. I., Chupakhin, M. S., Rik, K. G., Kropotova, O. I., Zhirova, V. V., and Fe-dorova, V. A. Vozrast dokembriyskikh porod Ukrainy [Age of Precambrian rocks of the Ukraine]: Akad. Nauk SSSR, Kom. O-predeleniyu Absolyut. Vozrasta Geol. Formatsiy, 4th sess., Trudy, p. 95-119, 1957.

The ages of Precambrian rocks of the Ukraine S. S. R. have been determined by the potassium-argon, the uranium-thorium-lead, and the rubidium-stron-tium methods. The oldest formations of the Ukrainian crystalline massif, according to determinations on allanite, are gneisses, which prove to be 2,600 ± 100 million years old. The methods used and the results obtained are discussed. The experimental data are tabulated. — A. J. S.

181-48. Timergazin, K. P. O diabazovykh porodakh Zapadnoy Bashkirii [Diabasic rocks of western Bashkiria]: Geologiya Nefti, no. 12, p. 36-43, 1958.

Diabase and gabbro-diabase in western Baskhir S. S. R. intrude the Lower Bavlin sediments and occur as pebbles in the basal unit of the Upper Bavlin. Potassium-argon age determinations yield ages of 1,010 and 1,140 million years for these diabasic rocks. Previous ideas on the age of the Lower Bav-lin are thus upset; this unit is now assigned to Late Proterozoic. —— J. W. C.

181-49. Zhirova, V. V., Zykov, S. I., and Tugarinov, A. I. O vozraste pegmatitov slyudyanskogo rayona [On the age of the pegmatites of the Slyudyansk region]: Geokhimiya, no. 7, p. 591-599, 1957.

Six different minerals from the pegmatites of the Slyudyansk region of the U.S.S.R. were investigated by means of chemical and isotopic analyses. Ages calculated from lead-uranium and lead-thorium ratios diverge widely, but those calculated by the total lead method are in good agreement. An isotopic exchange between the lead in solution in the pores of rocks and the radiogenic lead in radioactive minerals in the rocks is suggested. Taking this into account, the age of the Slyudyansk deposit is calculated as $550 \pm 50 \times 10^6$ yr. — D. B. V.

181-50. Krylov, A. Ya., and Silin, Yu. I. Primeneniye argonovogo metoda opredeleniya vozrasta dlya izucheniya migratsii terrigennykh osad-

kov   [Application of the argon method of age determination to the migration of terrestrial sediments]:   Akad. Nauk SSSR Doklady, v. 129, no. 3, p. 642-644, 1959.

The use of argon age determination in tracing the provenance of terrestrial sediments is illustrated by two examples, Baltic glacial deposits and Black Sea coastal sands.   Similar investigations can be made using the lead or helium method on accessory minerals. — D. B. V.

181-51.   Aswathanarayana, U.   Age of the pegmatite of Kishengarh, Rajasthan, India: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 333-344, 1959.

A condensed version of this paper has been published in Geol. Soc. America Bull., v. 70, no. 1, p. 111-114, 1959 (see Geophys. Abs. 176-16). — D. B. V.

181-52.   Hurley, P[atrick] M., and others.   Program of age measurements in Australia, in Variations in isotopic abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U. S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 46-50, 1958.

The argon ages of 10 granites from the Katherine-Darwin area, Northern Territory, Australia, are reported.   This area was selected for the initial age determination work in Australia as a part of a program of broad correlations of the Precambrian between continents.   These rocks were believed to be late Precambrian in age; however, the great age, 1,700-1,800 million years, found in this study will necessitate adjustment of ideas of what in the past has been called Lower Proterozoic in Australia.   These age determinations, along with the recently determined tectonic pattern of the Precambrian shield area of northwestern Australia, will be of use in dividing the Precambrian of Australia into systems.   It appears that the Australian Precambrian shield was consolidated early in the Archean, then broken up into polygonal blocks.   These blocks, with the aid of vertical movements, became the loci of sedimentation in the Proterozoic, and the zones of fracturing became channelways for igneous intrusion. — V. S. N.

Baranov, V[ladimir] I.   On the problem of the age of meteorites.   See Geophys. Abs. 181-64.

Goebel, K., Schmidlin, P., and Zähringer, J.   The tritium-helium and potassium-argon age of the "Ramsdorf" meteorite. See Geophys. Abs. 181-65.

Vinogradov, A. P., Zadorozhniy, I. K., and Florenskiy, K. P.   Content of inert gases in the Sikhote-Alin iron meteorite.   See Geophys. Abs. 181-58.

Fireman, E. L., and DeFelice, J.   Argon-39 and tritium in meteorites.   See Geophys. Abs. 181-61.

COSMOGONY

181-53.   Mason, Brian.   Origin of chondrules and chondritic meteorites: Nature, v. 186, no. 4720, p. 230-231, 1960.

It is suggested that the structure of chondritic meteorites is the result of reaction and recrystallization of preexisting material essentially in the solid

state, and that many, if not all, chondritic meteorites have always been independent and individual objects rather than fragments of a disrupted planet or asteroid.

The carbonaceous chondrites represent the original material. Heating to temperatures above 600°C can trigger reactions which produce the mineral-ogical composition of the usual chondritic meteorites (an aggregate of olivine and (or) pyroxene with some metallic iron). The carbonaceous chondrites may represent aggregates of cosmic dust most of which have, during the course of geologic time, approached sufficiently close to the sun to have been heated to above 600°C. The wide range of ages found for chondrites (720 - 3,000 × 10^6 yr) supports such an explanation. — D. B. V.

181-54.   Levin, B. Yu. O proiskhozhdenii meteoritov [On the origin of me-
           teorites]: Akad. Nauk SSSR Meteoritika, no. 17, p. 55-63, 1959.

Theories of the origin of meteorites are reviewed, and it is concluded that meteorites were formed from asteroids by repeated processes of collision, crushing, and aggregation. — A. J. S.

181-55.   Gast, P[aul] W.   Alkali metals in stone meteorites: Geochim. et
           Cosmochim. Acta, v. 19, no. 1, p. 1-4, 1960.

Potassium, rubidium, and cesium in meteorites have been of considerable interest because of their chemical similarity and because two of them have radioactive isotopes useful in measuring geologic and cosmic age. In this study the rubidium and cesium abundances in 4 chondrites and 5 achondrites were investigated by the method of stable isotope dilution. The average potassium-rubidium ratio for chondrites is found to be 280, for achondrites 1,360; the average potassium-cesium ratio for chondrites is 7,500 and for achondrites at least 3.4 times greater.

The low abundance of potassium, rubidium, and cesium and the potassium-rubidium and potassium-cesium ratios suggest a very efficient fractionation process. Further work, particularly on the relative volatility of these and other elements, would be of particular interest. — D. B. V.

181-56.   Ringwood, A. E. Silicon in the metal phase of enstatite chondrites:
           Nature, v. 186, no. 4723, p. 465-466, 1960.

Measurements of the lattice parameters of the metal phases from a number of chondrite meteorites show that these parameters are abnormally low in the enstatite chondrites. It is concluded that silicon is an important component of the metal phase of enstatite chondrites; it is present in amounts ranging between 2 and 18 atomic percent. This is very relevant to the hypothesis, suggested independently by Ringwood (see Geophys. Abs. 176-224, 177-232) and MacDonald and Knopoff (see Geophys. Abs. 176-222), that there are substantial amounts of silicon in the earth's core. A detailed discussion of these results and their bearing on this hypothesis will be published elsewhere. (See also Geophys. Abs. 181-322. — D. B. V.

181-57.   Fechtig, H., Gentner, W., and Kistner, G. Räumliche Verteilung
           der Edelgasisotope im Eisenmeteoriten Treysa [Spatial distribu-
           tion of the noble gas isotopes in the Treysa iron meteorite]: Geo-
           chim. et Cosmochim. Acta, v. 18, no. 1/2, p. 72-80, 1960.

The helium-4, argon-36, and neon contents in the Treysa meteorite are found to be about 21 × 10^{-6} cm^3 per g, 15 × 10^{-8} cm^3 per g, and 6 × 10^{-8} cm^3 per g, respectively. The Ar^{38}/Ar^{36} and He^4/He^3 ratios vary about 20 percent

with depth in the investigated disk. This variation can be explained qualitatively in the light of spallation investigations on copper with 0.34 and 2.2 Gev protons and on steel with 0.16, 0.43, and 3.0 Gev protons. Assuming that the ratio of the average postatmospheric radius of the meteorite to its preatmospheric radius is 0.44 and that the spectrum of cosmic radiation extends down to 500 Mev, it is calculated that the Ar^{38}/Ar^{36} ratio is caused only by the primary component. The variation of the He^4/He^3 ratio is presumably due to secondary radiation. The radiation age, calculated from the argon-38 content, is about 10^9 yr. — D. B. V.

181-58.   Vinogradov, A. P., Zadorozhniy, I. K., and Florenskiy, K. P. Soderzhaniye inertnykh gazov v zheleznom meteorite Sikhote-Alin' [Content of inert gases in the Sikhote-Alin iron meteorite]: Geokhimiya, no. 6, p. 443-448, 1957.

The content and isotopic composition of helium, neon, and argon have been determined on various parts of the Sikhote-Alin meteorite. The helium and argon isotope ratios decrease with depth from the surface, the argon ratio more rapidly than that of the helium. The original weight of the meteorite is calculated to have been at least 400-500 tons; 300-400 tons must have been burned in the atmosphere during fall. The age calculated from the helium-3 content is 1.4×10^9 yr, and from the helium-4 content is $50-700 \times 10^6$ yr. The latter is the age of its last consolidation and not the true age.— D. B. V.

181-59.   Kirova, O. A. Ispol'sovaniye tsentrifuzhnogo metoda dlya vydeleniya monomineral'nykh fraktsiy iz kamennykh meteoritov [Application of the centrifuge method for separation of monomineral fractions from stone meteorites]: Akad. Nauk SSSR Meteoritika, no. 17, p. 102-106, 1959.

The centrifuge method of mineral separation used for the Pervomayskiy Poselok meteorite is described, and the process of separation of maskelinite as an end product of the centrifuging is discussed. By repeated centrifuging, a fraction of 90 percent pure maskelinite was obtained. — A. J. S.

181-60.   Vinogradov, A. P., Dontsova, E. [Ye.] I., and Chupakhin, M. S. Isotopic ratios of oxygen in meteorites and igneous rocks: Geochim. et Cosmochim. Acta, v. 18, no. 3/4, p. 278-293, 1960.

New data concerning the oxygen isotopic composition of 16 igneous rocks and 16 meteorites are presented. The samples investigated included pallasites, chondrites and achondrites, dunites, basalts and "gabbrodiabases," and granites. The technique of extracting the oxygen and the mass spectrometric procedure are described. The results are presented in tables.
Comparison of the data for rocks and meteorites shows that the O^{16}/O^{18} ratios are almost identical in ultramafic rocks and meteorites, whereas the oxygen-18 content of mafic rocks is somewhat higher and that of granites still higher. It is concluded that the processes that take place in the development of the earth's crust have not affected meteorites, but that the mantle and meteorites may have undergone similar processes in the course of their formation. Special features of a group of carbonaceous stony meteorites suggest isotopic exchange in a nonreducing environment. (See also Geophys. Abs. 174-245). — D. B. V.

181-61.   Fireman, E. L., and DeFelice, J. Argon-39 and tritium in meteorites: Geochim. et Cosmochim. Acta, v. 18, no. 3/4, p. 183-192, 1960.

The radioactive isotopes argon-39 and tritium are measured in a number of iron and stone meteorites. The stable isotope helium-3 is also measured and the argon-38 content is estimated from the helium-3 content. The cosmic ray exposure ages obtained from the argon-39 and argon-38 are: 4.2×10^8 yr for the Sikhote-Alin iron meteorite, 4.5×10^8 yr for the Treysa iron meteorite, 0.3×10^8 yr for the Pitts iron meteorite, 5×10^8 yr for the Norton County a-chondrite, and 0.8×10^8 yr for the St. Michel chondrite. The ratio of tritium to argon-39 radioactivities at the time of fall is 140 ± 20 for the Norton County meteorite, 56 ± 15 for the St. Michel meteorite, 6 ± 1 for the Treysa meteorite, and less than $\frac{1}{2}$ for the Sikhote-Alin meteorite. For the stone meteorites this ratio is consistent with the production probabilities and the hypothesis of the constancy of cosmic rays. For the iron meteorites this is lower than expected from the production probabilities. Either the cosmic ray bombardment is not constant or tritium loss from diffusion occurs for the iron meteorites.

Also reported is the lack of argon-39 and tritium in a number of undated iron meteorite falls, which indicates that they fell more than 1,500 years ago. Only one undated iron meteorite fall, Washington County, gave a small trace of argon-39, indicating that it fell about 1,000 years ago.

Possible interpretations of the cosmic ray exposure ages are discussed. — Authors' abstract

181-62.　Starik, I. Ye., Petrzhak, K. A., Shats, M. M., Bak, M. A., and Semenyushkin, I. N. Rasprostranennost' urana i yego izotopnyy sostav v meteoritakh [Abundance of uranium and its isotope composition in meteorites]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy, 5th sess., Trudy, p. 336-345, 1958.

The uranium content of 4 iron meteorites, 3 chondrites, and 1 achondrite was measured. It is $0.79 \pm 0.04 - 2.24 \pm 0.10 \times 10^{-8}$ g/g for the iron meteorites, and $2.00 \pm 0.10 - 3.32 \pm 0.10 \times 10^{-8}$ g/g for the chondrites measured by using the activation method, and $0.8 \pm 0.1 - 2.3 \pm 0.2 \times 10^{-8}$ g/g and $2.00 \pm 0.2 - 3.0 \pm 0.1 \times 10^{-8}$ g/g respectively, measured by the luminescence method. The luminescence result for the achondrite was found to be $1.8 \pm 0.1 \times 10^{-8}$ g/g. Uranium content in iron meteorites is approximately one order lower than that in stone meteorites, and the isotopic composition in meteorites corresponds to that found on the earth. — A. J. S.

181-63.　König, H., and Wänke, H. Uranbestimmung an Steinmeteoriten mittels Neutronaktivierung über die Xenon-Isotope 133 und 135 [Uranium determination on stone meteorites by means of neutron activation over the xenon-133 and -135 isotopes]: Zeitschr. Naturforschung, v. 14a, no. 10, p. 868-869, 1959.

The uranium content of 8 stone meteorites (5 chondrites and 3 achondrites) was determined by a previously described neutron activation method (see Geophys. Abs. 171-12) in which the xenon-133 and -135 isotopes formed by fission of uranium-235 are measured. It is shown that with one exception the uranium content of the chondrites is almost constant at about 1×10^{-8} g per g, whereas in the achondrites it has a wide range. The thorium-uranium ratio in the stone meteorites averages 3.46. — D. B. V.

Reynolds, J[ohn] H. Isotopic composition of primordial xenon. See Geophys. Abs. 181-334.

181-64.   Baranov, V[ladimir] I.   K voprosu o vozraste meteoritor [On the
            problem of the age of meteorites]:   Geokhimiya, no. 2, p. 155-
            160, 1957.

Three ages can be determined for meteorites: The age of the chemical ele-
ments, the time during which the meteoritic matter existed in a solid unal-
tered state (age of the meteoritic matter), and the time during which the me-
teorite as such remained in cosmic space. According to Patterson (see Geo-
phys. Abs. 162-171) the age of stony meteorites may be determined accord-
ing to the isotopic composition of lead; the lead of iron meteorites is assumed
to be primary lead without radiogenic additions. From the slope of the iso-
chrone $Pb^{207} = f(Pb^{206})$, this age is 4.55 $\times 10^9$ yr. A similar age is obtained
for terrestrial lead from the $Pb^{208} = f(Pb^{206})$ isochrone, assuming a thorium-
uranium ratio of about 4. The results support the assumption that meteorites
and terrestrial matter are of the same age. — D. B. V.

181-65.   Goebel, K., Schmidlin, P., and Zähringer, J. Das Tritium-Hel-
            ium-und Kalium-Argon-Alter des Meteoriten "Ramsdorf" [The
            tritium-helium and potassium-argon age of the "Ramsdorf" me-
            teorite]: Zeitschr. Naturforschung, v. 14a, no. 11, p. 996-998,
            1959.

The tritium; helium-3 and -4; neon-21 and -22; and argon-36, -38, and -40
contents were measured on samples of the Ramsdorf chondrite meteorite tak-
en from the surface and from 3-4 cm below the surface. The potassium-argon
age is calculated as 370 $\times 10^6$ yr, and the cosmic ray age as 4 $\times 10^6$ yr. Both
ages are surprisingly low; however, the weak and porous nature of the materi-
al suggests that gas has probably been lost. — D. B. V.

181-66.   Vinogradov, A. P. Meteority i zemnaya kora [Meteorites and the
            earth's crust]: Akad. Nauk SSSR Izv. Ser. Geol., no. 10, p. 5-
            27, 1959.

An English version of this paper has been published in the Proceedings of
the Second International Conference on the Peaceful Uses of Atomic Energy
held in Geneva in 1958 (see Geophys. Abs. 178-271). — D. B. V.

181-67.   Nikolov, N. S. O neissledovannom bolgarskom meteorite Kon'ovo
            [On an unstudied Bulgarian meteorite Kon'ovo]: Akad. Nauk SSSR
            Meteoritika, no. 17, p. 93-95, 1959.

A meteorite fell on May 26, 1931, at lat 42°32' N. and long 26°10' E., near
the village of Kon'ovo, Bulgaria. The original size of the meteorite was about
2 cm, and the hole made by its impact sloped to the west.   A small fragment
(1.46 g) proved to be of the chondrite type. — A. J. S.

181-68.   Gnilovskoy, V. G. Novyy ekzemplar kamennogo meteorita Manych
            [A new specimen of the stone meteorite Manych]: Akad. Nauk SSSR
            Meteoritika, no. 17, p. 73-79, 1959.

The Manych chondrite meteorite fell October 20, 1951, in the northeastern
part of the Stavropol district near the towns of Spasskoye and Burlatskoye.
The first fragment found weighs 1,860 g.   A second fragment, which weighs
1,695 g, has now been located. The latter is described, and photographic re-
productions of both parts are given. — A. J. S.

181-69.   D'yakonova, M. I.   Meteority Kitaya [Meteorites of China]: Akad.
           Nauk SSSR Meteoritika, no. 17, p. 96-101, 1959.

Only nine meteorites with recorded falls have been found in China.   One of
them fell in the 19th century and eight in the 20th century.   The data on these
meteorites collected from different sources are reported. The Armanty me-
teorite was found at lat 47° N. , long 88° E. in Sin'-Tsian'; weighs about 20
tons; and is composed of magnetic iron.   The Koso-cho meteorite was first
mentioned in 1947 by the American National Museum; no further data are a-
vailabe.   The Kuli-Schu meteorite fell August 30, 1827; no data are available.
The Po-Wang-Chen meteorite fell October 23, 1938, in Tang-t'u, lat 31° 30'
N. , long 118° E. ; six stone fragments of total weight 665 g were recovered.
The Nanseki meteorite fell in the Hatung province at lat 30° N. , long 118° E.
on August 13, 1920; it is a pallacite type, and a fragment of 9. 5 g is at Kwa-
sau Observatory in Japan.   The Nan-Jang-Pao meteorite fell July 11, 1917 in
Kansu province; it is a chondrite type and weighs 53 g. The Fenghsien-ku me-
teorite, lat 34° 36' N. , long 116° 45' E. , fell October 5, 1924; it is a gray
chondrite of 82 g.   The Wu-chu-mu-chin meteorite fell in Inner Mongolia, lat
45° 30' N. , long 118° E. , in 1920; it is a stone of 68. 86 kg.   The Jukan me-
teorite fell in Kiangsi province, lat 28° 43' N. , long 116° 37' E. , August   27,
1931, followed by a meteorite shower; 10 specimens (the largest weighs 4. 8
kg) were collected.   The Jukan meteorite is an intermediate chondrite type.
— A. J. S.

181-70.   Hunter, W. , and Parkin, D. W.   Cosmic dust in recent deep-sea
           sediments: Royal Soc. [London] Proc. , v. 255, no. 1282, p.   382-
           397. 1960.

Black magnetic cosmic spherules found in deep-sea surface sediments are
of two main types.   Those of the first group (density about 3) consist of fine-
grained magnesium-rich olivine, and those of the second group (density about
6) are a partially oxidized nickel-iron alloy.   These compositions strongly
indicate a meteoritic origin.
If their extra-terrestrial origin is accepted, the number of spherules in a
given mass of surface sediments should give an estimate of the recent rate of
sedimentation (see Geophys. Abs. 173-234, 177-24).   More than 260 spherules
were extracted from 3 samples; 2 of these were taken from the Atlantic and 1
from the Pacific (A 1, from lat 34°11' N. , long 55°32' W. , depth 5, 582 m; A
2, from lat 24°30' N. , long 64°47' W. , depth 5, 949 m; and P, from lat 22°07'
S. , long 115°10' W. , depth 3, 060-3, 200 m).   Neglecting a possible latitude
effect in their accretion to the earth, the ratios of sedimentation are compu-
ted to be about 1 : 1. 55 : 26. 5 for the stations P, A 2, and A 1, respectively.
— D. B. V.

181-71.   Baker, George.   Origin of tektites: Nature, v. 185, no. 4709, p.
           291-294, 1960.

The australites are the youngest and best preserved of the tektites.   The
weight of evidence from detailed Australian studies made in the past two dec-
ades is strongly in favor of an extraterrestrial source.   Three factors— abla-
tion and fusion during flight; subsequent abrasion, fragmentation, and solution
by subaerial agents; and the activities of certain native birds and aboriginal
man—all add up to a logical reason why australites are not now piled up to the
thickness of 100 g per cm^2, calculated by Urey, if they came in a shower from
outer space.

It is demonstrated that cometary collisions spaced at 50-million-year intervals cannot satisfactorily explain the origin or present distribution of tektites. Other existing hypotheses are also shown to be inadequate. The position as to their origin still stands as it did approximately 70 years ago; although research since then has shown that, for the australites at least, an extraterrestrial origin is most likely, their source in space is still unknown. — D. B. V.

181-72.   Hawkins, Gerald S.   Tektites and the earth: Nature, v. 185, no. 4709, p. 300-301, 1960.

Arguments in favor of a terrestrial origin of tektites are that the bulk constituents of tektites are the same as the constituents of certain sedimentary rocks and that tektites are always associated with sediments. Discrepancies in percentage of minor constituents may be due to leaching and weathering of the sediment before the tektite was formed. The minor constituents that are not subject to differential weathering all support a terrestrial origin. A higher percentage of nickel, particularly, would be expected if tektites came from extraterrestrial bodies. Radioactive ages of tektites are fairly close to the age of the neighboring sediments. So far there is no evidence that tektites have been exposed to cosmic ray bombardment since their formation.

Lightning offers a ready explanation for the chemical and isotopic composition of tektites, their poor annealing and fused silica particles, their age, and their widespread yet infrequent occurrence. The possibility that tektites are produced by lightning acting on sandy sediments is being investigated at Boston University. Experiments will attempt to produce the "flight forms" by fusion, abrasion, and etching. — D. B. V.

181-73.   Pinson, W[illiam] H. Jr., Herzog, L[eonard] F., Fairbairn, H[arold] W., and Cormier, R. F. Sr/Rb age study of tektites, in Variations in isotopic abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U. S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 82-94, 1959.

This was previously published in Geochim. et Cosmochim. Acta, v. 14, no. 4, p. 331-339, 1958 (see Geophys. Abs. 175-408). — V. S. N.

181-74.   Vorob'yev, G. G.   Issledovaniye sostava tektitov. I. Indoshinity [Investigation of composition of tektites. I. Indochinites]: Akad. Nauk SSSR Meteoritika, no. 17, p. 64-72, 1959.

This paper reports on spectrographic analyses of indochinites from the meteorite collection of the Academy of Sciences of the U. S. S. R. It was found that indochinites have entirely different clarkes from those found in the earth's igneous silicic and ultramafic rocks. Their composition may have resulted f om a process of remelting of silicate rock wherein meteoritic substances could have been admitted to form the tektites. This geochemical process is equally possible on the earth and in meteoritic or asteroidal aggregations. Therefore, the findings reported here favor neither the cosmic nor the terrestrial theory of the origin of tektites. — A. J. S.

181-75.   Urey, H[arold] C.   On the chemical evolution and densities of the planets: Geochim. et Cosmochim. Acta, v. 18, no. 1/2, p. 151-153, 1960.

Urey points out difficulties in Ringwood's explanation of the variable densities of the terrestrial planets (see Geophys. Abs. 177-232). It provides no means for escape of the higher atomic weight gases from the earth. The amount of carbon needed to produce the silicon and iron is quite large, and the carbon monoxide produced would be very appreciable. The density trend from Mercury to Mars suggests a solar origin for the high temperatures necessary for the reduction process, but there is no evidence that the sun ever was 10^4 times brighter, as required to account for the high temperatures. Further, the low density of the moon does not fit this explanation. The postulated meteorite planet model is too simple to account for the structures of meteorites.

A more skeptical attitude toward averaged data—in this case the assumption that chondritic meteorites are a nearly average sample of nonvolatile solar matter—is urged. — D. B. V.

181-76.   United States Air Force. Lunar atlas: U. S. Air Force, Aeronautical Chart and Inf. Center, St. Louis, Missouri, 380 p., 1960.

This atlas of the moon, prepared under the direction of G. P. Kuiper of the Yerkes Observatory, consists of 280 photographs in addition to a large number of charts. Each photograph and chart is 20 by 16 inches and occupies a full page. The attempt was made to assemble the best photographs now available. Data are also given on the physical characteristics and motion of the moon. — J. W. C.

EARTH CURRENTS

181-77.   Volland, H[ans]. Modelle erdmagnetisch induzierter Ströme im inhomogenen Erdinnern [Models of geomagnetically induced currents in an inhomogeneous interior of the earth]: Zeitschr. Geophysik, v. 24, no. 4/5, p. 222-227, 1958.

In order to help clarify the observed earth current anomalies, the causes of which apparently lie more than 100 km deep in the earth's interior, the magnetic fields induced in a plane in the interior of the earth by an arbitrary one-dimensional plane current flowing in the ionosphere in a direction perpendicular to its polarity are calculated for three cases, including those of constant conductivity and linear conductivity. — D. B. V.

181-78.   Porstendorfer, Gottfried. Direkte Aufzeichnungen tellurischer Vektordiagramme und ihre Anwendungen in Bergbaugebieten [Direct recordings of telluric vector diagrams and their applications in mining districts]: Gerlands Beitr. Geophysik, v. 68, no. 5, p. 295-307, 1959.

A simple method is presented for determining the direction of telluric polarization and the area of the relative telluric field ellipse from the direct recording of telluric vector diagrams; it is suitable for the investigation of telluric microanomalies in mining districts. The instruments used are coordinate recorders adapted for telluric purposes merely by addition of compensation and resistance-adaptation circuits giving a recording sensitivity of 4 cm per mv. — D. B. V.

181-79.   Bossy, L., and De Vuyst, A. Relations entre les champs électrique et magnétique d'une onde de période très longue induits dans un milieu de conductibilité variable [Relationships between the electric and magnetic fields of a wave of very long period induced in a medium of variable conductivity]: Geofisica Pura e Appl., v. 44, p. 119-134, 1959.

The ratio between amplitudes and phase differences of pulsations of the magnetic and electric fields of more than 1-sec period recorded at ground level depends on the variation of conductivity with depth.   Various conductivity distributions are analyzed with a view to interpreting the results of observations made at the Centre du Physique du Globe at Dourbes, Belgium.   A composite model consisting of a uniformly conductive layer extended by a medium in which conductivity varies continuously seems best to represent the experimental results. — D. B. V.

181-80.   Schmucker, Ulrich.   Einige Ergebnisse der erdmagnetischen Tiefensondierung in Norddeutschland   [Some results of geomagnetic depth sounding in north Germany]: Zeitschr. Geophysik, v. 24, no. 4/5, p. 216-221, 1958.

Six geomagnetic "satellite stations" were established in northern Germany in order to examine the anomaly in the internal portion of geomagnetic variations caused by local inhomogeneities in electrical conductivity in this part of the earth's crust.   The internal parts of sudden commencements, magnetic bays, solar flare effects, and pulsations are analyzed; and earth current distributions satisfying Maxwell's equations are calculated.

A zone of higher electrical conductivity trends east-west, and its maximum is under a line from Ülzen to Bremen.   A corresponding east-west zone of lower conductivity underlies Göttingen.   According to the calculations, these zones cannot be attributed to differences in material in the sedimentary cover or in the glacial overburden, but to conditions at a depth of 50-100 km. — D. B. V.

181-81.   Verö, J.   Earth-current variations of different period in the observatorium near Nagycenk: Jour. Atmos. Terrest. Physics, v. 13, no. 3/4, p. 375-376, 1959.

The Geophysical Observatory of the Hungarian Academy of Sciences at Nagycenk is concerned chiefly with the distribution of earth-current variations of different period.   The frequency spectrum is divided into five bands (0-2, 2-6, 6-12, 12-24, and 24-60 min).   The activity of each band is characterized by a telluric index based on daily mean amplitudes.

In general, maximum activity of bands 2 and 5 occurs 1-2 days before that of bands 3 and 4.   A similar phenomenon is noted in the seasonal distribution. At equinox the order of activity is 1, 2, 5, 3, 4.   Activities in 2 and 5 often appear simultaneously as bay and pulsation. — D. B. V.

181-82.   Vladimirov, N. P., and Nikiforova, N. N.   O spektre variatsiy yestestvennogo elektromagnitnogo polya zemli [On the variation spectrum of the earth's natural electromagnetic field]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1867-1869, 1959.

Results of investigating the variation spectrum of the earth's natural electromagnetic field are reported.   A continuous spectrum was found within the frequency range 0.3-100 cycles per second, and the diurnal distribution of frequency is practically uniform.   Intensity of field variation depends on frequency and time of day; the amplitude increases with decreasing frequency and is smaller at night.   The mean amplitude of the horizontal components of the earth's electromagnetic field was found to be 0.1 mv per km, and the amplitudes of the magnetic field components to be 10^{-7}-10^{-8} eötvös. — A. J. S.

Kalashnikov, A. G., and Mokhova, Ye. N. On variations of the regional electromagentic field of small period. See Geophys. Abs. 181-373.

181-83.   Mishin, V. M., and Barsukov, O. M. O sutochnom khode vozmu-
shchennosti zemnykh tokov po nablyudeniyam sovetskikh stantsiy
v period MGG [On the diurnal rate of disturbance of earth cur-
rents according to observations at Soviet stations during the peri-
od of IGY]:   Akad. Nauk SSSR Ser. Geofiz., no. 1, p.   148-150,
1960.

Fourier harmonic analysis is applied to interpret the diurnal variation rate
of telluric currents obtained from hourly values of the tellurogram swing in
millivolts per kilometer.   It was found that the diurnal magnetic disturbance
consists of components that depend upon local and universal time.   The funda-
mental diurnal component of the telluric variation rate was found to consist of
two terms with approximate midday and midnight maximums; these vary with
latitude.   It is considered that the first term is due to the dynamo effect in the
ionosphere, and that the second is caused by a screening effect of the iono-
sphere at middle latitudes plus the night maximum of conductivity due to cor-
puscular intrusions at higher latitudes.   An analogous correspondence was
found for short period variations (a few seconds to a minute) of the earth's
electromagnetic field. — A. J. S.

181-84.   Popov, Yu. N. Nomogramma dlya kontrolya uglov pri postroyenii
vektornykh diagramm v metode telluricheskikh tokov [Nomogram
for checking of angles in construction of vectorial diagrams in the
method of telluric currents]: Razvedochnaya i Promyslovaya Geo-
fizika, no. 24, p. 22-23, 1958.

The use of two logarithmic scales for the determination of angles from known
values of the tangents of the angles is suggested to facilitate treatment of ob-
servational data on earth currents. — S. T. V.

Zagarmistr, A. M., and Berdichevskiy, M. N.   Electrical exploration oper-
ations by the method of telluric currents.   See Geophys. Abs. 181-193.

EARTHQUAKES AND EARTHQUAKE WAVES

181-85.   Byerly, Perry. The beginnings of seismology in America, in Sym-
posium on the physical and earth sciences: Berkeley, Calif., Univ.
of California Printing Dept., p. 42-52, 1958.

A short outline of the early history of seismology beginning with the intro-
duction of the seismography into the Western Hemisphere in 1887 at the Univ-
ersity of California is given, and the advances in the field of seismology dur-
ing the past 25 years with emphasis on contributions by the staff and students
of the University of California are reviewed.   The primary function of the
University of California seismograph stations has been the location of earth-
quake epicenters both as a public service and as a basis for research.   Two
lines of research have been pursued throughout the years: (1) to determine
the structure of the earth's surface layers in California, and (2) to determine
the nature of the forces acting at the focus of an earthquake from the nature
of the first P-wave on seismograms.   Major earthquakes of California are
also discussed. — V. S. N.

181-86.   Matthews, Samuel W. The night the mountains moved: Natl. Geog.
Mag., v. 117, no. 3, p. 328-359, 1960.

This is a report on some of the effects of the Yellowstone earthquake of
August 17, 1959.   Numerous photographs show the landslide that dammed the

Madison River to create a new lake, damage to the Hebgen Dam, earthquake cracks and scarps, offset fenses and highways, and other damage to roads and buildings. Nine persons were killed and 19 are missing, presumably buried under the landslide. — D. B. V.

181-87.   Oakeshott, Gordon B.   San Andreas fault in Marin and San Mateo Counties, in San Francisco earthquakes of March 1957: California Div. Mines Spec. Rept. 57, p. 8-24, 1959.

In the San Francisco Bay area the San Andreas fault is traceable across Marin County between Tomales and Bolinas Bays, is obscured by the ocean · west of San Francisco, and to the south traverses the valley of the Crystal Springs Lakes of San Mateo County. The fault, striking N. 35° W., divides San Mateo and Marin Counties into two geologic provinces with the subparallel, probably related, Pilarcitos fault forming the dividing line between these major structural units on the San Francisco Peninsula. Geologic evidence concerning the history and complexity of movements along the San Andreas fault is so varied that two conflicting interpretations of its history have been made by geologists: at one extreme is the belief that there has been several hundred miles of right-lateral, strike-slip displacement since Late Jurassic; and the other extreme is the belief that there has been large vertical displacement on an ancestral fault with relatively small lateral displacement in Late Tertiary and Quaternary time.

Two great epochs of displacement--pre-Miocene and post-Miocene--on the ancestral fault are recognized but the type of movement cannot be determined in the present state of knowledge of the geology of the West Bay. The early Upper Pliocene to mid-Pleistocene Coast Ranges orogeny initiated movement on the modern fault. The greatest displacement in historic times was the 21-foot right-lateral surface offset at the south end of Tomales Bay in 1906, and the latest was a small, vertical(?) displacement at shallow depth, which caused the earthquake of March 22, 1957. — V. S. N.

181-88.   Bonilla, M. G. Geologic observations in the epicentral area of the San Francisco earthquake of March 22, 1957, in San Francisco earthquakes of March 1957: California Div. Mines Spec. Rept. 57, p. 25-27, 1959.

The most concentrated damage to buildings in the San Francisco earthquake of March 22, 1957, was in the Westlake subdivision, which is underlain by Pliocene to Recent unconsolidated sediments. No evidence of new surface movement was visible on the San Andreas fault, about 0. 8 miles south of Westlake, nor was there evidence for the presence of other faults closer to Westlake. Structural damage was greatest in Westlake Palisades possibly because of proximity to sea cliffs where landslides occurred. Houses on compacted artificial fill were generally less damaged than those on natural ground. On natural ground no clear relationship between damage and foundation material could be established. — V. S. N.

181-89.   Tocher, Don. Seismic history of the San Francisco region, in San Francisco earthquakes of March 1957: California Div. Mines Spec. Rept. 57, p. 39-48, 1959.

Historical records of earthquakes in the California Coast Ranges adjacent to San Francisco and Monterey Bays reveal that moderately strong shocks were far more frequent in the years immediately preceding the major earthquakes in 1868 and 1906 than in the years immediately afterward. From 1942 to 1957, the period during which instrumental records for northern Califor-

nia have been available, almost the entire portion of the Hayward fault from San Leandro to Warm Springs that broke in the earthquake of 1868 has been remarkably quiet seismically in comparison with portions to the north and south. The portion of the San Andreas fault from San Juan Bautista to Humboldt County that broke in 1906 has been equally quiet except for the southern 20 miles and two isolated sections, one near Palo Alto, the other between San Bruno and Bolinas. The source of the earthquake of March 22, 1957, was at the southern end of the latter section. — V. S. N.

181-90.   Cloud, William K. Intensity and ground motion of the San Francisco earthquake of March 22, 1957, with Notes on remeasurement of the triangulation net in the vicinity of San Francisco by C. A. Whitten, in San Francisco earthquakes of March 1957: California Div. Mines Spec. Rept. 57, p. 49-57, 1959.

The main shock of the earthquakes, centering on the San Andreas fault near San Francisco on March 22, 1957, was felt over a land area of about 12,000 sq mi and was of intensity 7, modified Mercalli scale, near the epicenter. Twelve strong-motion seismograph stations, operated by the shock, registered maximum accelerations from 0.11 gravity at 7 miles from the epicenter down to 0.01 gravity at 40 miles. Duration of stronger accelerations was not more than 5 sec.

After the earthquake, reobservation of a triangulation net composed of points 6 - 8 miles apart filling the area between Mount Tamalpais, Sierra Morena, Mount Diablo, and Mocho was made. Vectors show the same systematic movement as disclosed in previous resurveys with no sharp break or discontinuity of vectors such as would be expected if there had been large horizontal displacement along any of the fault lines. The pattern suggests a possible clockwise rotation about the baseline. It is concluded that a major portion of the indicated displacement is real. — V. S. N.

181-91.   Tocher, Don. Seismographic results from the 1957 San Francisco earthquakes, in San Francisco earthquakes of March 1957: California Div. Mines Spec. Rept. 57, p. 59-71, 1959.

The epicenter of the main shock of the San Francisco earthquake of March 22, 1957, was at long 37°40' N., lat 122°29' W., which is located in the San Andreas rift zone near Mussel Rock. Origin time was $19^h44^m21.0^s$ G. c. t., and magnitude 5.3.

Epicenters of well-recorded aftershocks were disposed in an elongate zone that approximately bisects the San Andreas rift zone. No surface breakage was observed in the rift zone although there were landslides and slumps on the steep coastal cliffs between Mussel Rock and the southern edge of San Francisco.

A complete fault-plane solution based on first motions at stations at large distances was not possible. However, first motions at nearby stations are not consistent with right-lateral strike-slip movement on the San Andreas fault, suggesting instead movement of the continental side of the fault upward relative to the Pacific side. — V. S. N.

181-92.   Stauder, William. A mechanism study: the earthquake of October 24, 1927: Geofisica Pura e Appl., v. 44, p. 135-143, 1959.

The fault plane solution of the Alaska earthquake of October 24, 1927, is obtained and is found to be similar to that of the more recent earthquake of July 10, 1958, which occurred in the same general region. Using the data

from the plane of polarization of the S-waves, the mechanism at the focus is seen to conform to a single couple or faulting model rather than to a double couple. The S-waves, further, select one of the nodal planes for P as the fault plane. — Author's summary

181-93.   Tillotson, Ernest. The Agadir earthquake of February 29: Nature, v. 186, no. 4720, p. 199, 1960.

An earthquake of intensity 10 (on 10 degree scale) shook Agadir, Morocco, on February 29, 1960, at $23^h40^m12^s$ (u.t.). The district had never before experienced an earthquake of such intensity, and had not been alarmed by three premonitory tremors during the preceding week. The shock was felt strongly in Mogador, 100 miles to the north. Small aftershocks occurred on March 3, 4, 5 (two), and 6. Some 12,000 are estimated to have been killed and many thousands were injured. About 90 percent of the Talborjit quarter, which contained many multistoried apartment buildings (about 70 percent new buildings and 20 percent industrial buildings) was destroyed. A seismic sea wave added to the destruction. The preliminary epicenter has been located at lat 30° N., long 9° W.
Preliminary soundings indicate a tremendous submarine upheaval off the coast. In one case water depth charted at 1,200 feet was found to be 45 feet, and in a position 9 miles offshore soundings showed a depth of 1,200 feet instead of 4,500 feet. — D. B. V.

181-94.   Ambraseys, N[icholas] N.   The seismic sea wave of July 9, 1956, in the Greek Archipelago: Jour. Geophys. Research, v. 65, no. 4, p. 1257-1265, 1960.

The earthquake of July 9, 1956 (magnitude 7 1/2, epicentral intensity 8-9 MM), with epicenter at lat 36°54' N., long 26°12' E., was followed by a severe seismic sea wave which originated near lat 36°49' N., long 26°09' E. The wave was probably produced by a series of landslides on the steep banks of the submarine trench of Amorgos. The amplitude of the wave near its source was 100 feet, and the agitation of the sea within the central area lasted several days. A list of seismic sea waves in the Greek archipelago and adjacent seas is given in the appendix. — Author's abstract

181-95.   Kuznetsov, V. P.   Zemletryaseniye v Baku 28 noyabrya 1958 g [Baku earthquake of November 28, 1958]: Akad. Nauk Azerbaydzhan. SSR Doklady, v. 15, no. 8, p. 699-702, 1959.

Seismological data are given for the Baku earthquake, which occurred November 28, 1958, at 19^h32^m Greenwich time. The epicenter was located in the area of Baku, focus depth was about 1-2 km, and intensity was 3-4. P-wave velocity was 3.8 km per sec on the average but varied in different directions. The earthquake is interesting because of its extremely local character and the complete disagreement between its traveltime curves and the traveltime curves of other Caucasian earthquakes (see Geophys. Abs. 181-96). — A. J. S.

181-96.   Gorin, V. A.   K voprosu o zemletryasenii v. g. Baku 28 noyabrya, 1958 g.   [On the problem of the Baku earthquake of November 28, 1958]: Akad. Nauk Azerbaydzhan. SSR Doklady, v. 15, no. 8, p. 703-706, 1959.

Gorin presents geotectonic features of the Apsheron Peninsula (Caspian Sea) and of the Baku area where a local earthquake of magnitude 3-4 was re-

corded on November 28, 1958, at 19^{h}32^m Greenwich time. Tertiary and Quaternary deposits overlying a Mesozoic fault ridge are broken into five separate
blocks. The Baku earthquake was caused by movement of the block on which
the city of Baku is located; it was uplifted by movement of the Mesozoic ridge
(see Geophys. Abs. 181-95). — A. J. S.

181-97. Doubourdieu, Georges. Tectonique et tremblements de terre en
Algérie du Nord [Structure and earthquakes in North Algeria]:
Acad. Sci. [Paris] Comptes Rendus, v. 250, no. 5, p. 884-996,
1960.

In order to establish a possible relationship between earthquakes and the
northeast fault system of northern Algeria, the country was divided into belts
10 km wide parallel to the faults, and the distribution of earthquakes in each
belt was plotted. Data on about 100 earthquakes that occurred between 1716
and 1954, gathered for about 400 sites, were used.
Of the 10 peaks of seismicity thus revealed, 5 correspond exactly to the
axes of the dislocations. Earthquake risk in places situated on these faults
is three times greater than for other points in Algeria. Although the precision
of the data is variable and the period of observation relatively short geologically speaking, these results merit the attention of seismologists. — D. B. V.

181-98. de Bremaecker, J. Cl. Seismicity of the West African Rift Valley:
Jour. Geophys. Research, v. 64, no. 11, p. 1961-1966, 1959.

All the epicenters determined in the central part of the West African Rift
Valley up to the middle of 1958 have been plotted on a map. Most of them are
on the faults which border the rift; a few are on faults which crosscut it. The
eastern Virunga extinct volcanoes show a fairly strong seismic activity. The
most important discovery is that of a transverse zone stretching west from
Lake Kivu to the Congo River (450 km); extinct or active volcanoes are located at the intersection of this zone with the Rift Valley.
Diagrams show the amount of seismic energy liberated per year within 500
km of Lwiro. The mean value is 3.5 × 10^{20} ergs per yr, which is about 0.03
percent of that of the earth as a whole. — Author's abstract

181-99. Savarensk[i]y, E. [Ye.] F. Results of seismic investigations in
the USSR: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 203-212, 1959.

This is essentially an English version of a paper describing the seismicity
atlas of the U. S. S. R., published in Akad. Nauk SSSR Sovet po Seysmologii
Byull., no. 6, p. 16-18, 1957 (see Geophys. Abs. 173-35); it is illustrated
by a general map of epicenters in the U. S. S. R. and detailed maps of individual seismic areas. — D. B. V.

Ez, V. V. On tectonic features of the region of origin of deep focus earthquakes in eastern Carpathians. See Geophys. Abs. 181-246.

181-100. Kurbanov, M., and Nepesov, R. D. K voprosu o svyazi magnitnykh
i gravitatsionnykh anomaliy s seysmichnostu i sovremennymi dvizheniyami na territorii Turkmenistana [On the problem of the relationship of magnetic and gravity anomalies to seismicity and
contemporary movements in the territory of Turkmenistan]: Akad.
Nauk Turkmen. SSR Izv., no. 4, p. 3-9, 1959.

A correlation is found between tectonic movements and the distribution of
earthquakes in the Turkmen SSR. Leveling of the area in 1936, 1950, and

1957 show a maximum uplift of 200 mm and subsidence of 400 mm.   The zones of maximum change are found to have the highest seismicity.   Most of these earthquakes occur in zones of subsidence and of high magnetic and grav-ity anomalies. — A. J. S.

181-101.   Gorshkov, G. P.   On seismic regioning of Asian countries: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 407-411, 1959.

Seismic regionalization maps of the Asian part of the U. S. S. R. and of China are discussed.   Earthquake risk in different parts of India and Japan has also been studied. Enough data have been accumulated to permit compila-tion of seismicity maps for all Asian countries. Such work might be organized under the seismological section of the International Union of Geodesy and Geo-physics (see also Geophys. Abs. 177-47). — D. B. V.

181-102.   Kondorskaya, I. V., and Tikhonov, V. I.   K voprosu o seysmich-nosti i tektonike Kamchatki i severnoy chasti Kuril'skoy gryady [On the problem of the seismicity and structure of Kamchatka and the northern part of the Kurile ridge]: Akad. Nauk SSSR Doklady, v. 130, no. 1, p. 146-149, 1960.

The relationship of earthquakes in the Kurile-Kamchatka ridge to structure has been analyzed, mainly on the basis of records obtained by the seismic net-work of the Russian Far Eastern Region in 1954-57 and the distribution of earthquakes of magnitude M $\geq$ 7.   The seismic zone consists of a series of transverse belts of very strong earthquakes that trend north-south and north-west; these correspond to older fold trends superposed on a general northeast trend that is marked by deep earthquakes and corresponds to the front of Plio-Quaternary folding. — D. B. V.

181-103.   Petrushevskiy. B. A.   K issledovaniyam seysmichnosti territorii Kitayskoy Narodnoy Respubliki [Investigations of the seismicity of the territory of the Chinese People's Republic]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1729-1738, 1959.

A brief account of the seismogeologic relationships in the Gan'suy Corridor (lat 36°—40° N. and long 100°—107° E. approximately) in northwestern China is given.   Tectonic characteristics of the corridor are discussed, and the area is subdivided into 4 tectonic zones. This is one of the most active areas seismically in China, having records of earthquakes of magnitude 11 (1920) and 12 (1927).   The epicenters lie in a zone more or less along the boundary of the Nan'shan with the plains areas to the northeast.   The Nan'shan, known for its Neogene tectonism, has a low seismicity, however. — A. J. S.

181-104.   Bisztricsány, E[de].   On the problem of magnitude determination: Zeitschr. Geophysik, v. 24, no. 4/5, p. 154-160, 1958.

The magnitudes of 170 shallow earthquakes as determined at Prague have been used in order to eliminate error in the magnitude equation based on the duration of the surface waves and to establish the magnitude equation for Bu-dapest. At the same time a new magnitude equation was established for Pra-gue, which differs from the previously established equation by 0. 0005 units with respect to the $\Delta°$ coefficient; the constant term is identical to two decimal places.   For small distances the variation of magnitude with epicentral dis-tance is negligible. — D. B. V.

181-105. Solovyov [Solov'yev], S. L. Magnitude and energy of earthquakes:
          Bur. Central Seismol. Internat. Pubs., Ser. A, Travaux Sci.,
          no. 20, p. 39-53, 1959.

The first part of this paper discusses methods of determining earthquake
magnitudes used in the U.S.S.R. So far body waves have not been used, but
both velocity of oscillation and maximum ground displacement of surface waves
have been used (see Geophys. Abs. 165-41). There is a systematic disagree-
ment between values of magnitude calculated at stations in the Far East and
at other parts of the U.S.S.R.; negative values of δM are typical for Kurile-
Kamchatka earthquakes and for most Pacific earthquakes originating in trough
regions, and positive values of δM are shown for continental earthquakes.
The geographic distribution of the differences between values determined at
Vladivostok and at continental stations of the U.S.S.R. are shown on a world
map. Gutenberg found a similar distribution for differences between magni-
tude determined at Pasadena and the average at other stations in the world
(see Geophys. Abs. 121-7971). Another map shows the distribution of strong
earthquakes in the U.S.S.R. for the period 1911-56.
The second part of the paper is a discussion of the calculation of earthquake
energy from magnitude (see Geophys. Abs. 165-41). — D. B. V.

181-106. Di Filippo, Domenico, and Marcelli, Liliana. La "magnitudo uni-
          ficata" per i terrimoti a profondita normale, e la magnitudo dei
          terrimoti profondi per la stazione sismica di Roma [The "unified
          magnitude" for earthquakes at normal depth and the magnitude of
          deep earthquakes for the Rome seismic station]: Bur. Central
          Seismol. Internat. Pubs., Ser. A, Travaux Sci., no. 20, p. 17-
          30, 1959.

This paper was published previously in Annali Geofisica, v. 10, no. 3-4,
p. 247-261, 1957 (see Geophys. Abs. 174-43). — D. B. V.

181-107. Iosif, T., and Radu, C. Asupra determinări magnitudinilor cutre-
          murelor adînci din Vrancea [On the determination of magnitudes
          of deep focus earthquakes in Vrancea (with French and Russian
          abstracts)]: Acad. Romîne Studii şi Cercetări de Astronomie şi
          Seismologie, v. 4, no. 1, p. 261-269, 1959.

Using the method developed in an earlier paper, Iosif and Radu have deter-
mined the magnitudes of 59 deep-focus earthquakes in Vrancea, Rumania, and
found that the Bucharest station records P-waves for earthquakes of magni-
tude greater than 4.2 and S-waves for those above 2.7. The Cimpulung sta-
tion records P-waves for earthquakes of magnitude above 3.2 and S-waves for
those above 2.7. — A. J. S.

181-108. Tsuboi, Chuji. A new formula connecting magnitude and number
          of earthquakes: Tokyo Univ. Geophys. Inst. Geophys. Notes, v.
          12, no. 2, contr. 18, 1959.

This paper was published originally in the Jour. Physics of Earth [Tokyo],
v. 6, no. 2, p. 55-57, 1958 (see Geophys. Abs. 179-67). — D. B. V.

181-109. Kurimoto, Hiroshi. A statistical study of some aftershock prob-
          lems [in Japanese with English summary]: Tokyo Univ. Geophys.
          Inst. Geophys. Notes, v. 12, no. 2, contr. 19, 1959.

This paper was published originally in Zisin, ser. 2, v. 12, no. 1, p. 1-10, 1959 (see Geophys. Abs. 179-69). — D. B. V.

181-110. Byerly, Perry.   Earthquake mechanisms: Science, v. 131, no. 3412, p. 1493-1496, 1960.

The directional character of at least the beginnings of the longitudinal and transverse waves sent out when a sudden force is applied to part of an infinite homogeneous medium depends on the nature of the force system applied at the source.   It is widely agreed that the energy released as seismic waves was gradually stored as potential energy of strain before the shock.   The moot question is how this strain energy is transformed into kinetic energy of motion.

At present seismologists are divided into two groups. One group represented by Keylis-Borok (see Geophys. Abs. 178-68), finds a single couple with moment the most satisfactory mechanism; the single couple has generally been favored by those working in North America.   The other group, represented by Honda (see Geophys. Abs. 170-55) has found that the double couple fits observations better.

Statistical analysis of 179 fault-plane solutions (Scheidegger, Geophys. Abs. 179-71) shows that transcurrent faulting is about three times more frequent than dip-slip faulting.   As horizontal movements would not leave as definite a geologic record as vertical, the past frequency of transcurrent faulting is a matter of conjecture. — D. B. V.

181-111. Aki, Keiiti.   Study of earthquake mechanism by a method of phase equalization applied to Rayleigh and Love waves: Jour. Geophys. Research, v. 65, no. 2, p. 729-740, 1960.

Rayleigh waves and Love waves are used for the study of the earthquake mechanism by the application of a method of phase equalization. In this method, an impulse response is computed from known phase-velocity data and instrument characteristics, and is cross correlated with an actual record.   A comparative study of Love waves from Kern County aftershocks of 1952 and those from Nevada shocks of 1954 strongly supports the hypothesis of a pair of couples rather than a single couple for the earthquake source. Source functions for five Kern County aftershocks are derived from the Rayleigh waves recorded at Weston and Palisades.   It was found that the sense of principal motion in the source function is in agreement with the fault-plane solution obtained from the P-wave data.   Mantle Rayleigh waves are found to be useful for this purpose also. — Author's abstract

181-112. Knopoff, Leon, and Gilbert, Freeman. First motions from seismic sources: Seismol. Soc. America Bull., v. 50, no. 1, p. 117-134, 1960.

An application of dynamic dislocation theory gives the elasto-dynamic radiation resulting from the sudden occurrence of an earthquake due to faulting. The fault plane is visualized as a geometrical discontinuity across which there exists a sudden discontinuity in either one component of the strain tensor or one component of the displacement vector.   It is shown that there are eight independent models, if unilateral faulting is assumed; and an argument is presented to demonstrate the likelihood that unilateral faulting does not exist in nature.   For bilateral faulting the eight independent models are reduced in number to five.   Of these five, two are more likely to occur in nature than the others.   One of these, the displacement dislocation model, has a first-motion radiation pattern formally identical with that of a double couple in an

unfaulted medium. The second, the shear-strain dislocation model, has a first-motion radiation pattern formally identical with that of an isolated force in an unfaulted medium. The latter type of mechanism may occur in deep-focus earthquakes. Another type of radiation, corresponding to the single couple in an unfaulted medium, results from the sudden release of shear strain in a laminar region. — Authors' abstract

181-113. Båth, Markus. Polar graphs of initial motions at an earthquake source: Seismol. Soc. America Bull., v. 48, no. 2, p. 129-131, 1958.

A modified technique for fault-plane solutions is developed, using polar diagrams with the earthquake focus at the origin and with station azimuth and angle of incidence at the focus as coordinates. A figure is given illustrating the distribution of initial longitudinal motion in a perfectly general case for a plane fault source with rectilinear slip, together with all the special cases which can be derived from it. Formulas are given which combine all the quantities entering into the solution. — Author's abstract

181-114. Droste, Sophia [Zofia], and Teisseyre, Roman. The theory of the dislocation processes and its application to the Pacific region: Seismol. Soc. America Bull., v. 50, no. 1, p. 57-70, 1960.

This paper deals with the mechanism of earthquakes according to dislocation theory. An attempt is made to explain the dislocation processes in the region of troughs and ridges. A preliminary comparison of the proposed dislocation mechanism with the Pacific Region data is discussed.

For the sake of simplification the seismic processes are considered only in a plane which plays the part both of the hypocentral and the dislocation plane. Two factors are of special interest, namely, stresses and inhomogeneities. In the stress field we can describe the inhomogeneities by loop-type dislocations. The stress field influences their extent and movement by which the greater dislocation elements are formed. These elements may in approximation be regarded as pairs of two unlike linear dislocations. We may therefore assume the existence of pair creation areas. By the parting of the dislocation lines of a pair the dislocation area enclosed by them is increased. There may occur the junction of two or more extending dislocation areas. This junction is accompanied by release of the energy accumulated around the dislocation limiting lines, which are thus annihilated. Similarly, when the dislocation reaches the earth's surface a discharge of its dislocation energy occurs. — Authors' abstract

181-115. Shirokova, Ye. I. Opredeleniye napryazheniy, deystvuyushchikh v ochagakh gindukushskikh zemletryaseniy [Determination of strains acting at the focuses of Hindu Kush earthquakes]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1739-1744, 1959.

Distribution of forces acting at the focuses of Hindu Kush earthquakes are investigated for ϕ = 36.5° N. and λ = 70.5° E., the depth of the focuses being approximately 200 km. Focuses are assumed to be finite areas, the sides of which are displaced in the plane of rupture. Using the signs of the displacements in P-waves, and SV and Sh waves when possible, the system of stresses at a particular focus can be determined, as the directions of compression and tension forces coincide with the axes of the principle stresses acting at the focuses. Analysis of the direction of the stresses in 11 earthquakes showed that the earthquakes in the Hindu Kush area are caused by considerable horizontal compression and smaller almost vertical tension. — A. J. S.

181-116. Nagumo, Shozaburo.   A geometrical study of diffraction patterns
[in Japanese with English summary]:   Butsuri-Tanko, v. 11, no.
3, p. 131-136, 1958.

A geometrical study is presented for time-distance curves of a diffraction
wave from a fault in a 3-dimensional case.   The step-out time of a diffraction
wave depends upon the depth of the fault, the elastic wave velocity in the me-
dium, and the direction of the seismic line in relation to the direction of fault
strike.   When the seismic line is not perpendicular to the fault strike, the dif-
fraction pattern becomes asymmetric and the center shifts a little from the
fault. — V. S. N.

181-117. Savarenskiy, Ye. F.   Elementarnaya otsenka vliyaniya sloya na
kolebaniya zemnoy poverkhnosti [An approximate evaluation of
the effect of a stratum on vibrations of the earth's surface]: Akad.
Nauk SSSR Izv. Ser. Geofiz., no. 10, p. 1441-1447, 1959.

Investigation of the effect of destructive earthquakes shows that structures
built on loose and moist ground suffer much more than those erected directly
on solid rock.   Horizontal vibrations are generally the most destructive.   The
effect of a loose formation on incoming seismic waves is analyzed.   Such a
formation acts sometimes as an amplifier of the waves.   Examples are cited
where a longitudinal or transverse wave can become almost double in ampli-
tude. — S. T. V.

181-118. Brune, James N., Nafe, John E., and Oliver, Jack E.   A simpli-
fied method for the analysis and synthesis of dispersed wave
trains: Jour. Geophys. Research, v. 65, no. 1, p. 287-304, 1960.

A disturbance at one point of a dispersive medium resulting from an impulse
applied at another point may be represented as a superposition of traveling
plane waves.   The phase and period of the disturbance at any instant are re-
lated by the principle of stationary phase to the phase and period of a travel-
ing-wave component.   An equation is given for the instantaneous phase of the
traveling-wave component, from which the phase velocity can be computed as
a function of period if the initial phases are known, or initial phases can be
computed if distance and dispersion are known. From distance, initial phases,
and phase velocities, the disturbance at any point can be constructed.
The practical use of the method is demonstrated by application to antisym-
metric waves in a cylindrical rod, Rayleigh waves from nuclear explosions
and from the Hudson Bay earthquake of January 1959, and Love waves from
two Nevada earthquakes of 1954. — D. B. V.

181-119. Gilbert, Freeman, and MacDonald, Gordon, J. F. Free oscillations
of the earth. I. Toroidal oscillations: Jour. Geophys. Research,
v. 65, no. 2, p. 675-693, 1960.

The free periods of toroidal oscillations of the earth have been computed
for two earth models.   The lowest period for the Gutenberg model earth is
2, 651 sec and for the Jeffreys-Bullen model 2, 732 sec.   The surface ampli-
tudes of the oscillations have been computed for three kinds of delta function
stress sources—a unit force, a unit couple, and a unit torque—at depths of
600, 250, 100, and 30 km.   The amplitudes decrease with increasing depth of
the source.   For a unit couple at 600 km the maximum amplitude of the low-
est period for the Gutenberg model is 1.59×10^{-25} cm, and for the Jeffreys-
Bullen model it is 0.70×10^{-25} cm.   By using the free periods of oscillation

we have extended Love wave phase velocity and group velocity dispersion curves to include long-period Love waves.

The method used to compute the periods and amplitudes of the free oscillations is an extension of the Thomson-Haskell matrix method used in plane layered media.

An example is presented to show the correspondence between the free oscillations and ray theory. — Authors' abstract

181-120. Tolstoy, Ivan. Modes, rays, and travel times: Jour. Geophys. Research, v. 64, no. 7, p. 815-821, 1959.

Relationships between the normal-mode and the ray-optical interpretations of seismic and acoustic measurements are discussed, and applications to the theory and practice of refraction techniques are given. The validity of the ray theory is sometimes open to question; that is, the results of traveltime and intercept measurements may be subject to overinterpretation in terms of rays. Several questions of principle are examined in this connection. It is emphasized that the idea of mode cannot be brought into direct correspondence with the rays and traveltimes of the optical, approximate approach, and efforts to interpret mode behavior in terms of rays can lead to paradoxical conclusions. This can be understood in terms of the plane-wave, asymptotic nature of such concepts as phase and group velocity. — Author's abstract

181-121. Ben-Menahem, Ari. Diffraction of elastic waves from a surface source in a heterogeneous medium: Seismol. Soc. America Bull., v. 50, no. 1, p. 15-33, 1960.

A theory is developed for wave propagation of a given frequency emerging from a seismic surface source in a medium in which the velocity is a continuous function of one coordinate only. It is assumed that the relative change of the elastic parameters is very small over a wavelength. The wave equations are then solved in cylindrical coordinates under suitable boundary conditions and integral representations are obtained for the displacements, which are generally valid. These integrals are then evaluated for a special case with an almost linear velocity gradient and the surface displacements are obtained for long ranges. It is found that the amplitude of the body waves (both P and S) inside the shadow zone decays exponentially with the distance from the source at a rate proportional to one-third power of the frequency and two-thirds power of the velocity gradient. — Author's abstract

181-122. Gutenberg, B[eno]. Waves reflected at the "surface" of the earth: P'P'P'P': Seismol. Soc. America Bull., v. 50, no. 1, p. 71-79, 1960.

Phases of the 600 km deep earthquake of April 16, 1957, which have not been reflected at the earth's surface show very sharp beginnings arriving within the limits of error of a few seconds at the calculated times. However, phases which have been reflected at the surface, for example PP, pP', pPP, have more or less emergent beginnings which arrive between a few seconds and as much as 30 sec too early. These emergent beginnings are followed by an impulse which arrives at nearly the calculated time. In agreement with earlier findings, it is concluded that the emergent beginnings of such waves are caused by waves which have been reflected at the Mohorovicic discontinuity or other discontinuities below the surface. Observations of such early emergent arrivals also include waves of the types P'P', PKSP', P'P'P' which have passed twice or more through the mantle and the core.

P'P'P'P' has been observed for the first time. The traveltime of P'P'P'P'
and the coefficient of absorption calculated from P'P'P'P' and P' agree with-
in limits of error with the expected values; however, these limits of error
are so large that the results cannot be used to improve earlier findings. The
periods of P'P'P'P' which has traveled about 50,000 km through mantle and
core do not show a marked change from those observed in P waves which have
traveled only a few thousand kilometers through the mantle. — Author's ab-
stract

181-123.   Grinda, Louis. Nouveaux aspects des ondes T [New aspects of T
           waves]: Acad. Sci. [Paris] Comptes Rendus, v. 250, no. 12, p.
           2241-2243, 1960.

An explanation is proposed for the mechanism of passage of seismic T-waves
from the ground into the water and into a sound channel in the water. It is
shown that the shape and trend of submarine topography has a decisive effect
on the amplitude variations of T-waves. The suggested explanation, which
supplements the theory of Ewing and others (see Geophys. Abs. 141-11951,
148-13333), is illustrated by examples from the records at Monaco.—D.B.V.

181-124.   Ewing, Maurice, Mueller, Stephan, Landisman, Mark, and Sato,
           Yasuo.   Transient analysis of earthquake and explosion arrivals:
           Geofisica Pura e Appl., v. 44, p. 83-118, 1959.

An electronic sound spectrograph has been used to analyze the transients in
complicated earthquake and explosion signals. By this method, the group ve-
locity at each of the spectral frequencies for each of the separate arrival
branches can be obtained directly for any type of transient signal. In contrast
to frequency analysis, it presents the fine spectral structure of the signal as
it changes with time, not an average over a time that includes many parts of
the signal.
    Dispersion and body-wave spectrums of the P-wave have been observed by
transient analysis, and possibly dispersion has been observed also in the S-
wave and various multiply reflected S-waves; the latter increase in period
from one arrival to the next. The dispersed pattern of arrival of fundamental
and higher mode surface waves has been observed for oceanic, continental,
and mixed paths; among these signals there is a clear indication of the second
continental shear mode. The separation of surface waves for direct and com-
plementary paths has also been achieved. Results compare well with those
obtained by standard techniques.
    The dispersion of the fundamental and higher mode signals from explosive
sources in shallow water may easily be studied by means of sound spectro-
grams and amplitude sections. Bubble pulses and Airy phases are clearly
defined on the spectrograms and sections of such shots. — D. B. V.

181-125.   Enescu, D[umitru]. Aspura unor unde seismice observate la staţ-
           iile seismografice romîneşti [On certain waves observed at the
           Rumanian seismograph stations (with Russian and French ab-
           stracts)]: Acad. Romîne Studii şi Cercetări de Astronomie şi
           Seismologie, v. 4, no. 1, p. 247-260, 1959.

Using the existing theory of Love and Rayleigh waves, Enescu attempts to
distinguish these two types of waves on the seismograms of the Bucharest sta-
tion; agreement is found between the observational and theoretical data. The
peculiarities of certain R_E waves found on the seismograms of the Timisoara
and Bucharest stations are analyzed. These waves originated from earth-

quakes in Kamchatka and Kurile Islands and arrived 18-29 minutes after the P waves. As the amplitude of these waves is greater than that of compressional waves and smaller than that of ordinary Rayleigh waves, they are interpreted as Rayleigh boundary waves. This conclusion was reached on the basis of traveltime, direction of particle motion, amplitude, and period and on their correspondence with theoretical Rayleigh waves at the boundary between the crust and mantle. — A. J. S.

181-126. Lossovskiy, Ye. K. O tochnosti metoda srednikh skorostey v seys-mike prelomlennykh voln [On the accuracy of the method of mean velocities in the seismics of refracted waves]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1845-1849, 1959.

The interpretation of traveltime curves of waves refracted at a boundary overlain by a medium of higher velocity of elastic oscillations is discussed. The inverse problem of interpretation by the method of mean velocities is analyzed. It was found that this method of traveltime curve interpretation allows a well defined solution of the problem. The method is extended to the interpretation of traveltime curves of seismic waves refracted at a horizontal boundary in which velocities increase linearly with increasing depth. It is shown that the maximum possible error δH in the depth H of the refracting boundary, determined by the method discussed, is 7.5 percent, whereas the probable error was found to be not more than 6 percent. — A. J. S.

181-127. Pod"yapol'skiy, G. S. Priblizhennoye vyrazheniye dlya smeshcheniya v okrestnosti osnovnogo fronta v sluchaye malogo ugla mezhdu luchom i granitsey razdela [An approximate formula for a displacement in the proximity of the main front for the case of a small angle between a ray and a boundary]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1761-1773, 1959.

An approximate formula for a displacement in the vicinity of the main wave front is derived for the case where the angle between a seismic ray and the boundary of a layer is small. The formula is based on a rigorous solution of the problem for an elementary wave produced in a parallel-layered medium by a point source of axial symmetry. The formula derived is applied for the case of a wave refracted into a half space from the lower to the higher P-velocity region. — A. J. S.

181-128. Kogan, S. D., Pasechnik, I. P., and Sultanov, D. D. Razlichiye v periodakh seysmicheskikh voln, vozbuzhdayemykh pri podzemnykh vzryvakh i zemletryaseniyakh [The difference in period of seismic waves generated by underground explosions and earthquakes]: Akad. Nauk SSSR Doklady, v. 129, no. 6, p. 1283-1286, 1959.

Seismograms obtained mainly with Kirnos seismographs from two large underground explosions in the U. S. S. R. and from earthquakes of comparable magnitude have been analyzed and compared. It is found that natural earthquakes can be distinguished from explosions on the basis of the relationship of maximum period of surface waves to epicentral distance; the period of waves from explosions is smaller and does not increase with distance. For instance, at epicentral distances of about 200 km, the period of surface waves from explosions is twice as small as that from earthquakes, at 1,000 km it is about 4 times smaller, and at 2,000 km about 5 times smaller. This is explained by the very narrow spectrum of these waves. The high frequency spectral composition of oscillations in explosions evidently is due to the small

dimensions and short existence of the source in comparison to the dimensions and duration of existence of an earthquake focus. — D. B. V.

181-129.   Khovanova, P. I.   O faze T i vozmozhnosti eye svyazi s tsunami
           [The T phase and its possible relation to tsunami]: Akad. Nauk
           SSSR Izv. Ser. Geofiz., no. 10, p. 1506-1509, 1959.

It has been found by many investigators that tsunami often seem to be re-lated to the seismic T-waves. These waves, produced by underwater earth-quakes, are characterized by a short period (0. 5-1. 0 sec) and are not record-ed by Golitzin and Benioff long-period seismographs. The suggestion is made that the T-phase is a group of converted waves. This group propagates from the earthquake focus to the surface of the ocean floor as P or S(SV) waves with the usual velocity, then follows the deep-water acoustic channel as a long-itudinal wave with a velocity of 1. 5 kmps, and on the continent is transformed into P- or S-waves. It is hoped that further investigation of the nature of the T-phase will shed more light on the relationship between the T-phase and tsu-nami (see also Geophys. Abs. 148-13333). — S. T. V.

181-130.   Dorman, James, Ewing, Maurice, and Oliver, Jack.   Study of
           shear-velocity distribution in the upper mantle by mantle Rayleigh
           waves: Seismol. Soc. America Bull., v. 50, no. 1, p. 87-115,
           1960.

Comparison of Rayleigh-wave dispersion computations on 11 models of shear-velocity structure of the continental and oceanic crust-mantle systems permits a detailed explanation of observed mantle Rayleigh-wave dispersion for periods less than 250 sec.   The results support the distribution of shear velocity in the upper mantle of continental areas as determined by Gutenberg (Geophys. Abs. 151-184, 163-251) and by Lehmann (Geophys. Abs. 164-65). A striking feature is a very prominent region of low shear velocity between about 100 and 200 km.   The information given by mantle Rayleigh waves does not offer a means of choosing between the Gutenberg and Lehmann hypotheses of upper mantle structure.
The top of the low-velocity channel is shown to begin at about 60 km under oceans, about half the depth at which it begins under continents. This means that large differences between continental and oceanic structure extend to at least 100 km depth and small differences to about 400 km; this information is related to, if not an explanation of, the surprisingly large heat flow through the ocean floors.
The 20° discontinuity is shown to be the main cause of the prominent mini-mum in group velocity of the mantle Rayleigh waves observed at 225 sec per-iod.   Curvature of the earth is probably the cause of systematic differences beyond periods of 200 to 250 sec between observed group velocities and those computed for a flat earth.   When good dispersion data and an adequate com-puting method are available, the surface-wave method compares favorably with body-wave methods for deducing the layered structure of the earth. — D. B. V.

181-131.   Gutenberg, B[eno].   The shadow of the earth's core: Jour. Geo-
           phys. Research, v. 65, no. 3, p. 1013-1020, 1960.

Theoretically as well as from model experiments it has been shown that the amplitudes of seismic waves diffracted at the boundary of the earth's core should decrease relatively slowly from the beginning of the shadow zone, where no marked discontinuity should be observed.   Waves having small periods should show a greater decrease of amplitude with distance than those with large periods.

P-waves observed in the shadow zone beyond 103° exhibit the properties to be expected theoretically for diffraction at the core boundary. There is no indication that an assumed decrease of velocity in the lowest portion of the mantle could lead to the observed "diffracted" waves at distances beyone 110°. On the other hand, P-waves arriving at distances of 90° could not have gone deep enough to graze the core. A constant velocity or one decreasing by about 0.1 kmps in the lowest 100 km of the mantle would account for the nearly straight line traveltime curves and the decreasing amplitudes of P-waves at epicentral distances between about 90° and 100°. Observations for diffracted S-waves cover a much smaller range of distances but indicate similar behavior. — D. B. V.

181-132.   Rykunov, L. N. The study of a decrease of P-waves amplitudes in the shadow zone on the earth's model: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 123-127, 1959.

This is essentially the same as the paper published in Akad. Nauk SSSR, Izv. Ser. Geofiz., no. 10, p. 1262-1265, 1957 (see Geophys. Abs. 172-52). — D. B. V.

181-133.   Glivenko, Ye. V. Ob obmennykh i otrazhennykh volnakh na azimutal'nykh seysmogrammakh zemletryaseniy Garmskoy oblasti [Exchange and reflected waves on azimuth seismograms of Garm region earthquakes]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 1, p. 126-130, 1960.

Tests of azimuth seismographs in the Turkmen S. S. R. in 1951 and in the Garm region in 1953 showed that the apparatus records ground displacement in various directions, and that the displacement vector coincides with the direction of the seismic rays coming to the station. This defines the direction of the P-wave motion in its first arrival. The azimuth method of seismic recording is extended to the subsequent arrivals in an attempt to distinguish other wave types on the seismograms. Several hundred seismograms of local earthquakes were analyzed statistically. SP type waves were distinguished in the time interval between the first arrival of P- and S-waves. It was found that SP waves propagate at first as S-waves, and then are transformed by exchange into P-waves at a refraction boundary. PP waves, which arrive after the first arrival of S-waves, were also distinguished. Their origin is attributed to the existence of a deep (32-40 km) discontinuity and a reflection boundary at a depth of 20 km. — A. J. S.

Vvedenskaya, A. V., and Balakina, L. M. On some peculiarities of the displacement fields of the longitudinal and transverse waves propagating in the earth's mantle. See Geophys. Abs. 181-320.

181-134.   Takeuchi, Hitoshi, and Kobayashi, Naota. Surface waves propagating along a free surface of a semi-infinite elastic medium of variable density and elasticity [in Japanese with English summary]: Zisin, v. 12, no. 3, p. 115-121, 1959. Reprinted in Tokyo Univ. Geophys. Inst. Geophys. Notes, v. 12, no. 2, contr. 15, 1959.

The methods of the calculus of variations are applied to the problem of surface waves propagating along the free surface of a semi-infinite elastic medium of variable density and elasticity. Numerical examples are worked out for Love and Rayleigh waves in a medium in which density is constant and in which elasticity increases linearly with the depth from the free surface. — V. S. N.

181-135. Arkhangel'skaya, V. M. Nekotoryye rezul'taty issledovaniy pover-
          khnostnykh voln pri zemletryaseniyakh po eksperimental'nym dan-
          nym [Certain results of investigation of surface waves during
          earthquakes according to experimental data]: Akad. Nauk Turk-
          men, SSR, Inst. Fiz. i Geofiz. Trudy, v. 2, p. 175-194, 1956.

The long surface waves (L) recorded by Golitsyn and Kirnos seismographs
at teleseismic stations in the U. S. S. R. are studied. These waves are resolv-
ed into Rayleigh and Love waves, and their horizontal maximum displacement
vectors and the horizontal displacement vectors determined. The seismo-
grams of 11 earthquakes recorded at the "Moskva" seismic station were ana-
lyzed for L-waves. On resolving their component vectors of displacement,
the epicentral azimuths were determined. — A. J. S.

181-136. Shurbet, D. H. The effect of the Gulf of Mexico on Rayleigh wave
          dispersion: Jour. Geophys. Research, v. 65, no. 4, p. 1251-
          1255, 1960.

It is shown that the dispersion of Rayleigh waves crossing the Gulf of Mex-
ico can be accounted for by the presence of unconsolidated sediments of an
average thickness of 7 km. It is concluded that study of Rayleigh wave dis-
persion is a valuable method of measuring the thickness of sedimentary col-
umns.   A suitable distribution of stations around the Gulf of Mexico would
make possible improved accuracy of measurement and greater areal coverage.
— D. B. V.

181-137. Herrin, Eugene, and Minton, Paul D.   The velocity of Lg in the
          southwestern United States and Mexico: Seismol. Soc. America
          Bull. , v. 50, no. 1, p. 35-44, 1960.

The group velocities of 91 Lg arrivals at the Dallas Observatory in 1954,
1955, 1956, and 1957 have a mean of 3. 468 ± 0. 010 kmps. A t-test shows that
Lg waves traveling from Baja California to Dallas have a velocity significant-
ly larger at the 0. 999 probability level than those traveling from California to
Dallas.   Four Lg arrivals which traveled from Mexico to Dallas across the
outer continental shelf of the Gulf of Mexico have a mean velocity of 3. 22 ±
0. 03 kmps.   A table for estimating epicentral distances from P and Lg ar-
rival times is included. — Authors' abstract

181-138. Kobayashi, Naota. Vertical distribution of amplitudes of the Ray-
          leigh type dispersive waves [in Japanese with English summary]:
          Zisin, v. 12, no. 3, p. 101-114, 1959.

Results of a study of the vertical distribution of amplitudes for M_{11} type
dispersive Rayleigh waves propagated along the surface of a superficial layer
overlying a semi-infinite elastic medium with particular emphasis on the case
in which the substratum is a low velocity layer are presented.   It was found
that amplitude distribution and particle orbits of the M_{11} waves are analogous
to those of nondispersive Rayleigh waves propagated along the surface of a
semi-infinite elastic solid; this is true even where the substratum is a low ve-
locity layer.   If the substratum is rigid, particle orbits for waves of wave-
length longer than about 4. 6 H (H is thickness of superficial layer) are oppo-
site to the orbits for other waves in the existing domain. — V. S. N.

181-139. Richter, Gertraud. Über die Polarisation von SKS [On the polari-
          zation of SKS]: Zeitschr. Geophysik, v. 24, no. 4/5, p. 161-174,
          1958.

Reconstruction of the horizontal ground motion during transverse wave on-
sets in nearly 100 seismograms shows that there is a strong directional po-
larization of SKS, SKKS, sSKS, and sSKKS for earthquakes at epicentral dis-
tances greater than 83°. Polarization of direct S-waves is at right angles to
the azimuth and not as strong as that of SKS. The polarization is attributed
to the change of wave type from longitudinal to transverse on passing from
core to mantle. — D. B. V.

181-140. Benioff, Hugo. Long-period seismographs: Seismol. Soc. America
          Bull., v. 50, no. 1, p. 1-13, 1960.

Five different seismographs developed for recording very long-period seis-
mic waves are described and their theory presented. These include the elec-
tromagnetic strain seismograph with galvanometer of 8-minute period and
photographic recording; the displacement transducer strain seismometer with
resistance-capacitance network and short-period galvanometer photographic
recorder or ink-writing recorder; the electromagnetic pendulum seismometer
with resistance-capacitance network having transfer characteristic of a long-
period galvanometer recorder or a heated stylus visible writer; the electro-
magnetic pendulum with period increased tenfold or more using shunt capaci-
tance; and the electromagnetic pendulum with condenser-lengthened period and
triple resistance-capacitance integrating network recorder with either heated
stylus visible writer, ink writer, or short-period galvanometer photographic
recorder. — D. B. V.

181-141. Benioff, Hugo, and Press, Frank. Progress report on long period
          seismographs: Royal Astron. Soc. Geophys. Jour., v. 1, no. 3,
          p. 208-215, 1958.

Long period seismograph systems in operation in Pasadena are described.
Extension of the group velocity curves for mantle Rayleigh waves and G-waves,
the detection of these waves from earthquakes in the magnitude range 5 3/4 -
7, and the recording of unusual body waves with unsuspected long period com-
ponents are among the results which have been achieved. — Authors' summary

181-142. Pomeroy, Paul W., and Sutton, George H. The use of galvanome-
          ters as band-rejection filters in electromagnetic seismographs:
          Seismol. Soc. America Bull., v. 50, no. 1, p. 135-151, 1960.

The large-amplitude intermediate-period, 4-9 sec, microseisms are ef-
fectively removed from high-magnification long-period seismograms with
maximum magnification near 50-sec period. This has been accomplished by
the use of a galvanometer of natural period in the microseism range as a band-
rejection filter. Addition of the filter galvanometer greatly increases the use-
fulness of these instruments for studies of long-period microseisms and for
clear detection and resolution of the long-period components of both body and
surface waves from small shocks at very great distances. Magnification e-
quations and theoretical magnification curves show that extremely high sensi-
tivities for desired periods and low sensitivities for undesired periods can be
obtained by combining one or more filter galvanometers in seismograph sys-
tems, varying the damping constants and natural periods of the components,

and varying the coupling between the components. Also, by proper choice of instrument parameters, undesired periods can be rejected without appreciable modification of the seismograph magnification for periods outside the rejection band. — Authors' abstract

181-143. Bryunelli, B. Ye., and Alekseyev, V. V. Seysmopriyemnik s obratnoy svyas'yu [A seismic receiver provided with a reverse coupling]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 5, p. 748-751, 1959.

A system consisting of a seismic receiver and an amplifier containing elements of a negative reverse coupling (called a negative feed back in radio) is investigated. Theoretical and experimental investigations of this system show the possibility of transforming a seismic receiver into an instrument for measuring acceleration. Such an accelerometer has a wide range of frequencies. In the experiments described, frequencies from 6 to 300 cycles per second could be measured. This range can be further extended to 1 cycle per second. A great advantage of the system is the linearity of its recording over a wide range of frequency; this is achieved by increasing the damping of the instrument. The proposed system (receiver and amplifier) can be used not only in building seismic receivers but also in many other branches of geophysics and in engineering. — S. T. V.

181-144. Pasechnik, I. P., and Fedosenko, N. Ye. Opyt modernizatsii seysmografov tipa SVK i SGK [Experience in modernizing the type SVK and SGK seismographs]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1853-1860, 1959.

The vertical and horizontal SVK-M and SGK-M seismographs are improved models of the SVK and SGK types. The magnetic system is spherical, and the flat coils are cylindrical. It is shown that these new seismographs can produce well defined seismic records at epicentral distances over 7,000 km for earthquakes of intensity M = 5, and over 2,600 km for those with M = 4. The unimproved models cannot register earthquakes of M = 4 having epicentral distances more than 600 km. — A. J. S.

181-145. Obukhov, V. A. Laboratornyy seysmoskop vysokoy chuvstvitel'-nosti LS-1 [The LS-1 laboratory seismoscope of high sensitivity]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 11, p. 1625-1635, 1959.

The construction and principles of operation of the laboratory seismoscope LS-1 are described. Its amplification of 2.8×10^6 assures high sensitivity and makes it possible to model waves of weak intensity as, for example, diffracted waves. The electric impulse is amplified to 1,200 v. The instrument is adapted for use at frequencies ranging from 4 to 310 kc per second. Time marks can be recorded at intervals of 2μ sec; also larger time intervals (10 and 50μ sec) can be marked on the seismograms thus improving the accuracy of time recordings. — S. T. V.

EARTH TIDES AND RELATED PHENOMENA

181-146. Bernard, Pierre. Sur le bilan mécanique de l'influence solaire sur les phénomènes terrestres [On the mechanical balance of the solar influence on terrestrial phenomena]: Acad. Sci. [Paris] Comptes Rendus, v. 250, no. 15, p. 2738-2739, 1960.

Recent high precision measurements of the earth's rotation show a maximum length of day somewhat later than a maximum of solar activity. Varia-

tions of geomagnetic perturbations and of microseismic activity also show an 11-yr period with a maximum during the waning phase of the solar activity cycle. A simple mechanical relationship is suggested between each of these phenomena and the earth's rotation.

Calculations show that the mechanical effect of rotation on the exosphere, and therefore on geomagnetic perturbations, is too small by a factor of 5,000 to be noticeable. The effect on the atmosphere as a whole, however, is to create meteorological conditions that are reflected in microseismic activity. The explanation of the effect of solar activity on the earth's rotation, there-fore, should take meteorological phenomena into account. — D. B. V.

181-147. Fedorov, E. [Ye.] P. Researches on the nutation in connection with some problems of the constitution of the earth: Bur. Central Séismol. Internat. Pubs. , Sér. A, Travaux Sci. , no. 20, p. 255-259, 1959.

Some conclusions concerning the interaction between the earth's core and shell are drawn from the study of nutation. The discussion is confined to the main and fortnightly terms in the nutation. First, a theoretical expression is derived for the action between shell and core, assuming that no relative mo-tion of the core with respect to the shell is possible. This expression shows that in vector representation, the couple acting on the shell consists of two components, one due to the main term and one to the fortnightly term; each of these in turn can be resolved into two vectors ($\bar{U}_1$ and $\bar{U}_2$ and $\bar{V}_1$ and $\bar{V}_2$, re-spectively) rotating in opposite directions in space, but clockwise with differ-ent velocities relative to the earth itself.

Taking into account the actual motion of momentum, it is shown that the magnitude of the vector $\bar{U}_1$ inferred from observational data is larger than for a rigid core, that the direction of the vector $\bar{V}_1$ is opposite to that for a rigid core, and that the vectors due to the main term in the nutation are turned clockwise (that is, in the direction of rotation of these vectors relative to the earth), which could be the result of friction at the core boundary (see also Geophys. Abs. 180-79). — D. B. V.

181-148. Stoyko, N[icolas]. Periodicheskiye i sluchaynyye variatsii vrash-cheniya Zemli [Periodic and nonperiodic variations in the earth's rotation]: Astron. Zhur. , v. 36, no. 5, p. 938-943, 1959.

A comparison of cesium atomic frequency standards with the earth's time shows unsystematic changes during the last 3 years. The length of the day decreased by 2×10^{-5} sec per month for the period from June to November 1955, and increased from December 1955 to May 1957 by an average of 4×10^{-5} sec per month. The length of the day has remained constant since May 1957. An analysis of the data on latitude variation for 1952-58 resulted in the following formula for seasonal corrections:

$$S(52-58) = 0^s0240 \sin (j-31. 2) + 0^s0072 \sin 2(j+69. 7)$$
where j is in mean days, beginning from January 1. — A. J. S.

181-149. Markowitz, W[illia]m. Izmeneniye skorosti vrashcheniya Zemli. Rezul'taty, poluchennyye c lunnoy kameroy i fotograficheskimi zenitnymi trubami [Variation in the rate of the earth's rotation. Results obtained with a lunar camera and photographic zenith tele-scopes]: Astron. Zhur. , v. 36, no. 5, p. 949-958, 1959.

A comparison of observations using a photographic zenith telescope (FZT) with the time obtained from a quartz clock (1951-55) and a cesium frequency standard (1955-58) indicate that seasonal latitude variations remained the same during the successive years of observation. Lunar tidal inequalities of a per-

iod of 0. 5 month and of 1 month and with an amplitude 0. $^{S}001$ each were discovered. A preliminary value for the Love number K is obtained. — A. J. S.

Danjon, André. On a change in the regime of the rotation of the earth observed in the month of July 1959. See Geophys. Abs. 181-375.

ELASTICITY

181-150.   Ambraseys, N[icholas] N.   On the shear response of a two-dimensional truncated wedge subjected to an arbitrary disturbance: Seismol. Soc. America Bull. , v. 50, no. 1, p. 45-56, 1960.

The present work consists of a theoretical investigation of the shear response of a truncated two-dimensional elastic wedge subject to an arbitrary disturbance.   Expressions are derived for the deflections and shears which develop in the wedge owing to an imposed time-dependent disturbance.   The frequencies of the wedge are derived for the six first modes of oscillation and are given graphically for different degrees of truncation for the one- and two-dimensional cases. The solution derived is applicable to earthquake engineering problems, in particular to those dealing with the seismic stability of earth dams and embankments.   The concept of strong ground-motion spectra is introduced, and its advantages and limitations are discussed briefly. — Author's abstract

181-151.   Spencer, T. W.   Two dimensional problems: Jour. Geophys. Research, v. 63, no. 3, p. 637-643, 1958.

The response of a system consisting of two elastic half spaces in contact at a plane interface has been investigated mathematically for different types of line sources.   The first is a line source of circular cross section (a cylinder extending to infinity in both directions); in the second, the source function is directly related to stress variation at the source (rectangular cross section of width 2 h and height 2 ϵ, where ϵ approaches 0). It is found that within the critical angle, the first compressional arrival from the interface is the reflected compressional wave; outside the critical angle, the first compressional arrival is the refracted wave, which travels in the lower medium with the compressional velocity.   The time function characterizing the reflected arrival is approximately equal to the derivative of the time function characterizing the refracted arrival.
At angles of incidence exceeding the critical angle, both the reflected compressional wave and the wave converted to transverse type upon reflection possess forerunners; these merge with the refracted arrivals in a continuous manner so that the beginning of reflection events may be quite diffuse. — D. B. V.

181-152.   Rosenbaum, J. H.   The long-time response of a layered elastic medium to explosive sound: Jour. Geophys. Research, v. 65, no. 5, p. 1577-1613, 1960.

The long-time response of a layered elastic medium is considered for the particular case of a point-source explosion in a liquid layer lying above an infinitely deep liquid bottom. An asymptotic solution, valid for large values of the time variable, is obtained; it expresses the response in terms of harmonic vibrations of the liquid layer.   Special emphasis is placed on those vibrations which correspond to waves with small angles of incidence and which, because of radiation into the bottom, decay exponentially with time.   However, the well-known guided-wave phenomenon, first discussed by Pekeris [see Geophys. Abs. 135-10569] in 1948, is also included in the present formulation.

A detailed presentation is made of the method of analysis. This method is applicable to more complicated problems of direct geophysical interest. Numerical results are presented for some typical examples, the behavior of the phase velocity for the lower modes being of particular interest. — Author's abstract

181-153. Davydov, B. I. Physical properties of solids at high pressures: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 323-332, 1959.

This is an English version of the paper published in Akad. Nauk SSSR, Izv. Ser. Geofiz., no. 12, p. 1411-1418, 1956 (see Geophys. Abs. 169-194). —— D. B. V.

181-154. Press, F[rank]. Remarks on refraction arrivals from a layer of finite thickness: Jour. Geophys. Research, v. 63, no. 3, p. 631-634, 1958.

In order to arrive at any conclusion regarding the character of a refraction arrival through a layer of finite thickness, one must consider the result obtained by superimposing all the waves that have been reflected at nearly grazing incidence. Some qualitative information about the character of the refracted arrival can be obtained by requiring that the refracted and reflected waves interfere constructively. One of the more sophisticated procedures is to take the formal integral solution and expand the integrand in such a way that each term can be associated with one of the reflection events in the upper layer. Instead of getting a series of pulses corresponding to the maximums of the group velocity curves for the total system, one gets a superposition of more or less continuous oscillations whose beginning is governed by the condition for constructive interference within the layer.

By using the condition of constructive interference, one can get an approximate idea of what frequencies must be detected in order to determine the velocity in a given layer to within prescribed limits; for instance, to determine velocity to ±1 percent in a layer 100 feet thick, it would be necessary to detect frequencies in the neighborhood of 500 cycles per second. — D. B. V.

181-155. Knopoff, L[eon], Gilbert, F[reeman], and Pilant, W. L. Wave propagation in a medium with a single layer: Jour. Geophys. Research, v. 65, no. 1, p. 265-278, 1960.

The P- and SV-motions excited in a uniform medium with a single layer by means of a single isolated impulsive force directed normal to the upper surface are studied by methods previously considered for the SH-case (see Geophys. Abs. 180-87). The propagation of P- and SV-motions in a layer can be represented as the sum of contributions from an infinite set of images of the source taken in the two boundaries. A seismic model is set up to demonstrate the features of the wave propagation. The Rayleigh wave train lengthens as epicentral distance increases.

The other important events are the refracted P- and S-pulse groups, each of which lengthens with increasing epicentral distance. The duration and the envelope of the refracted P- and S-events are features not heretofore anticipated; their existence is verified by a theoretical investigation based on a quantitative ray theory. An experimental technique for directly determining group velocity in a layered model is presented. The results of the seismic model agree with the theoretical values. — D. B. V.

181-156. Pod"yapol'skiy, G. S. Razprostraneniye uprugikh voln v sloistoy
          srede. I [The propagation of elastic waves in a stratified med-
          ium, Part 1]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 8, p. 1103-
          1113, 1959.

The propagation of elastic waves through a stratified medium is discussed.
The problem is limited to finding a wave field in the case of a single ele-
mentary wave. The method of functional-invariant solutions, suggested in
1953 by Smirnov and Sobolev for homogeneous media, is used and is extended
to the case of stratified media consisting of several flat homogeneous isotro-
pic elastic strata. The potential theory is used in vectorial form; the expres-
sion for the potential function of an elementary wave in the case of a two di-
mensional medium is found first. Introducing a complex variable, equations
for a number of characteristic curves for a three dimensional case are ob-
tained. — S. T. V.

181-157. Pod"yapol'skiy, G. S. Razprostraneniye uprugikh voln v sloistoy
          srede. II [The propagation of elastic waves in a stratified medi-
          um, Part 2]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 9, p. 1265-
          1277, 1959.

This is the continuation of a study on an arbitrary elementary wave propa-
gating through a stratified medium (see Geophys. Abs. 181-156). As has been
shown by Smirnov and Sobolev, the solution of the equations of the theory of
elasticity in an homogeneous and isotropic medium in the case of axial sym-
metry can be obtained by the method of superposition of the corresponding so-
lutions found for the two-dimensional case, using a formula that involves sca-
lar potential functions for the three-dimensional and the two-dimensional case.
Further treatment is based on the theory of functions of complex variables.
Precise solutions are obtained at different points of an elementary wave in the
form of contour integrals. Introducing certain transformations into the pre-
cise solution, it is possible to obtain an approximate expression for the dis-
placements. — S. T. V.

181-158. Honda, Hirokichi. The elastic waves generated from a spherical
          source: Tohoku Univ. Sci. Repts., ser. 5, v. 11, no. 3, p. 178-
          183, 1960.

The particle motions of P- and S-waves at great distances from a source
in which the normal as well as the tangential forces vary with colatitude and
longitude and act on the inner surface of a spherical cavity in an infinite elas-
tic solid are analyzed by means of operational calculus. The assumed forces
are considered to represent a model of earthquake mechanism.
   The results show that the amplitude factor of the predominant first motion
of the S-waves is larger than that of the P-waves, and that the S-wave period
is longer. — D. B. V.

181-159. Yanovskaya, T. B. K voprosu ob issledovanii dispergiruyushchikh
          poverkhnostnykh voln v okrestnosti minimuma gruppovoy skorosti
          [On the problem of investigation of dispersive surface waves in the
          neighborhood of the group velocity minimum]: Akad. Nauk SSSR
          Izv. Ser. Geofiz., no. 12, p. 1753-1760, 1959.

An asymptotic expression for displacements in dispersive surface waves is
derived for a sufficiently broad neighborhood of the group velocity minimum.
The accompanying mathematical analysis shows that both the expression for

the Airy phase and the one obtainable by the method of stationary phase are included in the formula derived. The first term correction formula is given for the derived expression and checked for various amplitudes of the waves recorded on seismograms in the proximity of the group velocity minimum. It was found that the curve of group velocity versus period does not satisfy the dispersion law used for the interpretation of group velocities of surface seismic waves. This leads to the conclusion that the existing methods of interpretation of velocities should be revised when they approach the minimum of group velocity. — A. J. S.

181-160. Oguchi, Yuko. Reflection of elastic waves at a solid-fluid boundary (1)—On the case of SH-waves [in Japanese with English summary]: Tokyo Univ. Geophys. Inst. Geophys. Notes, v. 12, no. 2, contr. 17, 1959.

This paper was published originally in Zisin, ser. 2, v. 11, no. 4, p. 165-179, 1958 (see Geophys. Abs. 179-122). — D. B. V.

181-161. Verma, R. K. Elasticity of some high-density crystals: Jour. Geophys. Research, v. 65, no. 2, p. 757-766, 1960.

The adiabatic elastic constants of two garnets, synthetic spinel and rutile, and olivine are reported. The stiffness constants C_{pq} were determined from the velocities of acoustic wave propagation in crystals. The velocities of wave propagation were measured by McSkimin's method. A frequency range of 6-12 megacycles per sec was used. — D. B. V.

181-162. Mann, R. L., and Fatt, I. Effect of pore fluids on the elastic properties of sandstone: Geophysics, v. 25, no. 2, p. 433-444, 1960.

Bulk compressibility, Young's modulus, and Poisson's ratio were measured on both dry and water-saturated samples of Berea, Boise, and Bandera sandstone. Bulk compressibility of wet sandstone was 10-30 percent greater than for dry, Young's modulus was 8-20 percent less for wet than for dry, and Poisson's ratio was 100 percent greater on one sandstone when wet but only slightly greater or about the same on wet samples of the others. The great effect of water on the elastic moduli of sandstone is attributed to high clay content. — D. B. V.

181-163. Band, William. Studies in the theory of shock propagation in solids: Jour. Geophys. Research, v. 65, no. 2, p. 695-719, 1960.

In part 1 a permanent-regime solution of the equations of motion of a shear-yielding solid is presented for a single-parameter visco-elastic model, and some theoretical profiles of shocks in a number of metals are developed. In part 2 a general theory of the anelasticity of solids is applied to the theory of small-amplitude waves, that is, the linear approximation to the equations of motion. In part 3 the results are applied to the nonlinear equations of motion, and the profiles of permanent-regime or steady-state solutions are investigated under various conditions.

It is suggested that actual explosive-induced shocks may tend toward the permanent-regime profiles with propagation through attenuating material, and that the next step in theory must be to attempt a perturbation treatment of the nonlinear equations for the difference between actual and permanent-regime profiles. — D. B. V.

181-164. Subbarao, K., and Rao, B. Ramachandra. A simple method of determining ultrasonic velocities in rocks: Nature, v. 180, no. 4573, p. 978, 1957.

A simple, rapid, and sufficiently accurate method of determining ultrasonic velocities in rocks, based on the principle of the critical angle, is described briefly. A narrow beam of ultrasonic waves strikes the rock section immersed in a liquid at right angles to its axis of rotation, and the critical angles for total reflection of the longitudinal and transverse waves set up in the section are determined experimentally. Knowing these angles and the velocity in the liquid, the velocities of the ultrasonic waves can be computed.

Results of measurements on khondalite, shale, sandstone, red ochre, talc chlorite schist, chalk, and kaolin are tabulated. — D. B. V.

181-165.   Shumway, George.   Sound speed and absorption studies of marine sediments by a resonance method, Pt. 1: Geophysics, v. 25, no. 2, p. 451-467, 1960.

Laboratory measurements of compressional sound speed and absorption have been made on 111 samples of unconsolidated marine sediments ranging from shallow-water sands to deep-sea clays.   Frequencies of 20-37 kc were used.   At room temperature velocities ranged from 1.474 kmps (medium red clay) to 1.785 kmps (medium sand).   More than one-third of the values are lower than the value for sea water alone.   Variations in velocity are caused by porosity; rigidity, which appears to be related to the abundance of coarse grains; pressure; temperature; and compressibility of the aggregate, determined from the compressibilities of individual minerals.

Sound absorption ranged from 0.5 db per m for medium clay (28.4 kc) to about 20 db per m for silts and fine sands (30-37 kc). Maximum absorption occurs in sediments of intermediate porosity (0.4-0.6) and grain size (0.031-0.25 mm).   Absorption values and the absorption maximum can be predicted from the formula $\alpha = MA_S$, where α is the linear absorption coefficient, M is a frequency-dependent factor related to fraction of grains in mutual contact, and A_S is the computable total acoustically effective grain surface area.

Absorption measurements were made at more than one frequence for 65 samples. Assuming that absorption is directly proportional to frequency raised to a power n, the results indicate an average value of n = 1.79, with a standard deviation of 0.98. — D. B. V.

181-166.   Laughton, A. S., and Stride, A. H.   Velocity of compressional waves for a stratigraphic profile of Chalk at Flamborough, Yorkshire: Nature, v. 180, no. 4593, p. 977-978, 1957.

A laboratory determination was made of the compressional wave velocity in 30 samples from 12 stations distributed throughout the stratigraphic section of the Chalk (Cenomanian-Senonian) at Flamborough, Yorkshire, England. The results presented graphically, show that velocity increases linearly with depth from a little more than 3 kmps to almost 5 kmps; the velocity gradient is about 5 sec^{-1}.   These values are considerably higher than those given for the Chalk in other parts of England but are comparable to those in northwest Germany. — D. B. V.

181-167.   Davydova, N. I.   On zavisimosti amplitud prodol'nykh golovnykh voln svyazannykh s tonkimi sloyami, ot skorostnoy differentsiatsii sred [The dependence of amplitudes of longitudinal head waves, related to thin layers, upon the velocity difference of the media]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 5, p. 658-668, 1959.

Longitudinal head waves produced in a thin rigid layer floating on water were investigated experimentally.   Sheets of duralumin, plexiglass, textolite, and ebonite were used as the rigid layers. The thicknesses of the sheets were

so selected that they were less than $\frac{1}{4}$ the wavelength. The amplitude of these waves is strongly affected by the ratio $\delta = a_1/a_2$, where a_1 is the seismic velocity of the covered medium and a_2 is that of the refracting layer. The amplitudes reach a maximum with $\delta = 0.6$, whereas at $\delta = 0.29$ or $\delta = 0.76$ they are much smaller. These results are in agreement with Gamburtsev's formulas for this relationship. They also confirm theoretical computations as well as experimental results of Yepinat'yeva (see Geophys. Abs. 160-83, 161-93, 163-94). In Davydova's experiments, impulses were produced and the recording of head waves made by an ultrasonic seismoscope, as in the experiments of Riznichenko (see Geophys. Abs. 153-14479). The results of the experiments are presented on several tables and graphs. — S. T. V.

181-168. Volarovich, M. P., Balashov, D. B., and Stakhovskaya, Z. I. An investigation of elastic properties of rocks at high pressures: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 277-287, 1959.

This is essentially a summary of the results of experiments described in papers published in the Akad. Nauk SSSR, Izv. Ser. Geofiz., no. 3, p. 319-330, 1957; ibid., no. 5, p. 582-592, 1958; and in the Akad. Nauk SSSR Soveshch. Ekspt. i Tekh. Mineralogii i Petrografii, 5th, Leningrad, 1956, Trudy, p. 137-145, 1958 (see Geophys. Abs. 170-86, 175-91, and 178-106). — D. B. V.

181-169. Parkhomenko, E. I. Issledovaniya triboelektricheskogo effekta gornyk porod i nekotorykh dielektrikov dinamicheskim metodom [Investigations of the triboelectric effect in rocks and in certain dielectrics by the dynamic method]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 1, p. 55-62, 1960.

Samples of marble, syenite, labradorite, basalt, and some typical man-made dielectrics were tested for triboelectric effect in an attempt to find a possible explanation of the anomalous electromagnetic field arising from passage of elastic waves through rocks during earthquakes. Several oscillograms obtained during the test indicate intensive electric oscillations in the rock during passage of elastic waves. Labradorite, syenite, and basalt showed only very small oscillations as compared with marble. This is probably due to the conductivity of these three rocks being much higher than that of marble. No quantitative evaluation of the phenomenon is given in the paper. — A. J. S.

181-170. Shamina, O. G. Zavisimost' zatukhaniya impul'sov v sloyakh konechnoy tolshchiny ot chastotnykh spektrov [Relationship of impulse attenuation in layers of finite thickness to the frequency spectrums]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 1, p. 151-154, 1960.

The results of special model experiments to determine the absorption coefficients of P-waves in a finite layer by the impulse ultrasonic method are reported. Frequency analysis of impulses of equal duration, propagating in layers of finite thickness and having the same predominant frequency but different form, showed that the wider the spectrum of the impulse in the region of lower frequencies, the lower the attenuation of its amplitudes. — A. J. S.

181-171. Risnichenko, J. V. [Riznichenko, Yu. V.]. On the application of the ultrasonic pulse method to seismological problems: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 305-309, 1959.

Different types of problems have been studied in the U. S. S. R. by means of the ultrasonic pulse method in which seismic waves are modeled by means of the "seismoscope." Problems of interest to seismic exploration have included direct and surface wave propagation in a two-dimensional half space with the source at various depths; head waves refracted at the boundary of the half space; head waves related to wave guides of higher velocity; and refracted, diffracted, multiply reflected, and other waves. The seismoscope has also been used for modeling waves in the crust and in a spherical earth with central core, and waves from earthquake sources in the form of a dipole with moment.

The ultrasonic pulse method has proved more effective in studies of elastic properties of rocks than that of continuous vibrations. A special seismoscope has been developed for seismic well logging. The method has also been applied successfully in mines to study rock pressure and rockbursts (see also Geophys. Abs. 175-88). — D. B. V.

181-172.   Ivakin, B. N. O modelirovanii nekotorykh geofizicheskikh yavleniy na elektricheskikh setkakh [The modeling of some geophysical phenomena with the aid of electric grid models]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 5, p. 684-692, 1959.

Experiments were made on a model consisting of a two-dimensional electric network capable of simulating a wave motion mathematically. Longitudinal waves were studied here. An electromagnetic sinusoidal or impulse wave can be produced in the model by a special generator. Grounding one pole of the generator and connecting the other with the reactance element, it is possible to produce an electric voltage in the model corresponding in nature to a mechanical force. If a certain amount of potential energy is accumulated in the model, it is possible to produce a model of a seismic wave. The energy of the waves propagating in different directions from the "epicenter" can be estimated. It is also possible to simulate a rupture in an absorbing medium, to produce a plastic destruction of the rupture line, and to produce a multiple rupture followed by oscillations. Different possibilities of simulating electromagnetic phenomena are discussed in the second portion of the article. This work is a continuation of previous studies by Ivakin (see Geophys. Abs. 168-63, 176-82) and other Russian seismologists. — S. T. V.

181-173.   Angona, F. A.   Two-dimensional modeling and its application to seismic problems: Geophysics, v. 25, no. 2, p. 468-482, 1960.

Laboratory seismograms of a fault model demonstrate the mechanism for diffraction and clearly show the difference in amplitude decay and moveout between a reflection and a diffraction. The inverted order and the deflection to the side of reflected energy from a curved reflector with a buried focus is demonstrated. A comparison is made of seismograms from a simple fault model and from one combining a fault with curved reflectors leading to it. The curved surfaces increase the overlap of the reflected events and mask the fault. Modeling techniques, involving the control of the reflection coefficient between layers by thickness variations and the control of the propagation velocity through a layer by combining two or more materials into a laminated sheet, are demonstrated. — Author's abstract

181-174.   O'Brien, P. N. S.   Seismic energy from explosions: Royal Astron. Soc. Geophys. Jour., v. 3, no. 1, p. 29-44, 1960.

For underwater explosions it is shown that the amplitude of the first arrival of the ground wave should be proportional to $W^{2/3}$, where W is the charge

weight; also that its frequency content should be independent of W. Of the total chemical energy of the explosive it is estimated that about 3 percent is available in the frequency range 0-100 cycles per second.

For underground explosions it is postulated that the radiated pressure pulse begins to obey infinitesimal strain theory once its impulse per unit area has decreased below a limiting value. This value is constant for a given rock type. From this it follows that the seismic amplitude should usually be directly proportional to W. But for high frequencies or very large charges it should become proportional to $W^{1/3}$.

These predictions are compared with observational data, both original and those previously published. They agree well for underground explosions. For underwater explosions the data are themselves inconsistent and more are needed. — Author's summary

181-175.   Rocard, Yves.   Sur les signaux séismiques de courte période obtenus lors du test nucléaire de Reggane, le 13 fevrier 1960 [On the short-period seismic signals obtained at the time of the Reggane nuclear test, February 13, 1960]: Acad. Sci. [Paris] Comptes Rendus, v. 250, no. 11, p. 2041-2042, 1960.

The French nuclear explosion near Reggane in the Sahara on February 13, 1960, was monitored by short-period vertical seismographs at various points in the Sahara (2) and in the Orne (3), Morvan (2), and Massif Central (1) in France. At 556 and 686 km the complete sequence of P- and S-waves was very clear. The signals were received less strongly at 2,350 km (in the Morvan) than expected from the results of the Nevada tests. Preliminary results show that seismic waves propagate differently along the Africa-Mediterranean-Europe path than in the North American Continent. — D. B. V.

181-176.   Rocard, Yves.   Sur les signaux séismiques de longue période obtenus lors du test nucléaire de Reggane, le 13 fevrier 1960 [On the long-period seismic signals obtained at the time of the Reggane nuclear test, February 13, 1960]: Acad. Sci. [Paris] Comptes Rendus, v. 250, no. 12, p. 2244-2246, 1960.

The French nuclear explosion near Reggane in the Sahara on February 13, 1960, was monitored by long-period seismographs at El Goléa, Algeria, (556 km away, on sand) and at Tamanrasset, Algeria (686 km away, on granite). Each station was equipped with three long-period instruments having a natural period of 30 sec and nearly critical damping.

A surface wave corresponding very closely to a theoretical Rayleigh wave from an impulse source was recorded at El Goléa; at Tamanrasset only the vertical component was observed. This wave was not propagated across the Mediterranean Sea; no signals were received at a similarly equipped station in France, 2,500 km from the source. — D. B. V.

ELECTRICAL EXPLORATION

181-177.   Belluigi, A[rnaldo].   Neue Theorie für elektrische Sondierungen [New theory of electric soundings (with English summary)]: Zeitschr. Geophysik, v. 25, no. 3, p. 113-142, 1959.

In connection with a theory proposed in 1957 (see Geophys. Abs. 174-111), Belluigi here develops a new theory presented in three parts for electric soundings in a ground in which conductivity is a function only of depth and the

subsurface is infinitely conductive or insulating.   In the first part the distribution of electric potential on the surface of an isotropically conductive ground, with direct current fed through a point electrode at a distance r from the observation point, is analyzed as a function of depth.   The formulas developed are then generalized for n layers.   In the second part the results obtained from calculation of the electric potential by means of the power series of Kelvin functions of the order K_0, corresponding to eight cases frequently encountered in practice, are summarized. The third part concerns some properties of the surface potential where the subsurface contains one or more thin, very conductive or strongly insulating layers. — D. B. V.

181-178.   D'yakonov, B. P.   Difraktsiya elektromagnitnykh voln na kruglom tsilindre v odnorodnom poluprostranstve [The diffraction of electromagnetic waves at a circular cylinder in a homogeneous half space]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 9, p. 1332-1343, 1959.

The purpose of the present study is to find a solution to the problem of the diffraction of electromagnetic waves at a cylindrical inclusion located in a homogeneous half space.   The waves are produced by a source located either in the air or on the surface of the ground.   Both the ground and the cylinder are homogeneous and isotropic.   The cylinder is buried in the ground, and its axis is parallel to the surface.   The problem can be reduced to the solution of a wave equation with boundary conditions and conditions at infinity given in the problem.   As the final result, an infinite algebraic system of equations is obtained.   This solution yields only a formal value.   The final numerical solution must be determined for each case from the given conditions. — S. T. V.

181-179.   Tikhonov, A. N., Shakhsuvarov, D. N., and Rybakova, Ye. V.   O razreshaynshchey sposobnosti metoda elektricheskogo zondirovaniya pri nalichii promezhutochnykh neprovodyashchikh plastov [The resolving power of the method of electric profiling in the case of occurrence of intermediate nonconducting strata]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 10, p. 1455-1459, 1959.

Where a nonconducting layer is present in a geologic section, alternating electromagnetic fields may be used to probe structures shielded by the layer. If the nonconducting stratum is of small thickness, it affects neither the amplitudes nor the phase angles of the vertical component B_z of the magnetic field. If the stratum is of sufficient thickness, it affects the B_z vector strongly; therefore, changes in the amplitude and the phase of B_z make it possible to determine its thickness and in some cases its boundary with the underlying formation.   Where the shielding stratum is multilayered and of sufficient thickness, it may be assumed as an approximation to be a homogeneous layer, although this assumption may result in an erroneous total thickness. A thin nonconducting layer affects the electric field more strongly; the curves of apparent resistivity will have an inclined rather than a horizontal asymptote. The angle of this inclination is dependent on the thickness of the bed and on the parameters of the marker beds. — S. T. V.

181-180.   Matveyev, B. K., and Shkabarnya, N. G.   Elektroprofilirovaniye nad sharom raspolozhennym vblizi kontakta dvukh sred [Electric profiling over a sphere located near a contact of two media]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 10, p. 1492-1499, 1959.

The problem of the disturbance produced in an electric field by a sphere buried near the plane boundary of two media with different electric properties is analyzed, and an approximate solution is presented. A conductive sphere produces more pronounced anomalies of apparent resistivity than does a nonconductive sphere. Anomalies are better observed when the electric profiling is made with an asymmetric three electrode arrangement. The formulas derived can also be used in estimating the effect of caverns, sinkholes, and other such features. — S. T. V.

181-181. Chetayev, D. N. O reshenii obratnoy zadachi teorii elektromagnitnykh zondirovaniy [On the solution of the inverse problem of electromagnetic sounding]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1864-1866, 1959.

A mathematical treatment of the inverse problem of the theory of electromagnetic sounding is given and is applied to an analytical interpretation of data obtained from such soundings. The problem treated reduces to the solution of the Cauchy problem for a dynamic system described by an infinite system of ordinary differential equations of the first order given in the paper; it is further reduced to an asymptotic series rigorously analyzed for its convergence. — A. J. S.

181-182. Svetov, B. S. Nekotoryye rezul'taty model'nykh issledovaniy po induktivnomu metodu [Some results of modeling investigations by the induction method]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 1, p. 115-125, 1960.

The results of a series of modeling experiments and of theoretical study of quasi-stationary electromagnetic fields with respect to their frequency and amplitude-phase characteristics associated with an anomalistic field, and their relation to the form, location, and position of the disturbing ore body, the kind of the field source, and other factors are reported. It was found that the frequency and phase characteristics of anomalistic fields caused by conducting bodies can be expressed in terms of their parameters, independently of the form of the cross section of the body. This allows interpretation of geophysical anomalies of bodies of arbitrary cross section, without assuming a particular form. Determinations of anomalistic parameters from the frequency characteristic of the anomaly and from measurements of amplitude and phase at a fixed frequency are found to be equally reliable. Multifrequency amplitude-phase measurements are to be used in detailed exploration of the anomalies and where the ore body is complex. — A. J. S.

181-183. Gasanenko, L. B. K voprosu o svyazi mezhdu komponentami elektromagnitnogo polya vertikal'nogo garmonicheskogo magnitnogo dipolya nad gorizontal'no-sloistoy strukturoy [On the problem of the relationship between electromagnetic field components of a vertical harmonic magnetic dipole over a horizontally layered structure]: Leningrad Univ. Uchenyye Zapiski, v. 249, no. 10, p. 37-44, 1958.

Gasanenko demonstrates mathematically that because of their axial symmetry, the relationships existing between components of the electromagnetic field of a vertical magnetic dipole can be applied for verification of theoretical and experimental radial profiles over a medium consisting of homogeneous isotropic layers separated by horizontal boundaries, and also for determination of the vertical field component when the distance (h) to the point of measurement is small compared with the distance between the electrodes. — A. J. S.

181-184. Gasanenko, L. B., and Molochnov, G. V. Elektromagnitnoye pole gorizontal'nogo magnitnogo dipolya nad gorizontal'no-sloistoy strukturoy [Electromagnetic field of a horizontal magnetic dipole over a horizontally layered structure]: Leningrad Univ. Uchenyye Zapiski, v. 249, no. 10, p. 45-62, 1958.

The electromagnetic field induced in a layered medium by a horizontal harmonic magnetic dipole is analyzed mathematically. A vertical induction frame whose dimension is considerably smaller than the distance to the point of observation is used as the field source. A horizontal magnetic dipole having a moment varying harmonically is treated, and an equation for its vector-potential components is derived. A solution is given for the effect of a homogeneous and of a layered conducting medium, under the condition that the normal (undisturbed) field over the half space has been previously determined and expressed in the Descartes system of coordinates. The parameters of a conducting layer over a nonconducting basement, as used in the formulas derived, are tabulated and expressed graphically. — A. J. S.

181-185. Geier, S. Die Berechnung von geoelektrischen Modellkurven bei beliebiger Elektroden-Anordnung auf horizontal geschichteten Medien [The calculation of geoelectric model graphs for any electrode configuration on horizontally layered mediums]: Zeitschr. Geophysik, v. 24, no. 4/5, p. 326-331, 1958.

Flathe's method of calculating geoelectrical model graphs (see Geophys. Abs. 163-69) is applied to calculation of the potential for the case of horizontally stratified mediums for any electrode configuration. — D. B. V.

181-186. Kolbenheyer, Tibor. Über die Randwertaufgabe der Geoelektrik für ein dreiachsiges Ellipsoid [On the boundary value problem of geoelectric surveying for a triaxial ellipsoid (with Russian summary)]: Československá Akad. Věd Geofys. Sborník, no. 93, p. 363-400, 1958.

A solution is derived for the potential distribution in the case of a triaxial ellipsoid of uniform specific conductivity (σ_2) surrounded by a medium of uniform conductivity (σ_1) when direct current is supplied at any point inside or outside (but not on the surface of) the ellipsoid. The solution is developed in the form of a series of Lamé coefficients. Some simple special cases are calculated, using a semiellipsoidal model suitable for an eroded lens, a basin or (approximately) a syncline when the current source is on the earth's surface. — D. B. V.

181-187. Vendel'shteyn, B. Yu. Analiz rezultatov eksperimental'nogo issledovaniya diffuzionno-adsorbtsionnykh potentsialov [Analysis of the results of an experimental study of diffusion-adsorption potentials]: Vyssh. Ucheb. Zavedeniy Izv., Neft' i Gaz, no. 2, p. 9-15, 1959.

Vendel'shteyn suggests that the diffusion-adsorption potential arises from a change of the Hittorf number in the capillaries of the rock. Assuming the adsorbed anions to be immobile, and considering the concentration and mean effective mobilities of cations and anions within the pore volume, a formula for diffusion-adsorption potential at the boundary between two layers can be derived. The accuracy of the formula suffers, however, from the unknown effect of the concentration of the external electrolyte (outside the capillaries), as this effect cannot be taken into account in the formula. — A. J. S.

181-188. Gruntorad, Yan. Elektricheskoye pole polyarizovannykh provodni-
          kov v odnorodnykh i neodnorodnykh sredakh [Electric field of po-
          larized conductors in homogeneous and heterogeneous media]:
          Leningrad Univ. Uchenyye Zapiski, v. 249, no. 10, p. 134-156,
          1958.

The combined effect on the natural electric field of a set of polarized con-
ductors in uniform and nonuniform media was studied in the laboratory. The
experiment was carried out in a water tank 1. 5 X 1. 5 X 0. 8 m, and aluminum
plates 35 X 25 X 0. 2 cm were used as models of the polarized layers. The
upper edges of the plates were covered with an electrolytically deposited cop-
per layer, which created a potential jump of 500 mv in the water. Seven se-
ries of the potential curves with various combinations of the model are given.
The conclusion is reached that the method of natural electric field must be
complemented by the resistivity method to obtain a reliable interpretation of
data on the geology of deposits that consist of several conducting bodies im-
bedded in homogeneous or nonhomogeneous media. — A. J. S.

181-189. Stefănescu, Sabba S. Über die magnetische Wirkung einiger heter-
          ogenen Medien in der elektrischen Bodenforschung [On the mag-
          netic effect of some heterogeneous mediums in electrical investi-
          gation of the ground]: Zeitschr. Geophysik, v. 24, no. 4/5, p.
          175-183, 1958.

Calculation of the magnetic field induced at the earth's surface by the flow
of an electric current through a heterogeneous ground is attended by consider-
able mathematical difficulties. A simple theorem shows that this calculation
is easily carried out for the vertical magnetic component in the case of direct
current and a plane surface, if the magnetic field is known in the whole space
composed of the lower half space together with the half space symmetrical
with it with respect to the ground surface.
Using this theorem, the vertical magnetic component produced by direct
current introduced through point electrodes is calculated for the cases where
the ground consists of a series of vertical layers and where the ground is a
special "α medium," in which the surfaces of equal conductivity α = constant
are orthogonal and symmetrical with respect the surface Z = 0. — D. B. V.

181-190. Bordovskiy, V. P. Vychisleniye koeffitsientov dipol'nykh ustano-
          vok pri krivolineynom zondirovanii [The determination of the co-
          efficients of dipole arrangements in the case of curvilinear pro-
          filing]: Razvedochnaya i Promyslovaya Geofizika, no. 24, p. 24-
          27, 1958.

The dipole electrode arrangements of electric surveying have a great ad-
vantage over a symmetric arrangement; namely, they make probing possible
over curvilinear profiles, thus avoiding swamps and similar obstacles. The
coefficients of these dipole arrangements are usually computed by rather com-
plex, time consuming formulas. Bordovskiy suggests a method of an appro-
priate determination of these coefficients. The coefficient K of the dipole ar-
rangement is introduced as the product K = $K_1 K_2$. The value of K_1 is equal
to $[R^3/(AB)(MN)]10^{-3}$. AB is the length of the input line, MN is the length of
the measuring line, and R is the distance between the centers of the input and
the measuring lines. The factor K_2 is determined by a special alinement chart.
The article contains several graphs and three alinement charts to be used in
radial and parallel arrangements of electrodes. — S. T. V.

181-191. Tikhonov, A. N., and Dmitriyev, V. I. O vozmozhnosti primene-
niya induktsivnnogo metoda aeroelektrorazvedki dlya geologiche-
skogo kartirovaniya [On the possibility of application of the in-
duction method of airborne electrical surveying for geologic map-
ping]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 10, p. 1481-1485,
1959.

Determination of the characteristics of alluvium from measurement of the
vertical component of the magnetic field at various frequencies is discussed.
Two cases are presented in detail: (1) when the resistivity of the alluvium is
considerably less than that of the underlying rock, and it is possible to treat
the problem as a conductive stratum spread on an insulating foundation; and
(2) where the alluvium is very thin (as compared with the length of the wave)
and is spread over an homogeneous conductive semispace. The solution of
both cases is given in algebraic form as well as in the form of graphs. —
S. T. V.

181-192. Vladimirov, N. P. O vozmozhnosti ispol'zovaniya yestestvennogo
elektromagnitnogo polya zemli dlya geologicheskoy razvedki [On
the feasibility of utilization of the earth's natural electromagnetic
field for geologic exploration]: Akad. Nauk SSSR Izv. Ser. Geo-
fiz., no. 1, p. 139-141, 1960.

The feasibility of utilization of the short variations (0.3-1,000 c) of the
earth's natural electromagnetic field in geologic exploration is reported.
Magnetoelectric oscillograms were made in the Ryl'sk area of the Kursk Re –
gion where sand-clay deposits are underlain at the depth of 500 m by crystal-
line basement of practically infinite resistivity. The apparent electric resist-
ance ρ_k was determined from the recorded frequencies f, horizontal electric
intensity components E_x and E_y, and the variations of the horizontal magnetic
components H_y and H_x by the following formulas: $\rho_k = (1/5)f(E_x/H_y)^2$, and
$\rho_k = (1/5)f(E_y/H_x)^2$. In spite of relative errors in determination of ρ_k, the
calculated depth to basement was found to be $h = (x/8)(10\rho_1) \approx 0.45$ km as
compared to a depth of 0.5 km determined by other methods. — A. J. S.

181-193. Zagarmistr, A. M., and Berdichevskiy, M. N. Elektrorazvedo-
chnyye raboty metodom telluricheskikh tokov [Electrical explor-
ation operations by the method of telluric currents]: Geologiya
Nefti i Gaza, no. 1, p. 38-47, 1959.

The use of the telluric-current method of exploration in the U. S. S. R. is
reviewed. During 1957 there were 14 field parties and 33 detachments using
this method; an area of 80,000 sq km was covered.
The essence of the method is described. Observations are conducted on
variations in the natural electric field of the earth simultaneously at two points
which can be tens of kilometers from one another. Two mutually perpendicu-
lar short (500 m) measuring lines are used at each point. Anomalies in the
intensity of the field are generally associated with variations in the thickness
and mean resistivity of the sedimentary section overlying the basement; there-
fore, where the sedimentary section is uniform, a contour map of field inten-
sity is a schematic map of the surface of the basement. The depth reached
by this method is 3-5 km. Interpretation of the data becomes complicated
where the section contains carbonates, evaporites, or permafrost.
Examples are presented where the method of telluric currents was used to
map basement or marker horizons in the sedimentary section. Best results
are obtained when the work is supplemented by dipole soundings and by seis-

mic, gravimetric, and aeromagnetic surveys. In many places the results gained from the telluric-current survey appear to be as valuable as those obtained from a seismic survey. — J. W. C.

181-194. Gruntorad, Yan. Sravneniye metodov combinirovannogo profiliro-
         vaniya i profilirovaniya s parallel'nym peremeshcheniyem elek-
         trodov [A comparison of the combination profiling method and the
         method of parallel transposition of the electrodes]: Leningrad
         Univ. Uchenyye Zapiski, v. 249, no. 10, p. 114-133, 1958.

A comparison of the combination profiling method (KP) with the parallel transposition method (PP) was made by laboratory experiments in a tank with a 20-cycle electric current. Seven series of graphs for apparent resistances of the models were obtained. It is concluded that the method of combination profiling is superior to that of parallel transposition in most cases where nonconductive heterogeneities can be disregarded. — A. J. S.

181-195. Enenshteyn, B. S., Skugarevskaya, O. A., and Rybakova, Ye. V.
         Nekotoryye dannyye o zondirovanii metodom stanovleniya elektri-
         cheskogo toka v zemle [Some data on profiling by the method of
         build-up of electric current in the ground]: Akad. Nauk SSSR Izv.
         Ser. Geofiz., no. 10, p. 1486-1491, 1959.

The possibility of obtaining very reliable information on the geology of an area from the curves showing the build-up of current in the ground produced by a d-c impulse is discussed. Instruments with very little inertia are essential, and the electrode spacing in the usual MABN arrangement must be made long enough. A portable d-c impulse generator that gives a sharp step-shaped impulse in about 10^{-3} sec and a d-c amplifier are used. Filters are also necessary for the exclusion of different disturbances as, for instance, the signals coming from radio stations. The described method of prospecting is more economical than the usual electric method with four electrodes. Several wiring diagrams of the apparatus are given. Theoretically computed nomograms for the interpretation of field results must be prepared. — S. T. V.

181-196. Vogler, Gerhart. Die Grenzen der Anwendung von Erdungsmessern
         für Aufgaben in der angewandten Geophysik [The limits of appli-
         cation of ground testers to problems in applied geophysics (with
         English abstract)]: Zeitschr. Geophysik, v. 24, no. 4/5, p. 184-
         196, 1958.

The principles of the electrical ground tester are outlined, and the two types most commonly used in Germany are described; then the results of examination of the accuracy of six ground testers of four different makes (Metrawett, Gossen, Rentsch, and Siemens) are presented. The examination was accomplished by using a compensation circuit by means of which the resistance of the ground and the grounding resistances (R_E) that arise at the potential and current electrodes could be reproduced controllably.

It was found that in the lowest range of measurement of the ground testers (0.1 and 5 ohms) the error of measurement increases greatly as the measured value decreases; this lowest range, therefore, is not applicable or is only partly applicable to vertical electric sounding, where maximum permissible error is ± 5 percent. Within individual ranges of measurement, moreover, the error due to the grounding resistances of the electrodes is large and variable. These sources of error may render the results of vertical and lateral exploration data useless.

The effect of these errors is illustrated by three vertical sounding curves. The reduction of the data and limit of application of the instruments are discussed. The general agreement of the results obtained for all six models suggests that the properties ascertained are inherent in the instrument and should be taken into account in using ground testers and interpreting the results. — D. B. V.

181-197. Tikhonov, A. N., and Shakhsuvarov, D. N. Elektromagnitnoye zondirovaniye zemnoy kory [Electromagnetic sounding of the earth's crust]: Akad. Nauk SSSR Vestnik, no. 10, p. 42-46, 1959.

Three methods of electromagnetic sounding are discussed: the method of transitory state of the induced electromagnetic field, which exists from the moment when a direct current is introduced into a grounded cable or an ungrounded loop to the moment when the field is stabilized; the method of stationary electromagnetic field induced by alternating current; and the method of natural electromagnetic field of the earth. The method of magnetotelluric sounding is suggested for further development. — A. J. S.

181-198. Ohashi, Shuji. On the figures of SP distribution (Part 9)--Summary and conclusion [in Japanese with English summary]: Butsuri-Tanko, v. 11, no. 3, p. 113-120, 1958.

Results of spontaneous polarization studies in metallic ore deposits reported in previous papers by Ohashi (see Geophys Abs. 162-79, 166-143, 168-85) are summarized. This summary includes a discussion of the following: SP distribution from a 3-dimensional viewpoint at ore deposits and surroundings; the relationship between SP and resistivity; SP distribution due to topography; variation of SP values in relation to time lapse; the influence of electrodes and minerals on SP values; and SP distribution produced by mine installations and galleries.
It is concluded that four types of spontaneous polarization of metallic ore deposits may occur: the galvanic (or ohmic) potential, the static potential, the overlapped potential, and the nonpolarized. — V. S. N.

181-199. Campbell, Orton E. Why sedimentary structures show high self-potentials: World Oil, v. 150, no. 5, p. 97-98, 1960.

Geochemical anomalies consisting of concentrations of minerals in a halo around or over geologic structures are interpreted as a result of earth currents. A geologic structure is the site of an electric field with the highest potential at the top and the lowest on the flanks. Given this difference of electrical potential on and off structure and strata of various porosities carrying water impregnated with dissolved mineral matter, natural electrolysis can and does take place. The negative radicals are transported toward the crest of the structure, and the positive ions toward the flanks. Earth currents are thus capable of producing the observed geochemical anomalies. —J. W. C.

181-200. Nosske, G[erhard], and Franke, R. Einige Erfahrungen bei der geoelektrischen Kartierung von Mineralgängen, Spalten und Verschiebungen im Mittelgebirge [Some experiences in the geoelectric mapping of mineral veins, fissures, and faults in the Mittelgebirge]: Zeitschr. Geophysik, v. 24, no. 4/5, p. 340-350, 1958.

Resistivity and Turam methods were used in exploration of faults, fissures, and veins filled with well conducting or poorly conducting material in connection with prospecting for metallic ores, fluorite, and barite in the Mittelgebirge of Germany.

Resistivity measurements yield best results, especially over poorly conducting veins, if the electrode spacing is of the same order of width as is the outcrop. Considerable information as to the shape and attitude of complex disturbing bodies can be obtained by using different electrode spacings in conjunction with model experiments. Over well conducting bodies, the electromagnetic method gives better results than resistivity measurements.——D.B.V.

181-201. Paterson, N[orman] R. A sulphide discovery, Robb-Jamieson area, Ontario, in Methods and case histories in mining geophysics: [Canada] Commonwealth Mining and Metall. Cong. (6th), p. 246-259, 1957.

Exploration in the Robb-Jamieson area, just west of Timmins, northern Ontario, involving the use of a combination of geologic and geophysical methods located a sulfide body in a swamp area under approximately 100 feet of overburden. This body is a hydrothermal replacement deposit in Precambrian lava and is probably related to intrusives in the area. The area was surveyed first by the aeromagnetic method, next by geologic field mapping, and then by extensive ground geophysical operations. The magnetic method was valuable in resolving geologic problems; the electrical studies showed the position and dimensions of sulfide bodies; and gravity measurements helped in the differentiation of electrical conductors. Subsequent drilling verified the presence of a sulfide deposit estimated to contain at least 7 million tons of 25-percent ore—a combination of pyrite, chalcopyrite, and sphalerite. — V. S. N.

ELECTRICAL LOGGING

181-202. Walker, Terry. Log interpretation in the brackish water Frio trend: Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 171-177, 1959.

Interpretation of electrical well logs in the brackish water Frio trend of the Texas gulf coast region is complicated by thin sands containing numerous shale streaks; therefore, measurements of flushed zone resistivity and true formation resistivity over very short vertical intervals are required. These stratigraphic conditions coupled with higher resistivity of the formation water offer the ideal conditions for application of the FoRxo-Guard log combination because the fluid content can be resolved in sand stringers as thin as 1.5 feet. The formation fluid, percent saturation, and porosity can be determined reliably and rapidly with this combination of logs. The Guard log correlates well with conventional electric logs. Correlations between Guard logs are more accurate than between other logs and permit recognition of less conspicuous stratigraphic changes. — V. S. N.

181-203. Towle, Guy. An improved interpretation method for salt mud logging: Jour. Petroleum Technology, v. 11, no. 11, p. 37-41, 1959.

The FoRxo, Guard, and gamma logs in combination provide a detailed log of lithology. Porosity and water saturation may be calculated by a simple interpretation method when the following conditions are fulfilled: the formation must be invaded by mud filtrate; the ratio of mud-filtrate to formation-water resistivity must be known and should not exceed 10; the mud-filtrate resistivity must be known; and the mud cake cannot be thick. This logging system provides a method for interpretation of shaly sands when both formation water and mud filtrate are highly conductive.

A show is indicated when the Guard log resistivity is greater than the FoRxo log resistivity if the following conditions obtain: the ratio of mud-filtrate resistivity to formation-water resistivity should be approximately unity; the formation must be invaded by mud filtrate; the zone being tested must not be shale; and the borehole through this zone must not be large. The FoRxo and Guard logs are recorded on the same resistivity scales and then superposed. — J. W. C.

181-204.   Lehnert, Klaus. Die seitliche Bohrlochsondierung und ihre Anwendung im norddeutschen Mesozoikum [Lateral logging and its application in the north German Mesozoic]: Zeitschr. Angew. Geologie, v. 5, no. 10, p. 496-499, 1959.

The lateral resistivity logging technique is outlined, and results of its use in East Germany presented. Gradient sondes with 0.55-8.25 m spacings are used. Three examples are discussed and illustrated by reproduced curves. All three examples have "blind zones" where false values of resistivity are obtained. The laterlog method can be used to locate reservoirs in the Mesozoic of East Germany only if the rocks satisfy certain criteria regarding the nature of the layering, distance between high-resistivity zones, homogeneity, and isotropy; these conditions are so seldom fulfilled that quantitative interpretation is hardly possible. Lateral logging is limited chiefly to sand-clay sections; other methods must be used in indurated rock. — D. B. V.

181-205.   Polyakov, Ye. A. Ekvivalentnaya elektricheskaya skhema elektroda [An equivalent electric circuit of an electrode]: Prikladnaya Geofizika, no. 23, p. 217-225, 1959.

It was found that the contact resistance between a metallic electrode and a rock or borehole solution involves a capacity component resulting from a double electric layer that acts as a condenser. An electric-circuit analysis of two resistances in series (contact resistance plus grounding resistance) and a capacitance in parallel with the contact resistance was made experimentally in the laboratory (electrolytic tank). Graphs of contact resistance between flat and semispherical duralumin, brass, and copper electrodes, and NaCl solution were drawn in terms of grounding resistance and the double electric-layer capacitance. The specific capacitance was found to be of the order of several microfarads per cm^2, and the contact resistivity of the order of several hundred ohms. Both these quantities were found to depend on the solution resistivity, current density, frequency, temperature, and metal of the electrode. The contact resistance of an electrode is greater than grounding resistance when the borehole solution is highly mineralized; it is smaller in weak solutions. — A. J. S.

181-206.   Molochnikov, Z. I. Otsenka kharaktera neftenasyshchennosti karbonatnykh kollektorov po dannym elektricheskogo karotazha [Estimation of the oil saturation of carbonate reservoirs according to data of electric well logging]: Razvedochnaya i Promyslovaya Geofizika, no. 24, p. 34-37, 1958.

Estimation of oil saturation of the carbonate reservoirs of the Krasnokamensk and Palaznensk oil deposits was never possible by electric well logging, because the water and oil saturated strata showed almost equally high apparent resistivity. It was later found that using drill mud containing pure water produces different and significant results; the water-bearing strata show a resistivity of 10-20 ohm-m, whereas the oil-bearing strata yield a value of 100-200 ohm-m. — S. T. V.

ELECTRICAL PROPERTIES

181-207.   Tozer, D. C.   The electrical properties of the earth's interior, in
Physics and chemistry of the earth: New York, Pergamon Press,
v. 3, p. 414-436, 1959.

Present knowledge of the electrical properties of the mantle and core is re-
viewed, and the methods for obtaining new data on these properties are des-
cribed. First order discontinuities in the conductivity distribution are not be-
lieved to occur. It is shown that although ultramafic minerals exhibit both e-
lectronic semiconduction and ionic conduction at atmospheric pressure, the
mantle below a few hundred kilometers may be treated as an electronic semi-
conductor. At shallower depths in the mantle, ionic conductivity is compara-
ble with the electronic conductivity.

A derivation of the temperature distribution from the conductivity distribu-
tion is given, in which it is assumed that the mantle is composed largely of
magnesian olivine. This shows a steepening of the temperature gradient in
the transition region between depths of 400 and 900 km. Several explanations
of this are given; they are based on models of heat transfer. It is also shown
that the rapid rise in conductivity at about 700 km depth cannot be interpreted
as evidence for or against a compositional change. A temperature of 4, 500°K,
which is uncertain by several hundred degrees, is suggested for the core-man-
tle boundary. The Hall coefficient and thermoelectric power are estimated in
the lower mantle.

The various methods of estimating the conductivity of the core are describ-
ed; a value between 10^3 and 10^4 ohm^{-1} cm^{-1} is most probable. — J. W. C.

181-208.   Volarovich, M. P., and Parkhomenko, E. [Ye.] I.   Piezoelectric
effect of rocks: Bur. Central Séismol. Internat. Pubs., Sér. A,
Travaux Sci., no. 20, p. 289-304, 1959.

This is essentially the same as the Russian version of the paper that was
published in Akad. Nauk SSSR, Izv. Ser. Geofiz., no. 3, p. 215-222, 1955
(see Geophys. Abs. 162-68). — D. B. V.

EXPLORATION SUMMARIES AND STATISTICS

181-209.   Dennison, A. T., and Warman, Harry R.   Coordination of geology
and geophysics pays off: World Oil, v. 150, no. 5, p. 87-92, 1960.

The principal problems facing the geophysicists today are: (a) to increase
the speed of operation in areas of difficult terrain; (b) to increase the accur-
acy and resolving power of geophysical methods: (c) to extend the use of the
reflection method into "no-reflection" areas; and (d) to develop new methods
which will give direct indications of oil accumulation rather than geologic
structure.

Although recent instrumental developments in airborne magnetic surveying
have not made any appreciable impact on interpretation, the nuclear preces-
sion magnetometer provides an alternative to the earlier flux gate type, and
the Doppler navigation system may simplify positioning of survey lines in
areas lacking in topographic features.

Seismic exploration in North America is largely by the reflection method.
Synthetic seismograms are widely used to assist in correlation. These are
prepared in the laboratory from data of a continuous velocity log of a borehole.

The weight-dropping or "thumping" method is now used commercially in areas where shot holes are impractical. Various magnetic recording methods are in general use, but difficulties have arisen because of lack of standardization of the instruments. — J. W. C.

181-210. Assiter, Edward J. Electronic computers aid many exploration phases: World Oil, v. 150, no. 5, p. 105-111, 1960.

The use of electronic computers in geophysical exploration is briefly summarized. Log information can be fed into a computer and correlations made automatically. This has the advantage of rapid and impersonal evaluation. Interpretation of reservoir properties can similarly be made; approximately 100 sands per hour can be processed. Most of the routine reduction and handling of data on the average seismic survey requires standard calculations and decisions that are ideal for automation. The routine calculations and corrections of gravity data interpretation lend themselves to the speed and versatility of the computer for plotting maps. Studies of parameter variation are facilitated. — J. W. C.

181-211. World Oil. Geophysical activity at 13-year low: World Oil, v. 150, no. 3, p. 121, 1960.

Geophysical exploration in the United States extended its downward trend to 7 years in 1959. A total of 431 crews were working in November 1959, which is a drop of 40.3 percent from the peak of 722 crews in 1952. Seismic operations dropped from 420 crews working in November 1958 to 391 crews in November 1959. During this same 1-year period the number of gravity crews dropped from 42 to 37. — J. W. C.

181-212. Keller, G[eorge] V., and Plouff, Donald. Geophysical investigations at Fletcher's Ice Island, T-3, in Proceedings of the second annual Arctic planning session, October 1959: U.S. Air Force Cambridge Research Center, Geophys. Research Directorate Research Notes no. 29, p. 22-25, 1959.

The U.S. Geological Survey resumed geophysical fieldwork on Fletcher's Ice Island, T-3, on April 12, 1959. The seismic reflection program of the summer of 1958 was continued, and an unsuccessful attempt was made to use sonar in mapping the ocean bottom. The gravity measurements of other seasons were expanded by the use of a Worden gravimeter in addition to the North American gravimeter. A three-component magnetic variograph was used to measure the vertical and horizontal components of the magnetic field intensity and declination, and a dip circle and proton magnetometer were used to determine absolute values for the magnetic field. A small amount of electromagnetic work was done to check the accuracy of the work of 1958 (see also Geophys. Abs. 180-150). — V. S. N.

181-213. Gottis, Maurice. L'apport des travaux de la Compagnie d'exploration pétrolière (C. E. P.) dans la connaissance du bassin tertiare du Roussillon [The contribution of the work of the Petroleum Exploration Company (C. E. P.) to knowledge of the Roussillon Tertiary basin]: Soc. Géol. France Bull., ser. 6, v. 8, no. 8, p. 881-883. 1958.

The results of geophysical surveys in the Roussillon basin in the eastern Pyrenees are presented briefly. A detailed gravimetric survey (station den-

sity 1 station per km^2) was made of the area covered by Plio-Quaternary sediments.   Two seismic surveys were conducted, a reconnaissance survey in 1953 followed by more detailed examination of interesting structures in 1954. An aeromagnetic survey showed the basement depth to be about 4,000 m in the southern part and about 2,000 m in the northern.   One borehole was put down near Canet and another near Elne. — D. B. V.

181-214.   Lerici, Carlo Maurilio. Applicazioni geofisiche nella ricerca archeologica [Geophysical applications in archeological research (with English, French, and German summaries)]: Ricerca Sci., v. 30, no. 1, p. 3-60, 1960.

Recent developments in the application of geophysical methods to archeological problems in Italy are outlined. Seismic reflection and refraction surveys have been used to reveal buried trenches, canals, walls, tombs, and chambers.   Resistivity surveys also have successfully located trenches, foundations, and tombs.   Findings facilitated by geophysical methods in the years 1956-59 are summarized, and possible future lines of development are outlined briefly (see also Geophys. Abs. 165-148). — D. B. V.

181-215.   Godin, Yu. N.   Kompleksnyye regional'nyye geofizicheskiye issledovaniya yugo-vostoka Russkoy platformy [Complex regional geophysical investigations of the southeast of the Russian platform]: Geologiya Nefti, no. 4, p. 37-48, 1958.

An integrated regional geophysical investigation was begun in 1956 in the southeastern regions of the Russian platform by the VNIIGeofizika for clarification of the main features of the subsurface structure.   Gravity, magnetic, electrical, and seismic surveying were used in a combination designed specifically for the region and task.
Three to five 60-channel seismic stations were used simultaneously along a profile; the geophone spacing was 100 m, and therefore the segment occupied by the apparatus was 18-30 km.   At one set-up 12-20 explosions were registered; these were located 3-250 km from the seismic stations. The surface of the basement is traced with confidence by the method of refracted waves with observations at 30-70 km from points of explosions.   Horizons up to 50 km depth and more were mapped by reflected waves.   The most distinct reflections were recorded from the Mohorovičić surface at distances of 30-80 km from the point of explosion.
Depths to basement calculated from gravity and magnetic anomalies conform in general to those determined by seismic surveying and drilling.   There are marked departures from this regularity, however.
The use of the telluric current method as part of integrated regional geophysical surveys is advocated. Also, the extensive use of natural seismic waves in exploration is proposed.
The successful use of special regional seismic operations as part of integrated geophysical work in the Volga-Ural area in 1956-57 has resulted in similar operations now in progress in other oil districts of the U. S. S. R. — J. W. C.

181-216.   Brod, I. O., and Vasil'yev, V. G. Osnovnyye zadachi v oblasti metodiki poiskovo-razvedochnykh rabot na neft' i gaz [Main tasks in the area of method of exploration operations for oil and gas]: Geologiya Nefti, no. 2, p. 1-6, 1958.

The exploration program in the U. S. S. R. is continually subjected to critical evaluation in connection with proposed increases in oil and gas production

of the Seven Year Plan. Emphasis is placed on preliminary regional geophysical studies in conjunction with drilling. Regional tectonics should be investigated by a combination of aeromagnetic, gravity, and seismic surveys resting on a network of special drill holes. Only too often, however, one phase of such an operation lags behind the others, and this impairs the efficiency of the operation as a whole.

The relief of the basement apparently can be studied successfully by the telluric-current method, which is considerably cheaper and less cumbersome than seismic surveying. There is a serious lag in gravity surveying, which is generally conducted with an accuracy up to 0.3 mgal; the accuracy of this kind of work has been brought to 0.01 mgal abroad (outside the U.S.S.R.).

An outstanding deficiency in the exploration of oil and gas deposits is the great lag in well testing. This is due largely to a fallaceous approach to evaluating the results of such work: the criterion for a bonus is the amount of drilling and not the number of completed and tested wells. — J. W. C.

181-217. Kozlov, P. T. Stoimost' geofizicheskikh rabot [Cost of geophysical operations]: Geologiya Neft, no. 2, p. 10-16, 1958.

The costs of geophysical operations in the U.S.S.R. are broken down according to the form of the expense (wages, amortization, transportation, field allowance, and others), relative costs of exploration and well logging (wages, field allowance, and others), costs of individual phases (project estimation, field, liquidation), cost per employee, and cost per unit of field exploration (cost per station, linear mile of profile, km^2 area, structure prepared for drilling). The unit costs have gradually risen over the last few years; this is due in great part to the increasing depths to which exploration is being extended. The number of persons in a field party has gradually increased. Some seismic groups have as many as a hundred persons. The least costly method is magnetic surveying; next are gravity and electrical; and the most costly is seismic surveying.

One factor in the increased cost per explored structure lies in the criterion for performance of field parties. Success is judged by the number of days of fieldwork. This commonly results in emphasis being placed on fulfilling a quota rather than on deciphering the geology. — J. W. C.

181-218. Kozlenko, S. P. Organizatsiya poiskovykh rabot na neft' i gaz [Organization of exploration operations for oil and gas]: Geologiya Nefti, no. 2, p. 7-10, 1958.

During the pre-World War II years under the direction of I. M. Gubkin an area was thoroughly investigated using all known exploration methods before deep exploration drilling was begun. During the postwar era, ideas have turned more to the "efficient complex," which strives to exclude those methods that do not produce pertinent data. In eliminating any particular method from the complex, however, the tendency has been to make evaluations on each method intrinsically and not to consider mutual supplementations or duplications.

Exploration work is controlled at present by several organizations; this is regarded as inefficient, and its elimination is recommended. A single exploration service is called for. — J. W. C.

181-219. Burtmar, M. S. Ratsional'nyy kompleks geologopoiskovykh i razvedochnykh rabot na territorii zapadnoy chasti prikaspiyskoy vpadiny [Efficient combination of geologic exploration and prospecting operations in the territory of the western part of the Cas-

pian depression], in Geologiya i nefte-gazonostnost' yugo-vosto-
chnykh rayonov Russkoy Platformy: Leningrad, VNIGNI, Gosto-
ptekhizdat, p. 18-29, 1958.

This is another of the large number of articles that are being currently pub-
lished by the Soviet exploration geophysicist in which the "complex" of geo-
physical operations is discussed. Exploration in a particular area is elabor-
ately organized, and the attempt is made to integrate the activities of the var-
ious types of field parties. The success of this attempt is continually eval-
uated. Here the operations in the Caspian depression are discussed.
    The gravity and seismic methods played the most important roles. Gravity
data was the basis for dividing the area into individual structural zones—areas
of normal platform structures, areas of salt dome tectonics, and an area of
a buried ridge. Seismic methods were used to distinguish the configuration
of salt domes and anticlines.   There is doubt concerning the reliability of e-
lectrical prospecting data.   The regional structural subdivision of the area
of the Caspian depression is also discussed. — J. W. C.

181-220.   Kozlenko, S. P.   Rezul'taty geofizicheskikh rabot v nizhnem povol-
             zh'ye [Results of geophysical operations in the Lower Volga   re-
             gion], in Geologiya i nefte-gazonostnost' yugo-vostochnykh rayon-
             ov Russkoy Platformy: Leningrad, VNIGNI, Gostoptekhizdat, p.
             71-72, 1958.

On the basis of geophysical exploration the Lower Volga region is divided
into major structural units, each of which has its own tectonic characteristics.
Three types of structures are distinguished: areas of shallow Precambrian
basement, areas of deep Precambrian basement, and areas of shallow Upper
Paleozoic basement. The specific structures of each type are listed.—J.W.C.

181-221.   Andreyeva, R. I., and Chirvinskaya, M. V. Gipsometriya funda-
             menta Dneprovsko-Donetskoy vpadiny [Hypsometry of the base-
             ment of the Dnieper-Donets depression]: Geologiya Nefti, no. 6,
             p. 55-61, 1958.

In the area of the Dnieper-Donets depression a close relationship exists be-
tween the tectonics of the sedimentary cover and faulting of the basement.
Magnetic data were used in conjunction with refraction and drilling data to
compile a regional structure map.   Depths to basement calculated from the
magnetic anomalies agree within 15-20 percent with depths determined by
drilling. (See also Geophys. Abs. 172-122.)— J. W. C.

181-222.   Rankin, Philip A.   A review of airborne methods used in prospect-
             ing for oil and minerals with special reference to the Philippine
             Islands: Philippine Geologist, v. 13, no. 4, p. 142-160, 1959.

This paper is one that was presented in a lecture series conducted by the
Geological Society of the Philippines in December 1959.   It is a short review
of the types of surveys and techniques employed in aerial photography, aero-
magnetic, aeroelectromagnetic, and aeroradiometric methods of prospecting
for oil and minerals. — V. S. N.

GENERAL

181-223.   Krumbein, W. C.   Trend surface analysis of contour-type maps
           with irregular control-point spacing: Jour. Geophys. Research,
           v. 64, no. 7, p. 823-834, 1959.

Trend surface analysis is a procedure for separating the relatively large-
scale systematic changes in mapped data from essentially nonsystematic
small-scale variations due to local effects. The method can be applied to any
contour-type map, and has been used for analysis of gravity maps, isopach
maps, facies maps, and maps of igneous and sedimentary rock attributes.
When observations can be collected on a rectangular grid, orthogonal poly-
nomial analysis permits convenient separation of the trend from the residuals.
When observations are limited in number or are irregularly distributed over
the map, nonorthogonal polynomial analysis can be used to determine at least
the linear and quadratic components of the trend. These surfaces and devia-
tions from them have value in geological interpretation, and they suggest that
even when the complete trend is known, maps of selected trend components
may be useful for examining special problems. Polynomial analysis of maps
is facilitated by use of high speed computers. Organization of an IBM 650
program is outlined in this paper. — Author's abstract

181-224.   Millard, F. S.   Varied logging program required in the Paradox
           Basin: World Oil, v. 148, no. 7, p. 141-145, 1959.

Several types of geophysical logs are used in the Paradox Basin, Utah, for
correlation and evaluation of the Hermosa formation. The neutron log can be
used to locate porous carbonate intervals and to evaluate the porosity provided
the limestone is relatively pure. The gamma-ray curve can sometimes be
used with the neutron log to locate dolomites because the natural gamma level
is slightly higher for dolomite than for limestone. The continuous velocity
log has a tremendous potential in this region for correlation purposes and for-
mation evaluation. Focused logs are also run for further information. —J. W. C.

181-225.   Trevisan, Livio, and Tongiorgi, Ezio.   La Terra [The Earth]:
           Torino [Italy] Unione Tipografico-Editrice Torinese, 730 p. , 1958.

Physical and historical geology are presented in well organized chapters
accompanied by excellent illustrations. The chapter on volcanoes deals with
current volcanic activity in various parts of the world with particular atten-
tion given to the evolution of this activity with time. The chapter on internal
constitution of the earth discusses seismic methods of elucidating the earth's
interior; also, the hypothesis of continental drift is set forth. — J. W. C.

181-226.   Aquilina, Carmelo.   Lezioni di prospezione geofisica [Lessons of
           geophysical prospecting]: Rome, Univ. Degli Studi di Roma, Fa-
           colta di Ingegnerica, v. 1, 470 p. , 1958.

This textbook on geophysical exploration is divided into two chapters; one
on gravity methods, and one on magnetic methods. The treatment of gravity
methods includes extended discussions of pendulum apparatus, the torsion
balance, and interpretation of results. The chapter on magnetic methods deals
with terrestrial magnetism, magnetic properties of rocks, absolute and rela-
tive determination of the components of the earth's magnetic field, and anal-
ysis of the results of measurements and their interpretation. — J. W. C.

181-227. Savinskiy, K. A., Mandel'baun, M. M., Troitskiy, V. N., Shekht, N. I., and D'yachkov, N. P.   Effektivnost' geofizicheskikh metodov razvedki v yuzhnoy chasti Sibirskoy platformy, vpadinakh Zabaykal'ya i Dal'nego Vostoka   [Effectiveness of geophysical methods of exploration in the southern part of the Siberian platform, Trans-Baikal depression, and Far East]: Moscow, Gostoptekhizdat, 116 p., 1959.

This book is a comprehensive review of the present status of geophysical exploration in the areas of eastern Siberia that are present or potential sources of oil and gas.

The southeastern part of the Siberian platform has been studied extensively by magnetic, gravity, and electrical surveys.   The Kamsko-Taseyev depression, for example, has been completely covered by an aeromagnetic survey.

The Irkutsk amphitheater has been completely mapped by aeromagnetic surveys of different scales but has been only partly covered by gravity surveys. Electrical exploration has proved valuable for thickness studies.   Seismic studies have distinguished a number of continuous reflecting horizons, which are a basis for structural and isopach maps.

The depressions of the Trans-Baikal type have been studied by gravity and magnetic surveys. One of the principal tasks here is to map the configuration of the surface of the basement. — J. W. C.

181-228.   Geologiya Nefti. Vklad razvedchikov nefti i gaza v semiletiye 1959-1965 gg [Contribution of oil and gas exploration men in the seven-year plan 1959-65]: Geologiya Nefti, no. 12, p. 1-5, 1958.

The results of recent exploration in the U. S. S. R. are reviewed and evaluated with respect to the current 7-year plan (1959-65).   An increase of 110-115 percent in capital investment for geological-exploration operations for oil and gas is planned.   The expenditures for carrying out these operations during this same period are to increase 96-98 percent.   The share in this expenditure assigned to geophysical exploration is large and will continuously increase; it was 31 percent of the total in the years 1952-58 and 45 percent in 1958; it is to be 51.6 percent in the years 1959-65 and 57.8 percent in 1965. The expenditures on geophysical operations will thus increase 172 percent during this period.   Seismic exploration will play the most prominent part. Expenditures on seismic surveying were 40 percent of the total for geophysical exploration in 1946, 64 percent in 1958, and are to be 81 percent in 1965. — J. W. C.

181-229.   Khitarov, N. I.   Izucheniye glubin zemnoy kory [Studies of the depths of the earth's crust]: Akad. Nauk SSSR Vestnik, no. 8, p. 32-35, 1959.

Advances and deficiencies in various branches of earth science in the U. S. S. R. are critically reviewed.   Intensive study of endogenic processes in the crust are recommended.   Volcanism, geophysical mapping, and age determination are fields in which study is regarded as grossly inadequate. — A. J. S.

181-230.   Kasatkin, D. P. Stroyeniye fundamenta severnoy Turkmenii i Karakalpakii po dannym geofizicheskikh issledovaniy [Structure of the basement of north Turkmenia and Karakalpakia according to data of geophysical studies]: Sovetskaya Geologiya, no. 1, p. 10-33, 1960.

A coordinated program of geophysical investigation was carried out in parts of Central Asia between 1952 and 1958. Aeromagnetic, gravity, and regional seismic surveys were made of the entire region, and vertical electrical sounding surveys covered individual parts; an area of a half million square kilometers was investigated.

The seismic survey was made by the refraction method along a net of profiles 30-60 X 70 km with more detailed coverage in some areas. The accuracy in determination of boundary velocities was 3-5 percent, and that for depth determinations was generally 3-3.5 percent.

The aeromagnetic survey was on a scale of 1:200,000 and in places at 1:1,000,000. The accuracy was ±15 gammas.

Maps showing geophysical regionalization and the surface of the basement are presented (see also Geophys. Abs. 175-222). — J. W. C.

181-231.   Jeou-jang, Jaw, and Cheng-Yi, Fu.   Advancement of geophysical sciences in China 1949-1959: Scientia Sinica, v. 8, no. 9, p. 910-920, 1959.

Recent geophysical research in China is reviewed. Twelve permanent seismic stations are now in operation, and microseismic research has recently been initiated. Aeromagnetic and surface-magnetic surveys have been employed to delineate ultramafic rock bodies, to find igneous contacts, and to map basement relief; ore bodies have been located in this manner. Electric and radioactive logging have been used effectively to determine thickness and depth of coal deposits. — J. W. C.

GEODESY

181-232.   Heiskanen, W. A.   Geodetic base lines: Jour. Geophys. Research, v. 65, no. 2, p. 454-456, 1960.

The end goal of geodesy, to determine in detail the shape of the geoid and to establish a world geodetic system mostly through worldwide gravity studies, is in sight. The shape of the geoid has been computed with relatively high accuracy. The exact size of the earth, however, must be determined by arc measurement methods, which require accurate triangulation chains and good astronomic observations. To get the scale of these chains, field base lines measured with high accuracy are required. An exact geodetic world scale can be furnished only by geodetic standard base lines measured in different parts of the world, and existing scales are not sufficiently unified.

In 1954 the International Association of Geodesy passed a resolution calling for member countries to establish a standard base line using the Väisälä light-interference method or similar apparatus to assure a uniform scale in all networks and to calibrate Invar tapes and Geodimeters. Such lines have already been measured at Nummela in Finland, at Buenos Aires in Argentina, at Loenermark in the Netherlands, 'and at Munich in Germany. — D. B. V.

181-233.   Bomford, G.   The figure of the earth.   Its departure from an exact spheroid: Royal Astron. Soc. Geophys. Jour., v. 3, no. 1, p. 83-95, 1960.

This paper describes recent progress in the measurement of the irregular departures of the geoid from any spheriod, with special reference to their direct measurement by the method of geoidal or "astrogeodetic" section. — D. B. V.

181-234. Lagrula, Jean. Explication d'une propriété de la courbe hypsogra-
          phique [Explanation of a property of the hypsographic curve]:
          Acad. Sci. [Paris] Comptes Rendus, v. 249, no. 25, p. 2810-
          2811, 1959.

The hypsographic curve is the statistical representation of areas as a func-
tion of altitude (positive for continents, negative for oceans); its shape is such
that the eustatic level of the oceans is independent of the volume of continental
ice during processes of a duration long enough to include isostatic readjust-
ment. It is concluded that isostasy imposes an equilibrium on exchanges be-
tween ice and ocean water which is stable during times of melting and unstable
during times of glaciation. — D. B. V.

181-235. Sztompke, Wacław, editor. Słownik geodezyjny w 5 językach [Geo-
          detic dictionary in 5 languages]: Warsaw, Państwowe przedsię-
          biorstwo wydawnictw kartograficznych, 525 p., 1955.

This geodetic dictionary gives the Russian, German, English, and French
equivalents of 4,355 Polish words and professional terms on geodesy and re-
lated sciences, 457 map terms and symbols, and 332 Polish synonyms. —
A. J. S.

181-236. Lukásc, T. A geodézia szerepe a vizszintes kéregmozgas vizsgá-
          latában [Role of geodesy in determination of horizontal crustal
          movement (with German summary)]: Geodézia és Kartográfia,
          v. 11, no. 4, p. 269-275, 1959.

Horizontal crustal movements can be determined by means of high-accura-
cy triangulation. This paper deals with the results of such measurements in
the Mecsek Mountains of Hungary. — J. W. C.

GEOTECTONICS

181-237. Billings, Marland P.   Diastrophism and mountain building: Geol.
          Soc. America Bull., v. 71, no. 4, p. 363-398, 1960.

The chief purpose of this paper is to consider the relative importance of
the various types of diastrophism (folding and thrusting, broad vertical move-
ments, broad vertical movements with high-angle faulting, large-scale strike-
slip displacements, and slipping of crust over mantle) and especially their
relation to mountain building. Mountain building is merely one manifestation
of vertical movements of the crust. In the past it has been erroneously con-
sidered by many to be primarily the result of folding and thrusting, but many
ranges are the result of vertical uplift unrelated to folding. Mountain build-
ing should not be equated with one type of diastrophism.
A successful theory of diastrophism must explain among other things (1)
the horizontal compression that is essential to form belts of folded and thrust-
faulted strata; (2) extensive vertical movements with or without high-angle
faulting and unrelated to folding; and (3) extensive strike-slip faults. — D. B. V.

181-238. Jacobs, J. A. Continental drift: Nature, v. 185, no. 4708, p. 231-
          232, 1960.

The fact that heat flow is approximately the same in oceanic and continen-
tal areas is difficult to reconcile with the continental drift theory. Only 10
percent of the observed values of heat flow in oceanic areas can be produced
by the relatively thin, mainly basaltic crust, and no more than 1 percent by

the ocean sediments; the remainder must come from the mantle. Therefore, there is a striking difference between the mantle under oceans and that under continents. If a continent, with its more radioactive crust, were to drift over an oceanic area with its more radioactive mantle, much greater continental heat flows would be expected than those observed.

Convection currents in the mantle have been offered as an explanation of the variations in oceanic heat flow, but it is difficult to see why convection cells should not also be present under continents.

The fundamental difference in the constitution of the upper mantle under o-ceans and under continents makes it very difficult to see how continental drift can have occurred, unless the continents have dragged the upper few hundred kilometers of the mantle along with them; this seems extremely unlikely. — D. B. V.

181-239. Beck, A[lan] E.   An expanding earth with loss of gravitational po-
            tential energy: Nature, v. 185, no. 4714, p. 677-678, 1960.

The possibility that a nonuniform earth can expand and lose gravitational po-tential energy at the same time is suggested. If there is no external or inter-nal source of energy, the earth will tend to proceed from a higher state of po-tential energy to a lower; and one way to do this would be to expand to its pre-sent form. Expansions of the order of 100 km are possible without postulating any source of energy.

If the mass of the earth has remained constant and if its average density is 2. 85 g per cm^3, earth models of smaller radii but higher potential energies can be found for any value of $n \geq 1$, where $\rho_r = \rho_0(1-kr^n)$, where ρ_r is density at a radius r, ρ_0 is original density, k is a constant. The higher the value assumed for n, the greater the possible expansion. — D. B. V.

181-240. Pakiser, L[ouis] C. Transcurrent faulting and volcanism in Owens
            Valley, California: Geol. Soc. America Bull., v. 71, no. 2, p.
            153-159, 1960.

In the Owens Valley region of California, volcanic activity of Cenozoic age was confined mainly to three areas near the ends of important faults.   The volcanic eruptions seemingly took place in regions of relative tension, if the horizontal movement along these faults was left lateral. The deep depression of Owens Valley may have resulted from compression associated with left-lateral horizontal fault movement. The transfer of molten rock from beneath this deep depression laterally into the regions of tension and thence to the sur-face seems to account for the relief of abnormal stresses and the volume of the volcanic rocks. — Author's abstract

181-241. Allen, Clarence, R., Silver, Leon T., and Stehli, Francis G. Agua
            Blanca fault--a major transverse structure of northern Baja Cali-
            fornia, Mexico: Geol. Soc. America Bull., v. 71, no. 4, p. 457-
            482, 1960.

The Agua Blanca fault is a major right-lateral strike-slip fault at least 80 miles long, which cuts across the peninsula of Baja California about 70 miles south of the California border. Its trend is more nearly parallel to the Trans-verse Ranges of southern California than to the San Andreas fault system, which dominates the tectonic grain of the peninsula elsewhere.

The physiographic expression of the Agua Blanca fault is remarkably sim-ilar to that of the San Andreas. Despite its orientation, the Agua Blanca fault does not appear to represent a deep-seated structural feature analogous to those of the Transverse Ranges. Instead, it is probably one of several paths

by which the San Andreas fault tends to break around the "knot" caused by the great bend of the San Andreas in southern California. — D. B. V.

181-242.   Wilson, J. Tuzo. Evolution of the crust and its rock associations--geophysics and continental growth: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 413-417, 1959.

This is essentially a condensation of the ideas expressed in the paper published in Am. Scientist, v. 47, no. 1, p. 1-24, 1959 (see Geophys. Abs. 176-162). — D. B. V.

181-243.   Beloussov [Belousov], V. V. Fundamental features of the structure and development of geosynclines: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 369-381, 1959.

This is a summary of Belousov's views on the nature of geosynclines, which are developed in greater detail in a number of other publications (see Geophys. Abs. 147-13189, 148-13425, 164-191, 167-114, -117). Geosynclines are characterized by great diversity in crustal oscillations; at all stages of development, uplift is no less pronounced than subsidence, but the latter is more easily detected in the form of the sediments accumulated. The zones of subsidence and uplift within a geosyncline are termed "intrageosynclines" and "intrageanticlines." Platforms are regions of gentle oscillatory movements; they too are divided into areas of subsidence (synclises or subgeosynclines) and uplift (anteclises or subgeanticlines).
The undulatory oscillations in geosynclines and platforms reflect differentiation processes taking place at different depths in the earth. Differentiation proceeds with different speeds at different levels; in the upper level it develops most energetically and is manifested in intense movement of geosynclinal style, whereas slower differentiation at a lower level causes the undulatory movements of platform style.
Continents and oceans as structural elements are much more general in character than geosynclines and platforms. Geosynclines do not represent an intermediate stage in crustal evolution from an oceanic to a continental state. — D. B. V.

181-244.   Lyustikh, Ye. N. O gipotezakh talassogeneza i glybakh zemnoy kory [On the hypothesis of the genesis of the oceans as well as the blocks of the earth's crust]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 11, p. 1542-1549, 1959.

The theory explaining the formations of oceans by the settling and the subsequent disintegration of former continents is disputed. Such a process could not have resulted in the present structure of the crust wherein the basaltic layer beneath the oceans has a thickness of only about 5 km, whereas under the continents it is up to 35 km thick. — S. T. V.

181-245.   Ushakov, S. A., and Lazarev, G. Ye. Ob isostaticheskom progibanii zemnoy kory v Antarktide pod tyazhest'yu ledovoy nagruzki [On the isostatic downwarping of the earth's crust in Antarctica under the weight of the ice load]: Akad. Nauk SSSR Doklady, v. 129, no. 4, p. 785-788, 1959.

The thickness of the Antarctic icecap has been established seismically by various expeditions; comparison of these results with gravimetric data should show whether the ice load is isostatically compensated. Along the profiles

Little America-Byrd and Mirnyy-Pionerskaya, depth calculated from Faye anomalies is shown to correspond well with seismic results, indicating isostatic compensation.

It is calculated that 3 km of ice of average density 0.9 g per cm^3 would depress the bedrock surface by 1 km. The fact that the Antarctic shelf is 200 m deeper than other continental shelves agrees with a value of 600-700 m for the mean thickness of the ice from the coast to 50-70 km inland. Crustal thickness, calculated from Bouguer anomalies, increases from 30 km at Mirnyy to 40 km at the Kosmol'skaya station; this is typical of continental crust. Nevertheless, a substantial part of Antarctica has been transformed into an archipelago of islands beneath the ice; bedrock in places is 500-1,000 m below sea level. If the glaciation began in the middle of the Tertiary period, isostatic compensation has been reached in 20 million years at most; it is very likely, however, that less time was required. — D. B. V.

181-246.   Ez, V. V. O tektonicheskikh osobennostyakh oblasti vozniknoveniya glubokofokusnykh zemletryaseniy v vostochnykh Karpatakh [On tectonic features of the region of origin of deep focus earthquakes in the eastern Carpathians]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1839-1844, 1959.

The tectonism of the highly seismic Fokshani area of Rumania is analyzed with the aid of topographic maps in combination with the isostatic anomaly map (in Airy reduction for a 30 km normal thickness of the crust). The data from these maps, the apparent change in the direction of the flow of rivers in the region during recent geologic times, and a considerable development of swamps along the Seret, Ramnicul, and Putna Rivers indicate a current subsidence of the region adjacent to Fokshani. The conclusion was reached that an intense subsidence of the basement is taking place in the Fokshani region and that the epicentral zone of deep earthquakes in the eastern Carpathians coincides with the western part of the deep Fokshani depression. — A. J. S.

181-247.   Scheidegger, A[drian] E[ugen].   The orogenetic significance of a soft layer at 140 km depth: Jour. Geology, v. 68, no. 1, p. 177-181, 1960.

Gutenberg (see Geophys. Abs. 162-234) has shown that certain features in the traveltime curves of seismic phases can be explained by the presence of a velocity minimum for wave propagation at a depth of approximately 140 km. The velocity minimum is caused by a proximity of the melting point to the actually prevalent temperature in the zone under consideration. On this basis Gutenberg suggests that the low-velocity zone is a "decoupling" zone between the material above it and that below it and represents the depth to which orogenesis is felt. Because this low-velocity zone represents the wave guide for the G-waves, and the latter reach around the whole globe, the decoupling zone would have to be present everywhere.

Scheidegger investigates the effect of the presence of such a decoupling zone at the specific depth upon the various theories of orogenesis. It is shown that all those theories of mountain building that are based upon the assumption that crustal shortening is the cause of mountains are effected to the extent that the shortening required is now much less than previously estimated. The other theories are only superficially affected. — V. S. N.

181-248.   Wilson, J. Tuzo. Some consequences of the expansion of the earth: Nature, v. 185, no. 4717, p. 880-882, 1960.

The geological and geophysical evidence for expansion of the earth is examined in the light of recent observations. The concept that existing ocean basins have grown by widening of rifts such as the African Rift Valleys requires an improbable amount of expansion (nearly doubling the earth's radius). If only the midocean ridges have grown, however, the required expansion would be about 6 percent in circumference, which is close to Dicke's estimate of 4.5 percent (see Geophys. Abs. 176-179). This does not prove that expansion has occurred, or if it has occurred that it is due to a change in the gravitational constant. Many features of the earth's surface, however, can be explained by the expansion hypothesis. These include heat flow under the ocean floors and midocean ridges; location of mountain systems, island arcs, grabens, and other features; continental zoning and growth; transcurrent faulting; the pear-shaped figure of the earth; and a limited amount of continental drift. — D. B. V.

181-249.   Gzovsk[i]y, M. V.   Method of modelling in tectonophysics: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 383-406, 1959.

Tectonophysical problems such as development of folds and faults, their spatial and temporal distribution, stresses in the crust, earthquake focuses, and details of deep crustal structure can be investigated with the help of scale models based on theory and made of materials that simulate rocks in mechanical properties. Some examples of such studies are given. This review is based on a bibliography of 59 entries. — D. B. V.

GRAVITY

181-250.   Tsuboi, Chuji.   Applications of Fourier series for computing gravity anomalies and other gravimetric quantities at any elevation from surface gravity anomalies: Ohio State Univ. Inst. Geodesy, Photogrammetry, and Cartography Repts., no. 1, 20 p., 1959.

A single Fourier series method has been developed for computing gravity anomalies, deflection of the vertical, and undulation of the level surface at higher elevations from surface gravity anomalies. As an example of its application, the method has been used to deduce these quantities at elevations, 93 km, 187 km, 280 km, 374 km, above the profile No. 17 of Vening Meinesz across the East Indies. — Author's abstract

181-251.   Kivioja, Lassi.   Significance of the isostatic equilibrium: Ohio State Univ. Inst. Geodesy, Photogrammetry and Cartography Pubs., no. 7, p. 86-89, 1957.

The purpose of isostatic studies of gravity anomalies is to try to determine in what way and to what extent different parts of the world are compensated, as well as to investigate the reasons for deviations from isostatic equilibrium. The conditions that must be satisfied by the reduction methods to be used in the geodetic applications of gravity anomalies are listed. Isostatic anomalies are more representative than Bouguer because they do not change as rapidly from point to point. Bouguer anomalies distort the geoid too much.

High speed computers can be used except in computing the effect of the closest neighborhood of mountain stations. There are still large isostatically unmapped areas. For further studies, isostatic maps are prepared not only for a crustal thickness of 30 km but for 20, 40, and 60 km as well; the extra time involved is not great. — D. B. V.

181-252. Olberg, Manfred. Das Verhalten der Krümmungsradien der Äqui-
potentialflächen und derjenigen ihrer orthogonal Trajektorien an
Diskontinuitätsflächen der Dichte [The behavior of the radii of
curvature of the equipotential surfaces and that of their orthogo-
nal trajectories at surfaces of density discontinuity]: Gerlands
Beitr. Geophysik, v. 68, no. 5, p. 263-267, 1959.

A general equation is derived for the changes in the curvature ratios of the
equipotential surfaces of the gravity potential at a surface of density disconti-
nuity. — Author's summary, D. B. V.

181-253. Jung, Karl. Zur gravimetrischen Bestimmung der Bodendichte
[On the gravimetric determination of the density of the ground]:
Gerlands Beitr. Geophysik, v. 68, no. 5, p. 268-279, 1959.

Different variations of Nettleton's method of determining rock density from
gravity measurements are examined with respect to their reliability. The
formulas of Jung (1943) and Steiner (Geophys. Abs. 177-200) must be used with
caution, unless the effect of buried masses can be shown to bear a linear re-
lationship to the height of the stations. The most accurate method is one with
adjustment compensation, but it is laborious and requires much calculation.
— D. B. V.

181-254. Caputo, Michele. Ein graphisches Verfahren für die Berechnung
der vertikalen Komponente der Anziehungskraft zylindrischer Kör-
per und dessen Anwendung für die Bestimmung der Gestalt von
Gletscherbetten [A graphic procedure for the calculation of the
vertical component of the force of attraction of cylindrical bodies
and its application for the determination of the configuration of
glacier beds]: Zeitschr. Geophysik, v. 24, no. 6, p. 359-368,
1958.

A graphic method is presented for computing the vertical component of the
gravitational attraction of an infinite horizontal cylinder. The configuration
of the bottom of the Godwin Austen Glacier in the Karakorum Range is then
determined by this method on the basis of gravimetric measurements made
during the Italian K2 expedition of 1954-55. — D. B. V.

181-255. Tyapkin, K. F. Opredeleniye obshchego ugla naklona dvukhmernykh
geologicheskikh ob"ektov po resultatam gravitatsionnykh i mag-
nitnykh ismereniy [Determination of the general angle of inclina-
tion of two-dimensional geologic objects from the results of gravi-
tational and magnetic measurements]: Akad. Nauk SSSR Doklady,
v. 129, no. 5, p. 1005-1007, 1959.

Expressions are derived by means of which the dip of two-dimensional bod-
ies can be calculated from gravitational or magnetic measurements. Values
of the horizontal components of the gravitational or magnetic field and of the
vertical gradient of gravity, which enter into these expressions and are not
usually measured instrumentally, can easily be calculated from measurements
of the vertical component by methods described earlier (see Geophys. Abs.
164-165, 171-175). — D. B. V.

181-256. Kalinina, T. B. K teorii lineynykh preobrazovaniy dvumernykh
magnitnykh i gravitatsionnykh poley [On the theory of linear trans-
formations of two-dimensional magnetic and gravity fields]: Akad.
Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1774-1786, 1959.

The theory of linear transformation of potential fields is discussed from the point of view of Fourier frequency analysis and synthesis. The integral linear transformation used for interpretations of magnetic and gravity fields is replaced by a discrete sum, the formula for which is given. The errors arising from the discrete method and the accumulation of accidental errors are considered, and the means for their correction discussed. The proposed discrete transformation method is applied to the problem of an analytical extension of the potential function to the lower and higher half planes and to calculation of the derivatives of the potential function for the levels $z = 0$ and $z < 0$. It is shown that an analytical extension into the lower half plane and calculation of higher derivatives by the discrete method of transformation are limited by the accumulation of accidental errors in the data of the initial field. — A. J. S.

181-257.   Tomoda, Yoshibumi.   On the difference between $\partial g/\partial z$ obtained from vertical distribution of gravity and that obtained from horizontal distribution [in Japanese with English abstract]:   Geod. Soc. [Japan] Jour., v. 5, no. 3-4, p. 79-83, 1959; reprinted in Tokyo Univ. Geophys. Inst. Geophys. Notes, v. 12, no. 1, contr. no. 7, 1959.

The direct method of obtaining the vertical gravity gradient uses the difference in gravity values at two points at different altitudes; the indirect method uses the horizontal distribution of gravity, adding anomalies in $\partial g/\partial z$ calculated from gravity anomalies to the standard $\partial g/\partial z$. The values of $\partial g/\partial z$ obtained by the two methods theoretically should be identical if the difference in altitude of the two vertical sampling points is infinitely small and if the information on the surface gravity anomalies is perfect. This does not always obtain in practice, however.

Study of the difference in results obtained by the two methods from the point of view of the spectrum shows that the direct method gives no new information about $\partial g/\partial z$ if the instrument used for this purpose is the same as the one used in observation of the horizontal distribution. The value of $\partial g/\partial z$ obtained by the difference in gravity value at a vertical distance of 5 m will also be given with about the same error by the weighted sum of the gravity values at three points at the surface which are 5 m apart. — D. B. V.

181-258.   Tomoda, Yoshibumi.   The necessary condition for surface gravity anomalies to give always positive distribution on the surface at a certain depth [in Japanese with English abstract]: Geod. Soc. [Japan] Jour., v. 5, no. 3-4, p. 84-87, 1959; reprinted in Tokyo Univ. Geophys. Inst. Geophys. Notes, v. 12, no. 1, contr. no. 8, 1959.

It is not always possible to decide from a surface anomaly whether or not the underground mass distribution responsible for the anomaly is positive. The problem is investigated from the point of view of the spectrum, and a formula is derived for the necessary and sufficient condition for the underground mass distribution always to be positive on a surface at a given depth. Examples are given for three different cases in which gravity distribution is symmetrical about the origin. — D. B. V.

181-259.   Egyed, L[ászló].   A new method of average density determination: Univ. Sci. Budapest. Eötvös Annales, Sec. Geol., v. 1, p. 33-36, 1957.

This is essentially the same as the paper published in Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, v. 4, no. 2, p. 31-36, 1955 (see Geophys. Abs. 165-172). — D. B. V.

181-260.   Kinoshita, W. T., and Kent, B. H.   Photogrammetric determination of elevations for regional gravity surveys: Geophysics, v. 25, no. 2, p. 445-450, 1960.

Precision photogrammetric methods were used to obtain elevations of gravity stations in an area in the southern Sierra Nevada and in west-central Idaho. In both areas, relief is more than 3,000 feet and in the Idaho area there is also a dense cover of forest and brush.

In addition to photogrammetric determinations of gravity station elevations in the Idaho area, 55 photogrammetric elevations were determined for ground points that had been established previously by topographic surveys. A statistical analysis of the differences between photogrammetric and known ground elevations indicated that the mean of the errors is -0.2 feet; 71 percent of the photogrammetric errors are included within one standard deviation (3.4 ft), and 96 percent of the errors are included within twice the standard deviation (6.8 ft).

The photogrammetric combination used in both areas was the multiplex stereoscopic plotting instrument and 1:49,500 scale photography taken with a 6-inch focal length lens.   It is probable that smaller standard deviations can be obtained by combining larger scale photography with more precise stereoscopic plotting instruments. — Authors' abstract

181-261.   Whitworth, Virgil L., Haye, Edward F., and Lindholm, Thomas M.   Gravity-photogeology method boosts accuracy, cuts costs: World Oil, v. 150, no. 5, p. 99-100, 104, 1960.

Gravity surveys commonly reveal anomalies that are not structurally controlled; rather, they are produced by alluvial deposits at the surface.   Photogeology can detect such surface features and thereby eliminate possible misinterpretation of the gravity data. — J. W. C.

181-262.   Jones, V. L.   Correlation of adjacent gravimeter surveys: Tulsa Geophys. Soc. Proc., v. 5, p. 48-49, 1957-58.

Gravity surveys conducted on adjacent areas at different times with different gravimeters often result in poor correlation at the common boundary, particularly if the calibration of one instrument is incorrect. A corrected meter factor may be calculated by extrapolating several profiles from the survey done with the properly calibrated instrument into the area surveyed with the faulty meter.   An extrapolation formula and a least-squares method for calculating the corrected meter factor is presented.   Gravity values computed with this corrected factor will contour smoothly across the common boundary of the two surveys. — V. S. N.

181-263.   Sazhina, N. B.   Primer ratsional'nogo vybora secheniya isoanomal dlya gravimetricheskikh kart [An example of a rational choice of isoanomaly lines on gravimetric maps]: Razvedochnaya i Promyslovaya Geofizika, no. 26, p. 40-44, 1959.

An estimation of interpolation error of gravity maps for several regions in the U. S. S. R. is made in order to determine the correct spacing of isoanomaly lines when gravity maps of a scale 1:1,000,000 are enlarged 2-4 times. It was found that in the selection of the spacing, the usually applied factor of 2.5

should be multiplied by the determined mean quadratic error E = 9 mgal, resulting in a spacing value of approximately 20 mgal for a regular anomalous field, and 2-2.5 times as much for regions of complicated anomalies. — A. J. S.

181-264. Hinze, William J. Application of the gravity method to iron ore exploration: Econ. Geol., v. 55, no. 3, p. 465-484, 1960.

The gravity method has played an increasingly important role in exploration for iron ore since the development of portable gravimeters of high precision. This method was first applied as a tool for detecting nonmagnetic ores, but advantages over other methods have also made it useful under certain geologic conditions in the study of magnetic ores and regional structures favorable for occurrence of iron ore. The gravity method, however, is restricted by such limitations as: (1) The anomalous property used in the gravity study of magnetic iron ores is less diagnostic than the anomalous property used in the magnetic study of these ores; (2) the gravity method is incapable of detecting beds or masses of waste material in iron ores that do not have a density contrast with the ore; (3) the ledge surface is not necessarily a horizontal plane as is often assumed; and (4) a wrong combined elevation correction factor is commonly used. In addition, the full utilization of the method is dependent on complete knowledge of the density relationships of the ores and of their contrasts with the country rocks. — J. W. C.

181-265. Bott, M[artin] H[arold] P[hillips]. The use of rapid digital computing methods for direct gravity interpretation of sedimentary basins: Royal Astron. Soc. Geophys. Jour., v. 3, no. 1, p. 63-67, 1960.

A rapid digital computing method for the direct calculation of the shape of a two-dimensional sedimentary basin of known density contrast based on residual gravity anomalies is described. A flow diagram of the program is given, and the use of the method is illustrated by the example of the Dumfries New Red Sandstone basin in south Scotland. — D. B. V.

181-266. Gilbert, R. L. G. An investigation into the calibration of gravity meters: Royal Astron. Soc. Geophys. Jour., v. 1, no. 4, p. 330-340, 1958.

Gravity observations made with gravity meters over large gravity ranges have shown the instruments to be less satisfactory than is desirable. Figures are given showing the errors which have been found using three gravity meters under various field procedures, and some possible causes of error are discussed. The scale constants of the gravity meters are shown to change substantially with time, and a system is described which was built into one gravity meter in order to check the scale constant at any time. The results obtained from this device are tabulated and discussed; no satisfactory mechanism has been produced to explain the change in scale constant, and the calibration device has some use, although not so much as had been hoped.
It is concluded that for the accurate measurement of large gravity differences careful operation of the gravity meters is essential, the calibration of the instrument being checked regularly; and that pendulum measurements may be preferable for the measurements of very large gravity differences. — Author's summary

181-267. Gantar, C., and Morelli, C[arlo]. Some pressure effects on the behaviour of Worden gravity meters: Geophys. Prosp., v. 8, no. 1, p. 111-117, 1960.

Tests made on a Worden "Educator" gravimeter no. E 302 show that pressure variations have a significant effect on the readings. Two groups of observations were made using a decompression chamber. The first group consisted of gravimeter readings taken at normal and low pressures with abrupt variations, the second group of readings taken at various intermediate pressures during "descent" in steps of about 1,000 m. The "highest" observation was made at a pressure equivalent to an altitude of about 6,100 m. The pressure changes caused changes in readings of the same sign. Corrections for the effect are given. — D. B. V.

181-268.   Thompson, Lloyd G. D., and LaCoste, Lucien J. B. Aerial gravity measurements: Jour. Geophys. Research, v. 65, no. 1, p. 305-322, 1960.

This is a full report on tests of the airborne use of the LaCoste and Romberg surface-type sea gravity meter (see Geophys. Abs. 177-204). At high altitudes the aircraft was sufficiently stable for the instrument to operate satisfactorily. Analysis of in-flight acceleration problems shows that observations can be made from an airplane flying at a high speed when proper flight programing and navigation systems are used. North, south, and west traverses over an Askania tracking range gave 5-minute average gravity readings which were plotted into smooth profiles. An accuracy of better than 10 mgal was obtained, which meets requirements for geodetic applications where mean gravity values for $1° \times 1°$ squares are required. — D. B. V.

181-269.   Sukhodol'skiy, V. V. Pribor dlya registratsii uskoreniy i naklonov pri opredelenii sily tyazhesti na more [An instrument for recording acceleration and inclination in the determination of gravity at sea]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 11, p. 1570-1578, 1959.

Several geophysicists (among them Vening Meinesz and Sorokin), investigating the possibilities of measuring gravity on ships at sea, came to the conclusion that such measurements can be successful if accompanied by the simultaneous measurement of the inclination and vertical acceleration of the gravimeter. New gravimeter elements designed by Sukhodol'skiy designed for this purpose are described. With these additional elements it is possible to make all necessary corrections for obtaining the true value of gravity at the point of measurement. Field tests are now in progress. —S. T. V.

181-270.   Popov, Ye. I. Morskiye izmereniya s gravimetrom "Gal" [Offshore measurements with gravimeter "Gal"]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1793-1798, 1959.

The results of gravity measurements at sea with the gravimeter "Gal" during the period February-June 1958 are reported, and the method of accounting for the mean quadratic error at observation points is discussed. A formula for the determination of the total quadratic error $\sigma_{\Delta g}$ for the difference Δg is given. Whenever possible the gravimeter records were compared with those obtained on a four-pendulum apparatus. It was found that the mean quadratic error of the observation point varies between ±3.5 and ±14.0 mgal, depending on the magnitude of disturbing accelerations. — A. J. S.

181-271.   Jackson, J. E. Observations with the Cambridge pendulum apparatus in North, Central, and South America in 1958: Royal Astron. Soc. Geophys. Jour., v. 2, no. 4, p. 337-347, 1959.

The results are tabulated of gravity observations made with the Cambridge pendulum apparatus in August-December 1958 at Teddington, England; Madison, Wisconsin; Mexico City, Mexico; Panamá, Panama; Caracas, Venezuela; Quito, Ecuador; Lima, Peru; La Paz, Bolivia; Santiago, Chile; Buenos Aires, Argentina; and Rio de Janiero, Brazil. Stations were reoccupied on the return journey so that eight measures of the gravity difference between consecutive stations were obtained. — D. B. V.

181-272. Gough, D. I. A new determination of the difference in gravity between the N. P. L. Teddington and the South African fundamental and secondary stations: Royal Astron. Soc. Geophys. Jour., v. 1, no. 4, p. 298-307, 1958.

Observations were made with the Cambridge pendulum apparatus at the British fundamental gravity station at the National Physical Laboratory at Teddington, England, and at the South African fundamental gravity station at Johannesburg and secondary stations at Pretoria and Mowbray. The mean gravity differences are as follows: Teddington-Mowbray = 1. 5495 ± 0. 0001 cm per sec^2; Teddington-Johannesburg = 2. 6472 ± 0. 0003 cm per sec^2; and Teddington-Pretoria = 2. 5672 ± 0. 0003 cm per sec^2.

Using a gravity value of 981 1963 cm per sec^2 for Teddington, the values at the South A' thus are g = 979. 6468 cm per sec^2 at Mowbray, 978. 5631 cm per s at Johannesburg, and 978. 6251 at Pretoria. These values agree well with 1948-49 determinations by Hales and Gough (see Geophys 19-13563). — D. B. V.

181-273. Jackson, J. E. Pendulum observations at Teddington, Singapore, Darwin, and Melbourne in 1959: Royal Astron. Soc. Geophys. Jour., v. 3, no. 1, p. 78-82, 1960.

Gravity differences between the British fundamental gravity station at Teddington, England; Singapore, Malaya; and Darwin and Melbourne, Australia, were measured with the Cambridge pendulum apparatus in August and September 1959. Differences in gravity acceleration are tabulated for 4 different pendulum pairs and for the outward and return journeys. The range of values is as follows: Teddington-Singapore, -3, 113. 8 to -3, 114. 7 mgal; Singapore-Darwin, +231. 5 to +233. 1; Darwin-Melbourne, +1, 664. 3 to +1, 665. 2. The measurement procedures and location of stations are described. —D. B. V.

181-274. Pakiser, L[ouis] C., Press, Frank, and Kane, M[artin] F. Geophysical investigation of Mono Basin, California: Geol. Soc. America Bull., v. 71, no. 4, p. 415-448, 1960.

Gravity and seismic studies in Mono Basin, completed in 1957, show that a large roughly triangular block has subsided about 18, 000 feet and has received about 300 ± 100 miles^3 of light clastic sediments and volcanic material of Cenozoic age. The boundary faults are generally parallel to basin-and-range trends.

The gravity minimum associated with the Mono Basin structure has a residual relief of about 50 mgal, and the lowest readings yield a Bouguer value of about -260 mgal with respect to the International Ellipsoid. The computations of depth of subsidence are based on an assumed density of 2. 3 g per cm^3 for the fill and 2. 7 g per cm^3 for the basement rocks.

Refraction profiles at several places demonstrate that the Cenozoic deposits are thick where gravity is low and relatively thin where it is higher. Steep seismic dips coincide with steep gravity gradients. Anomalies on four aeromagnetic profiles are related in part to volcanic material within the Cenozoic section.

It is concluded that the Mono Basin may be a volcano-tectonic depression caused by subsidence along faults following extrusion of magma from a reservoir at depth. — D. B. V.

181-275.   Woollard, G[eorge] P[rior], Ostenso, N[ed] A. , and Thiel, E[dward]. Gravity anomalies, crustal structure, and geology in Alaska: Jour. Geophys. Research, v. 65, no. 3, p. 1021-1037, 1960.

A regional Bouguer gravity map of Alaska is interpreted in terms of variations in crustal structure and local geology, and the results are compared with seismic data from two areas in Alaska and one in Alberta.

It is found that crustal composition must be taken into account in the derivation of crustal thickness from gravity values, and it is suggested that regional isostatic anomalies are probably more indicative of abnormal crustal composition than of abnormal crustal thickness.   The positive anomaly in the Prince William Sound area of Alaska is related to a thick crust of high density, rather than to a thin crust as might be deduced on the assumption of normal crustal density.   The opposite effect is noted in the common association of negative anomalies with granitic intrusions in southern Alaska, where the crust is thinner than the gravity values suggest.

Several areas of local gravity anomaly are defined; in general, these can be correlated with known geologic features such as sedimentary basins, igneous intrusions, and basement relief. — D. B. V.

181-276.   Stackler, W. F. A profile of structural gravity survey on the North Sturgeon Lake field: Alberta Soc. Petroleum Geologists Jour. , v. 7, no. 12, p. 275-278, 1959.

The gravity method is capable of mapping reef structures, provided rigid standards are maintained in carrying out the survey and in applying corrections. This is illustrated by results from the North Sturgeon Lake field where one-eighth mile station spacing was used. The interpretation was made from isopach residuals according to Stackler's own method. In this method, the regional gravity is the integrated gravity of the surroundings and not the average of several neighboring gravity points.   The method results in regional values of very high accuracy if station spacing is chosen to give an unequivocal gravity feature in detail. With this accuracy the separation of isopach depths becomes possible by changing the radii in the surrounding region.

Ambiguities inherent in gravity work limit the information obtainable; it is concluded, however, that the techniques illustrated by this survey can be successful in following geological trends from known into unknown areas. —V. S. N.

Koryakin, Ye. D. Relationship between Bouguer gravity anomalies and thickness of the earth's crust in the region of the Atlantic Ocean.   See Geophys. Abs. 181-306.

181-277.   Svejgaard, B. J. Gravity measurements in western Greenland 1953 and 1955: [Denmark] Geod. Inst. Skr. , ser. 3, v. 32, 19 p., 1959.

A first order net of gravity stations covering the western coast of Greenland between lat 69° N. and lat 78° N. was established in the years 1953 and 1955.   Coordinates of the gravity stations, gravity observations, and final gravity values are given in tables. A chart of anomalies is included. — V. S. N.

181-278.   Jones, L. , Mathieu, P. L. , and Strenger, H. Catalogue des stations gravimétriques et magnétiques. Définitions et résultats des mesures.   Fasc. 1 — Degrés carrés Nord 2° à Sud 1° [Catalog

of gravimetric and magnetic stations. Definitions and results of measurements. No. 1 — Degrees square 2° north to 1° south]: Mus. Royal Congo Belge Annales, Sci. Geol., v. 26, 165 p., 1959.

Complete data for stations occupied in the geophysical surveys of the Belgian Congo are tabulated. The area covered extends from lat 2° N. to lat 1° S. and from long 18° E. to long 25° E. The stations are listed for each "square degree," designated by the geographic coordinates of its southwest corner. For each station the table gives the number, date of survey, number of original 1:200,000-scale map on which reported, mileage from initial station according to speedometer readings, description, latitude and longitude, altitude, observed gravity, gravity according to international tables, free air and Bouguer anomalies, residual magnetic anomaly, and vertical magnetic intensity. — D. B. V.

181-279. Honkasalo, Tauno. Gravity survey of the Baltic Sea: Ohio State Univ. Inst. Geodesy, Photogrammetry and Cartography Pubs., no. 7, p. 67-69, 1957.

A gravity survey was made in 1956 in the Baltic Sea, Gulf of Bothnia, and Gulf of Finland, using a Gulf underwater gravimeter. Preliminary results have been calculated and are presented in the form of a map of free air anomalies. — D. B. V.

181-280. Grosse, Siegfried. Ergebnisse gravimetrischer Regionalvermessungen im Westerzgebirge [Results of regional gravity surveys in the western Erzgebirge]: Zeitschr. Geophysik, v. 24, no. 4/5, p. 321-325, 1958.

Results of gravimetric surveys in the western Erzgebirge in East Germany are presented and interpreted. The Bouguer map shows a decrease in gravity of about 55 mgal toward the crest of the range, reflecting the trend of known granitic bodies. The great amplitude of the gravity low can be explained by the presence of an extensive granitic pluton at depth. — D. B. V.

181-281. Zaccara, Gaetano, and Maino, Armando. Brevi cenni su due lavori gravimetrici effettuati nell'Italia meridionale [Brief account of two gravimetric operations carried out in southern Italy]: [Italy] Servizio Geol. Boll., v. 80, no. 1, p. 59-61, 1959.

Experimental gravity surveys were made in southern Italy for supplementing surface geological data in interpretation of the local structure. The number of gravity determinations in the Melfi quadrangle were increased from 85 to 180 in 1957; the resulting Bouguer anomalies confirmed the structure suggested by the earlier measurements (see Geophys. Abs. 180-160).

Approximately a hundred gravity measurements were made in the Benevento quadrangle along lines of precise leveling and along railroads. The Bouguer anomalies show a gradual decrease in size from southwest to northeast; a large minimum in the center of the quadrangle, including the village of Benevento; and a zone of lows in the northwest corner of the quadrangle that joins a known sharp minimum in the Alifano quadrangle. The number of observations is too small as yet for precise structural interpretation; however, two more programs of measurement are still in progress. — D. B. V.

181-282. Renner, J[ános], and Szilárd, J. Gravity network of Hungary: Acad. Sci. Hungaricae Acta Tech., v. 23, no. 4 (Ser. Geod. et Geophys. v. 1, no. 4), p. 365-395, 1959.

The gravity base network of Hungary, surveyed in 1950-55 with a Heiland gravimeter, consists of 16 first-order stations some 100-120 km apart and 493 second-order stations at 15-20 km intervals. Since publication of the preliminary report in 1956, the results have been processed. The first-order network was corrected for the lunisolar effect, for the effect of orientation of the instrument, and for the fact that the readings of this type of instrument are not entirely a linear function of gravity variations ("square correction"). The second-order network was adjusted to the corrected values of the first-order points. Accuracy was found to be ±0. 02 mgal for the first-order network and ±0. 029 mgal in the second-order network.

For each station in each network, tables give the number; name; location; height; adjusted observed gravity; topographic effect; theoretical gravity (according to the 1930 international formula); Faye, Bouguer, and isostatic corrections; and Faye, Bouguer, and isostatic anomalies (calculated for density = 2. 67 and depth of compensation T = 30 km). The Faye, Bouguer, and isostatic anomalies are also shown on 5-mgal contour maps. — D. B. V.

181-283.   Airinei, Ştefan. Imagini gravimetrice şi geomagnetice din regiunea de curbură pentru Carpaţii orientali şi Ţara-Bîrsei [Gravimetric and geomagnetic maps of the bend region of the eastern Carpathians and Ţara-Bîrsei (with Russian and French abstracts)]: Acad. Romine Ştudii şi Cercetări de Geologie, v. 4, no. 1, p. 127-162, 1959.

An attempt is made to correlate gravimetric and magnetic data of six profiles made for the bend area of the eastern Carpathians and the region of Ţara-Bîrsei from 1953 to 1957. Contour maps show mean densities, Bouguer anomalies for a uniform density of 2. 20 g per cm^3, Bouguer anomalies for mean densities, vertical components of the geomagnetic field, and magnetic anomalies; these are compared with profiles, and their similarities and differences are interpreted. — A. J. S.

181-284.   Botezatu, Radu, and Bacioiu, Traian. Anomalia gravitatii in Dobrogea centrala [Gravity anomaly in central Dobrogea (with Russian and French summaries)]: Acad. Romîne Bul. Ştiinţ., Sec. Geologie-Geografie, v. 2, no. 2, p. 237-252, 1957.

A synthesis of gravity studies made from 1952 to 1955 in Dobrogea is presented. Four zones are distinguished on the basis of correlation of the gravity data with the geology. It is concluded that the gravity anomalies reflect the contrast of higher density basement rocks, particularly the greenschists, to the sedimentary cover. A Bouguer map of the area is presented. — J. W. C.

181-285.   Stoenescu, Scarlat, and Airinei, Ştefan. Contribuţii geofizice la cunoaşterea substratului bazinului Haţegului [Geophysical contribution for the investigation of the basement of the Haţeg basin (with Russian and French summaries)]: Acad. Romîne Bul. Ştiinţ., Sec. Geologie-Geografie, v. 2, no. 2, p. 275-287, 1957.

The nature of the basement in the Haţeg basin is interpreted on the basis of gravity and magnetic data. This structural feature is a postorogenic intermontane basin located in southwest Transylvania. A strong elliptical negative gravity anomaly occurs in the central part of the basin. Two positive magnetic anomalies are present, one in the central part of the basin and one on the north. The Bouguer map indicates subsidence of the basement. The positive magnetic anomalies are probably the effect of basic intrusions along faults. (See also Geophys. Abs. 175-217.) — J. W. C.

181-286. Botezatu, Radu, and Dumitru, Stelian. Efectul gravimetric al lim-
          itei externe a flisului in Moldova de nord [Gravity effect of the
          outer limit of the flysch in north Moldavia (with Russian and French
          summaries)]: Acad. Romîne Bul. Ştiinţ., Sec. Geologie-Geo-
          grafie, v. 2, no. 2, p. 369-375, 1957.

The results of a gravity study in the region of the outer limit of the flysch
in the east Carpathians are summarized, and a gravity map with a 1-mgal con-
tour interval is presented for the area. The gravity field is characterized by
2 lines of local anomalies, 1 negative and 1 positive. These lines are regard-
ed as a reflection of the limit of occurrence of the flysch in this region. (See
also Geophys. Abs. 174-191.) — J. W. C.

181-287. Grushinskiy, N. P. O sistematizatsii gravimetrovykh s"yemok i
          sozdanii gravimetricheskoy seti [Concerning the systematization
          of gravimetric surveys and establishment of a gravimetric net-
          work]: Razvedochnaya i Promyslovaya Geofizika, no. 17, p. 60-
          65, 1957.

At present pendulum points are located throughout the U. S. S. R. : 1 or more
stations per 1, 000 km^2 in the European and more populated Asiatic sections
of the U. S. S. R., and 1 for each 2, 000 km^2 in the underpopulated regions in
Siberia and along specific routes in the far north and in eastern Asia.   The
gravity values are referred to the pendulum base stations at Moscow, Pulko-
vo, Kazan, or Poltava, and from there tied to Potsdam.   Grushinskiy pro-
poses a general gravimetric survey to form the basis of a new gravimetric
map of the entire U. S. S. R. for theoretical purposes (study of temporal vari-
ations of gravity, vertical displacement of the earth's crust, relationship be-
tween levels of oceans and seas, geodetic measurements on Krasovskiy's
spheroid, and others), as well as for exploration for mineral deposits.   A
survey should be made on a 10 km grid; this would secure data for a gravi-
metric map with a 5-mgal contour interval. The proposed first order survey
would have an accuracy of ±0. 4-0. 5 mgal mean quadratic error, and the sec-
ond order survey would have a mean quadratic error less than ± 1 mgal. —
A. J. S.

181-288. Nevolin, N. V. Rezul'taty obobshcheniya geofizicheskikh material-
          ov po Prikaspiyskoy vpadine i severnoy chasti Ustyurta [Results
          of generalization of geophysical data for the Caspian depression
          and the north part of Ustyurt], in Geologiya i nefte-gazonostnost'
          yugo-vostochnykh rayonov Russkoy Platformy: Leningrad, VNIGNI,
          Gostoptekhizdat, p. 95-100, 1958.

The southeast of the European part of the U. S. S. R. is geologically compli-
cated and heterogeneous. There are four main structural units: the platform,
the area of Late Paleozoic (Hercynian) folding, the area of Early Mesozoic
folding, and the area of Alpine folding. Since the geology of these areas is
largely masked by younger, little deformed sediments, their study must be
almost entirely by geophysical methods.
  Gravity investigations in the central and eastern part of the Russian plat-
form show that in a number of areas an inverse relationship exists between
the structure of the basement and the gravity value; that is, regional gravity
minimums correspond to uplifts of the basement and maximums correspond
to depressions. There are exceptions to this, however, particularly where
salt domes are present. In northern Ustyurt there is a direct relationship
between the gravity values and the structure of the basement; high gravity val-

ues correspond to uplifts of the basement and low values to depressions. In this last area gravity surveys can be used as an exploration tool in outlining the structural elements of the basement. — J. W. C.

181-289. Kotlyarevskiy, B. V. Ispol'zovaniye vertikal'nykh gradientov sily tyazesti dlya geologicheskoy interpretatsii [The use of the verti-cal gradient of gravity for geologic interpretation]: Razvedoch-naya i Promyslovaya Geofizika, no. 21, p. 56-68, 1958.

In the Ural-Emba region there are many discrepancies between the data of gravimetric surveying and those of other geophysical methods as well as with the results of geologic investigations. These discrepancies are generally manifest in noncoincidence of the axes of gravity anomalies with those of geo-logic structures. Such discrepancies arise where the gravitational anomaly is produced by several component masses, or by a salt dome that has a com-plex form. The latter is explained by secondary salt intrusions in addition to the main salt dome. A pictorial explanation of complications in the gravita-tional field produced by such occurrences is given. A map of isoanomalies of the vertical gradient of gravity is more sensitive to local variations of the salt surface than is the map of gravity isoanomalies. — S. T. V.

181-290. Oganisyan, S. S. O prirode regional'nykh anomaliy sily tyazhesti Araratskoy kotloviny [Nature of regional gravity anomalies of the Ararat trough]: Akad. Nauk Armyan. SSR Izv. Ser. Geol. i Gecg. Nauk, v. 11, no. 1, p. 45-52, 1958.

The Ararat trough lies within the Alpine geosynclinal zone and is character-ized by negative values of gravity. It is divided into two parts: a southwest-ern zone distinguished by higher values (from -60 to -90 mgal) and a north-eastern zone with lower values (from -90 to -130 mgal). These negative grav-ity anomalies are governed by deep-seated processes and characterize the more mobile parts of the crust; this is indicated by the earthquakes of inten-sity up to 7 that occur in this area. The relief of the surface of the basement is the main factor controlling changes in the gravity field. The differences in density of the rocks of the sedimentary cover have little effect. A direct relationship between the relief of the basement and gravity anomalies, how-ever, does not exist everywhere; indeed, the opposite effect obtains in some areas. — J. W. C.

181-291. Oganisyan, S. S. O plotnosti gornykh porod Armenii [On the den-sity of rocks of Armenia]: Akad. Nauk Armyan. SSR Izv. Ser. Geol. i Geog. Nauk, v. 11, no. 3, p. 55-62, 1958.

Data on the density of the rocks' of the geologic section of Armenia are pre-sented for use in gravity studies. A total of 3,376 specimens were processed, and the maximum, minimum, and average values are broken down in a table according to geologic period. — J. W. C.

181-292. Gorzhevskiy, D. I., and Ivankin, P. F. Geotektonika pozitsiya Rudnogo Altaya i Kalby po geologo-geofizicheskim dannym [Geo-tectonic position of the Rudnyy Altay and Kalba according to geo-logical and geophysical data]: Akad. Nauk SSSR Izv. Ser. Geol., no. 4, p. 26-40, 1960.

The Bouguer anomaly map of the southwestern part of Altay Territory, U. S. S. R., an area lying between the structures of central and northwestern Kazakh S. S. R. and the folded structures of southern Siberia, is used to help

interpret the geologic structure. The thickness of the sial layer increases regularly toward the southeast; it is least thick in the region of the Rubtov a-nomaly and greatest in the Yuzhnyy (Southern) Altay. Crustal thickness is estimated as 20-30 km in the southwestern Rudnyy Altay and 50-60 km in the Yuzhnyy Altay. — D. B. V.

181-293. Thiel, Edward, Crary, A. P., Haubrich, Richard A., and Beh-rendt, John C. Gravimetric determination of ocean tide, Weddell and Ross Seas, Antarctica: Jour. Geophys. Research, v. 65, no. 2, p. 629-636, 1960.

The use of the gravity meter for measurement of ocean tides is illustrated by studies on the floating ice shelves of Antarctica. The observations are complicated by high-frequency oscillations of the ice, attributed to oceano-graphic influences. Factors involved in the reduction of the gravimetric data are analyzed. Amplitude and phase are computed for the more significant tidal components, and the energy spectra from 0.03 to 4 cycles per day are presented. The Weddell Sea tide has both diurnal and semidiurnal components. The Ross Sea tide is diurnal, with the solar component predominating. The tidal range is greater in the Weddell Sea than in the Ross Sea. Correlation of tidal currents with changes in surface elevation provides an estimate of the inward dimension of the Ross Ice Shelf. — Authors' abstract

HEAT AND HEAT FLOW

181-294. Strong, H. M. Fusion curve of iron to 96,000 atmospheres: tem-perature of the earth's core: Nature, v. 183, no. 4672, p. 1381-1382, 1959.

If the earth's core is composed of iron the solid phase of which near the melting point is the same as that at the surface, then a determination of the melting point of iron at about 1.4×10^6 atm (the pressure at the boundary be-tween the mantle and the liquid core) would set a minimum for this depth with-in the earth. As no such pressures are available for static tests at the sur-face, this melting point must be found by extrapolation.

The results of experimental measurements of the melting point of iron at pressures up to 96,000 atm are summarized briefly. The extrapolation is thereby reduced to one order of magnitude. At 96,000 atm the melting point is 1,740°C ± 15°C; from this value it is calculated that the melting point at the core boundary should lie in the range 2,340°C ± 200°C. — D. B. V.

181-295. Jacobs, J. A. Temperatures within the Earth's core: Nature, v. 185, no. 4712, p. 521-522, 1960.

Taken together, results obtained by Strong (Geophys. Abs. 181-294) and Verhoogen (Geophys. Abs. 163-173) fix the temperature T_1 at the core-mantle boundary rather precisely: $2,610°K < T_1 < 2,700°K$; a value of 2,650°K seems reasonable.

It is shown that a solid inner core could arise on the hypothesis of a cold origin of the earth, in which case melting would progress inward from the core-mantle boundary as the temperature of the interior increased. The ad-iabatic gradient in the outer core is recomputed on the basis of Jacobs' tem-perature-pressure hypothesis (Geophys. Abs. 152-14349). It is found that the melting-point gradient exceeds the adiabatic temperature gradient so that con-vection in the core would be possible. The adiabatic temperature at the bound-ary of the inner core is estimated as 2,900°K; the melting point at this depth has been calculated to have exactly the same value. Although this agreement might be fortuitous, it would appear that the inner core is solid. — D. B. V.

181-296. Gilvarry, J[ohn] J. Temperatures in the earth's interior: Jour. Atmos. Terrest. Physics, v. 10, no. 2, p. 84-95, 1957.

Fusion temperatures are evaluated for the earth's mantle from Lindemann's law by use of elastic parameters determined for a given depth from seismic data. The results are substantially consistent with prediction from the Simon equation, on the basis of a theoretical evaluation of the Simon exponents. The same formulation of the Simon equation is used to obtain fusion temperatures for the core. No inconsistency with these values is shown by deductions from Lindemann's law for the outer core. The melting temperatures found for the core are considerably higher than those predicted by Simon or Bullard, and show no substantial conflict with Jacob's hypothesis on the origin of a solid inner core. By using data on the temperature in the earth at small depth, and limits imposed on the possible values by melting temperatures at large depth, the actual temperature in the earth is represented approximately by a quartic polynomial in the depth; the limit of error at large depth if the inner core is solid is estimated as ±25 percent. — Author's abstract

181-297. Lubimova, H. A. [Lyubimova, Ye. A.]. Thermal history of the earth with consideration of variable thermal conductivity of its mantle: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 345-368, 1959.

This is essentially the same as the paper published in Royal Astron. Soc. Geophys. Jour., v. 1, no. 2, p. 115-134, 1958 (see Geophys. Abs. 174-214). — D. B. V.

Jacobs, J. A. Continental drift. See Geophys. Abs. 181-238.

181-298. Kraskovskiy, S. A.   O nekotorykh ocherednykh zadachakh geoter-micheskikh issledovaniy [On some outstanding problems of geothermal investigations in the USSR]: Akad. Nauk SSSR, Problemy Geotermiki i Prakticheskogo Ispol'zovaniya Tepla Zemli, v. 1, p. 116-125, 1959.

The value of 32° per km for the geothermal gradient of the crust as a whole is considered as too high since it was determined to such a great extent by measurements on sedimentary rocks, which have above average gradients. The average gradient for crystalline rocks, which make up 95 percent of the crust, is 12° per km. Bullard's and Birch's values for the standard heat flux of the earth's crust ($1.23 - 1.3 \times 10^{-6}$ cal per cm^2 per sec) are considered as too high. Taking the geothermal gradient of crystalline rock as 12°C per km, and the thermal conductivity of granodiorite as 7.2×10^{-3} cal per deg cm sec, a value for the average heat flux of the earth of 0.86×10^{-6} cal per cm^2 per sec is obtained.
This value agrees with that of 0.81×10^{-6} cal per cm^2 per sec found by Spicer in 1941. Bullard's values of $0.58 - 1.42 \times 10^{-6}$ cal per cm^2 per sec for the floor of the Atlantic Ocean are considered to be invalid because the interval measured was too small and because cooling of the crust by the ocean was not taken into account. — A. J. S.

181-299. Mavritskiy, B. F. Geotermicheskaya zonal'nost' Zapadno-Sibir-skogo artezianskogo basseyna [Geothermal zoning of the West Siberian artesian basin]: Akad. Nauk SSSR Izv. Ser. Geol., no. 3, p. 72-83, 1960.

The term "geothermal zone" is defined as a group of strata within which the rocks and their enclosed waters are characterized by a definite temperature interval. The West Siberian artesian basin is divided into six geothermal zones (< 0°C; 0°C-25°C; 25°C-50°C; 50°C-75°C; 75°C-100°C; and > 100°C) on the basis of analysis of temperature measurements in wells. The minimum is in the Ust'Porta region, where the temperature at 20-25 m depth is 5.2°C. The maximum was encountered in Koplashevsk borehole 2-P, where the temperature at 2,900 m depth is 125°C.

The distribution of temperature is shown in three profiles (Berezovo-Bol'-sherech'ye-Semipalatinsk, Kushmurun-Pokrovskoye-Khanty-Mansiysk, and Turinsk-Tar-Maksimkin Yar) and three maps (at the absolute -1,000 m and -2,500 m levels in Mesozoic formations, and on the pre-Mesozoic basement surface). (See also Geophys. Abs. 180-21.)— D. B. V.

181-300. Ratcliffe, E. H. The thermal conductivities of ocean sediments: Jour. Geophys. Research, v. 65, no. 5, p. 1535-1541, 1960.

The thermal conductivities of samples of sediment from the Pacific, Atlantic, and Mediterranean areas have been measured in the laboratory by a steady-state method. Average values over a wide range of water content are found to depend more on the water content than on the solid phase constituents; conductivity can be read from a diagram if the amount of contained sea water or wet density is known.

A graph compares the thermal conductivities of some other wet granular materials (copper powder, carborundum powder, diatomaceous earth, silver sand) with those of ocean sediment. It is clear that the relatively small differences in the conductivities of ocean sediment grains can be neglected, and that the aforementioned diagram can be used confidently for different sediments. — D. B. V.

Parasnis, D. S. The compaction of sediments and its bearing on some geophysical problems. See Geophys. Abs. 181-485.

181-301. Aksel'rod, S. M. Odnozhil'nyy elektronnyy termometr [An electronic thermometer with a single-core cable]: Razvedochnaya i Promyslovaya Geofizika, no. 23, p. 16-19, 1958.

An electronic thermometer operated with a single-core cable is described. The main element is a copper tube filled with oil through which a copper braid is passed. The temperature measurement is made with a Wheatstone bridge operating with an alternating current. The voltage generated in the diagonal of the bridge is amplified, then rectified, and conducted to the voltmeter at the surface. The temperature range of the apparatus is +15°C - +1,350°C. The velocity during measurements in the borehole must not exceed 2,500 m per hr. — S. T. V.

181-302. Savul, M., and Pomîrleanu, V. Temperatura de formare a cuartului în filoanele hidrotermale din diabazele submarine de la Niculiţel [Temperature of formation of quartz in hydrothermal veins of submarine diabases of Niculiţel (with Russian and French summaries)]: Acad. Romîne Bul. Ştiinţ, Sec. Geologie-Geografie, v. 2, no. 2, p. 311-328, 1957.

Hydrothermal veins within the submarine basalts of Niculitel contain white quartz in paragenetic association with epidote along the outside and clear quartz without epidote in the middle. The temperatures at which two-phase inclusions became homogeneous are presented in tables, and histograms show

the frequency distribution of these temperatures by vein and group of veins. The temperature of homogenization may vary from one inclusion to the next within the same crystal, but the arithmetical mean values of this temperature for crystals from the same vein has little range.

The temperature of homogenization ranges from 90°C to 140°C. There is a maximum frequency at 115°C-120°C for veins at Dealul Tugulea and at 125°C-130°C for those at Dealul din Mijloc. — J. W. C.

INTERNAL CONSTITUTION OF THE EARTH

181-303.   Gutenberg, Beno.   Physics of the earth's interior: New York, Academic Press, 240 p., 1959.

The interior of the earth as revealed by geophysical investigations is reviewed.   The chapters deal successively with fundamental problems and fundamental data; the structure of the earth; the earth's crust; the mantle of the earth; the core; temperature and thermal processes in the earth; density, pressure, gravity, and flattening in the earth; and elastic constants and elastic processes in the earth.   Unsolved problems are pointed out along with results of a more positive nature. — J. W. C.

181-304.   Schmidt, O. J. [Shmidt, O. Yu.], and Levin, B. J. [B. Yu.]. Origin and composition of the earth: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 311-322, 1959.

This is an English version of a paper prepared after Shmidt's death and published (under Levin's name alone) in Akad. Nauk SSSR, Izv. Ser. Geofiz., no. 11, p. 1323-1331, 1957 (see Geophys. Abs. 176-216). — D. B. V.

181-305.   Press, Frank.   Crustal structure in the California-Nevada region: Jour. Geophys. Research, v. 65, no. 3, p. 1039-1051, 1960.

Only by combined use of seismic refraction, surface wave phase velocity, and gravity methods can the fine details of crustal structure in a given region be revealed. The standard phase-velocity curves are revised to take into account recent refraction results in South Africa (see Geophys. Abs. 177-249) and the low-velocity zone in the mantle; restrictions on the use of the phase-velocity method alone are discussed.

In the southern California-Nevada region, seismic-refraction measurements indicate a granitic layer 23 km thick with velocities of 6.11 kmps and 3.49 kmps for P- and S-waves, respectively; 26 km of gabbroic-ultramafic rock with a P-wave velocity of 7.66 kmps; and a substratum of ultramafic rock with a P-wave velocity of 8.11 kmps.   When this structure is used to compute theoretical Rayleigh wave phase velocities and gravity anomaly, discrepancies are found with observed values that can be resolved by reducing the mean shear velocity and density in the crust.   This reduction probably is limited to the intermediate layer.

The occurrence of the unusual P_2 layer in this region and elsewhere in the Basin-Range province has many implications.   This layer may be more important that the M-discontinuity in isostatic adjustment for the region.   Because of its high velocity, the P_2 layer might be identified as shallow mantle if refraction profiles are not sufficiently long. This layer must contain a larger proportion of ultramafic rock than usual in the lower crust.   If the less likely interpretation of a shallow, low-velocity mantle is accepted, then the interesting possibility occurs that the low-velocity zone of the mantle has migrated upwards to the M-discontinuity in this tectonically active region. ——— D. B. V.

181-306.   Koryakin, Ye. D. Zavisimost' mezhdu gravitatsionnymi anomaliya-
mi Buge i moshchnost'yu zemnoy kory v oblasti Atlanticheskogo
okeana   [Relationship between Bouguer gravity anomalies and
thickness of the earth's crust in the region of the Atlantic Ocean]:
Akad. Nauk SSSR Doklady, v. 129, no. 6, p. 1287-1289, 1959.

The relationship between Bouguer anomalies, calculated for a density of
2.8 g per cm^3 for the intermediate layer, and depth of the Mohorovičić dis-
continuity, determined seismically at more than 50 points in the North Atlan-
tic, is plotted and found to be linear.   The slope of the line is less steep than
that plotted by Andreyev for continental regions (see Geophys. Abs. 174-181).
In both continental and oceanic areas, a change of 100 mgal is produced in
the anomaly by a relative change of 22 percent in crustal thickness (10 km on
continents where mean crustal thickness is 45 km, and 3.3 km under the o-
cean where mean crustal thickness is 15 km).
From the relationship between crustal thickness and Bouguer anomalies, the
density contrast at the M-discontinuity is calculated to be 0.72 g per cm^3;
therefore, if the density of basalt is taken as 2.8 g per cm^3, the density of
the substratum must be 3.52 g per cm^3. — D. B. V.

Woollard, G[eorge] P[rior], Ostenso, N[ed] A., and Thiel, E[dward]. Gravity
anomalies, crustal structure, and geology in Alaska. See Geophys. Abs. 181-
275.

181-307.   Balavadze, B. K., and Tvaltvadze, G. K. Structure of the earth's
crust in Georgia from geophysical evidence: Bur. Central Séis-
mol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 81-96,
1959.

This is an English version of the paper that was published in Akad. Nauk
SSSR, Izv. Ser. Geofiz., no. 9, p. 1075-1084, 1958 (see Geophys. Abs. 176-
235). — D. B. V.

Vinogradov, A. P.   Meteorites and the earth's crust.   See Geophys. Abs.
181-66.

181-308.   National Academy of Sciences.   Drilling thru the earth's crust:
[U. S.] Natl. Acad. Sci., Natl. Research Council Pub. 717, 20
p., 1959.

The American Miscellaneous Society (AMSOC) committee has studied the
desirability and feasibility of drilling through the Mohorovičić discontinuity
into the earth's mantle.   Problems connected with drilling in deep water are
discussed; present marine drilling vessels are regarded as satisfactory for
preliminary testing operations. The desirability of such an investigation lies
in direct determination of the nature of the Mohorovičić discontinuity, the
composition and density of the mantle, and a large number of parameters
fundamental to a better understanding of the structure of the earth. Also many
problems in earth history would be elucidated. — J. W. C.

181-309.   Bascom, Willard.   The mohole: Canadian Oil and Gas Industries,
v. 13, no. 3, p. 49-50, 1960.

This is a summary by Beach of a talk by Bascom to a joint meeting of the
Canadian Society of Exploration Geophysicists and the Alberta Society of Pe-

troleum Geologists. The material covered is essentially the same as that in the paper by Lill and Bascom published in Nature, v. 184, no. 4681, p. 140-144, 1959 (see Geophys. Abs. 179-256; see also 181-308). — V. S. N.

181-310.   Bascom, Willard. Operation mohole: Petroleum Engineer, v. 31, no. 9, p. B24-B27, 1959; reprinted in Mines Mag., v. 50, no. 2, p. 15-19, 1960.

This paper covers essentially the same material as that by Lill and Bascom published in Nature, v. 184, no. 4681, p. 140-144, 1959 (see Geophys. Abs. 179-256). — V. S. N.

181-311.   Lill, Gordon G. The deep hole project, in The undiscovered earth: Southern Research Inst. Conf., Birmingham, Alabama, June 1959, Proc., p. 49-52, 1959.

This paper was presented at the annual conference for laymen of the Southern Research Institute and is essentially the same as the paper by Lill and Bascom in Nature, v. 184, no. 4681, p. 140-144, 1959 (see Geophys. Abs. 179-256). — V. S. N.

181-312.   Kuno, Hisashi. Discussion of paper by J. F. Lovering, "The nature of the Mohorovičić discontinuity": Jour. Geophys. Research, v. 64, no. 8, p. 1071-1072, 1959.

Lovering, J. F. Author's reply to preceding discussion: ibid., v. 64, no. 8, p. 1073, 1959.

In an earlier paper (see Geophys. Abs. 175-240) Lovering assumed that the gabbro layer of the earth is thicker than generally accepted, and that the Mohorovičić discontinuity lies within this layer and represents a level of gabbro — eclogite transition. Kuno believes that the petrologic evidence shows that the M-discontinuity is a boundary between a gabbro layer and a peridotite substratum, and that the gabbro — eclogite transition takes place below this discontinuity. His arguments are based on the worldwide occurrence of peridotite inclusions in basaltic rocks and on the nonoccurrence of gabbroic inclusions in association with eclogitic inclusions in basaltic rocks.

Lovering replies that recent work seems to rule out a direct mantle origin for the olivine nodules in basaltic rocks, and that a number of intrusions in eastern Australia show inclusions of eclogitic and gabbroic, as well as peridotitic types in alkali basalts, the eclogitic predominating over the peridotitic. — D. B. V.

181-313.   Dachille, Frank, and Roy, Rustum. High pressure studies of the system Mg_2GeO_4-Mg_2SiO_4 with special reference to the olivine-spinel transition: Am. Jour. Sci., v. 258, no. 4, p. 225-246, 1960.

Results of a study of the system Mg_2GeO_4-Mg_2SiO_4 to the experimental limits of available hydrothermal and uniaxial high-pressure apparatus lead to the conclusion that an olivine-spinel transition in the mantle is a reasonable explanation of the seismic and density discontinuities starting at 400 km. The inversion temperature of the Mg_2GeO_4(spinel)-Mg_2GeO_4(olivine) equilibrium is 810°C at atmospheric pressure. The ΔV of the inversion is 3.5 cc per mole, and ΔH is 3,690 ± 180 cal per mole. The inversion temperature is raised by 0.025°C per bar for the first 5,500 bars. Infrared adsorption spectra, X-ray intensities, and molar refractivities show clearly that Mg_2GeO_4 is an inverse spinel.

Solid solution between Mg_2GeO_4 and Mg_2SiO_4 is complete at temperature above that of the inversion in Mg_2GeO_4. The maximum silicate content of the spinel solid solutions at lower temperatures increases steadily with pressure, from 10 mole percent at 700 bars to 50 mole percent at 60,000 bars at 542°C. Extrapolation places the spinel-olivine transition for Mg_2SiO_4 at 100,000 ± 15,000 bars. The change in the lattice spacings of spinel solid solutions of $Mg_2(Ge, Si)_4$ shows that Mg_2SiO_4(spinel) has a cell edge of 8.22Å. Therefore, the ΔV for this transition is 2.00 cc per mole. The pressure dependence of the transition in Mg_2SiO_4 is estimated by extrapolation at 0.013°C per bar. Substitution of Fe^{+2} for Mg^{+2} markedly increases the maximum silicate content of the spinel solid solution under corresponding pressure-temperature conditions. — V. S. N.

181-314.   Bernshteyn, V. A. O velichine napryazheniy razvivayemykh kon- vektsiey v obolochke na granitse yeye s zemnoy koroy [Intensity of stresses at the crust-mantle boundary caused by convection in the mantle]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 9, p. 1278- 1295, 1959.

An analysis of the physical consequences of a steady convectional move- ment in the spherical shell some 400-500 km thick forming the upper portion of the mantle is presented. It is assumed that this convection is produced by the presence of a constant temperature gradient in the mantle at a certain depth. This makes it possible to derive formulas for the stress components at the boundary surface between the mantle and the crust. Estimation of this stress is made on the assumption of a certain temperature distribution result- ing from the content of radioactive material under the continents being differ- ent from that under the ocean. It is concluded that steady convection in the mantle can involve a layer not greater than 500 km. The formulas show that the tangential component of the stress is proportional to the square of the thickness h of the convectional layer. Numerical evaluations were made for h = 400 km and h = 450 km. The tangential stress is on the order of 10^6 d per cm^2 and probably does not exceed 10^7 d per cm^2. If we assume the lower boundary to be free, then the tangential stresses are increased about 1.5 times; in the literature, however, it is possible to find values as high as 10^9 d per cm^2. — S. T. V.

181-315.   Press, Frank, and Takeuchi, Hitoshi. Note on the variational and homogeneous layer approximations for the computation of Ray- leigh-wave dispersion: Seismol. Soc. America Bull., v. 50, no. 1, p. 81-85, 1960.

An earlier study of upper mantle structure using a variational method [see Geophys. Abs. 179-254] is repeated using the homogeneous layer approxima- tion programed for an electronic digital computer to obtain dispersion curves. The dispersion curves computed by the two methods differ significantly but systematically so as to yield the same conclusion about the presence of the Gutenberg low-velocity zone in the upper mantle. — Authors' abstract

181-316.   Gast, Paul W. Limitations on the composition of the upper mantle: Jour. Geophys. Research, v. 65, no. 4, p. 1287-1297, 1960.

New determinations of the isotopic composition of strontium and of the con- centration of potassium, rubidium, cesium, strontium, and barium in rocks and meteorites are given. The isotopic abundance of strontium-87 in the up- per mantle and the crust appears to be lower than that found for chondrites.

Furthermore, for a chondritic earth model, the concentrations of potassium, rubidium, and cesium in the earth's crust are anomalous when compared with those of uranium, barium, and strontium. These two concurring arguments indicate that the upper mantle and crust of the earth do not contain potassium, rubidium, cesium, uranium, barium, and strontium in the proportions found in chondrites, and that the alkali metals are depleted relative to uranium, strontium, and barium. This depletion may be an indication of a nonchondritic earth composition; it may also result from an earth differentiation in which potassium, rubidium, and cesium were concentrated or retained in the lower mantle. — Author's abstract

181-317.   Licht, A. L.   Convection currents in the earth's mantle: Jour. Geophys. Research, v. 65, no. 1, p. 349-353, 1960.

Using recent measurements by O'Keefe, Eckels, and Squires of the third zonal harmonic component of the earth's gravitational potential (see Geophys. Abs. 176-159), the characteristics of a hypothetical convection current in the mantle according to the Vening Meinesz theory (see Geophys. Abs. 175-191) are determined. The velocity of the current is calculated as 3.6 cm per yr, corresponding to an overturn of 1.75×10^8 yr. Temperature perturbation is found to be 9.7°C. The flow is found to impose a distortion of 159 m on the crust and 237 m on the surface of the core. The mass loading associated with these distortions are calculated as 5.3×10^7 d per cm^2 at the top and 8.9×10^7 d per cm^2 at the bottom of the mantle. The Vening Meinesz theory can explain the results of O'Keefe and his colleagues quantitatively, but if the Vening Meinesz value for viscosity in the mantle is accepted, the required thermal efficiency becomes too high (about 70 percent compared with an estimated maximum of 4 percent) for a convective process. It remains to be seen whether a more realistic theory of convection with a lower efficiency could account for the gravitational observations. — D. B. V.

181-318.   Lyubimova, Ye. A.   O temperaturnom gradiente v verkhnikh sloyakh zemli i vozmozhnosti ob"yasneniya sloya ponizhennykh skorostey [On the temperature gradient in the upper strata of the earth and a possible explanation of the low velocity layer]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1861-1863, 1959.

An attempt is made to explain the low velocity layer at 100 km depth (Gutenberg, Geophys. Abs. 157-184) without resort to special hypothesis of a different physical state of the layer. Considering the upper mantle to consist of three layers (granite, basalt, and peridotite or dunite) the following values were found for dT/dx: 6°C, 13°C, 16°C, 18°c, 19°C, 9°C, and 4°C per km for the depths of 40, 50, 60, 80, 100, 150, and 200 km, respectively. Consequently, the change in the temperature gradient due to a decrease of thermal conductivity in layers 50-200 km deep is capable of explaining the lower seismic velocities in this interval. Similar considerations of the oceanic crust lead to the conclusion that a layer of meteoritic composition under the Mohorovičić discontinuity (40 km) is more probable than one of eclogite. — A. J. S.

181-319.   Zharkov, V. N.   Termodinamika obolochki zemli [The thermodynamics of the mantle of the earth]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 9, p. 1414-1419, 1959.

It is generally assumed that the earth's mantle is solid and is composed of silicates. The independent thermodynamic parameters necessary for descrip-

tion of its mass are its thermal expansion coefficient, specific heat, density, coefficients of the adiabatic and isothermic compressibilities, and others. Zharkov in his studies on silicates introduces, in addition to natural acoustic frequencies, the optical frequencies, following in this respect Einstein's model of a solid body. For the distribution of density in the mantle the A-theory of Bullen is assumed and a number of physical properties such as temperature and density are computed; these values are then compared with the generally assumed characteristics of the mantle. Variations of these values as computed by Zharkov for different depth are shown on several graphs. It is concluded that the Bullen hypothesis as to variation of temperature and pressure cannot be accepted if the mantle is homogeneous; rather, it must undergo a change in chemical composition at a certain depth. (See also Geophs. Abs. 176-246.)—S. T. V.

181-320. Vvedenskaya, A. V., and Balakina, L. M. On some peculiarities of the displacement fields of the longitudinal and transverse waves propagating in the earth's mantle: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 145-149, 1959.

This is an English version of the paper published earlier in Akad. Nauk SSSR Sovet po Seysmologii Byull., no. 6, p. 59-62, 1957 (see Geophys. Abs. 173-245). — D. B. V.

181-321. Magnitsk[i]y, V. A., and Kalinin, V. A. Properties of the earth's mantle and the physical nature of the transition layer (layer C): Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 20, p. 129-144, 1959.

This is an English version of the paper published in the Akad. Nauk SSSR, Izv. Ser. Geofiz., no. 1, p. 87-95, 1959 (see Geophys. Abs. 177-238). — D. B. V.

Ringwood, A. E. Silicon in the metal phase of enstatite chondrites. See Geophys. Abs. 181-56.

181-322. Knopoff, Leon, and MacDonald, Gordon J. F. An equation of state for the core of the earth: Royal Astron. Soc. Geophys. Jour., v. 3, no. 1, p. 68-77, 1960.

Recent shock wave measurements upon the compressibility of iron and 8 other metals, at pressures up to 5 megabars, permit an investigation of the equation of state of the earth's core. The density of iron at T = 0 at 1.4 megabars (core-mantle boundary pressure) is 11.8. The density at the core boundary is estimated to be between 9.1 and 10.0, depending upon the particular earth model. The temperature correction is small. The discrepancy can only be resolved by stating that the core is not pure iron, but rather that it contains significant amounts of alloying elements of lower atomic number than iron. The seismic velocity in pure iron at core pressures is also significantly different from the velocity in the core and also indicates the existence of lighter components within the core. A material of mean atomic number 23 in the core is consistent with the shock wave velocity and density measurements and with seismic observations. — Authors' summary

Strong, H. M. Fusion curve of iron to 96,000 atmospheres: temperature of the earth's core. See Geophys. Abs. 181-294.

Jacobs, J. A. Temperatures within the Earth's core. See Geophys. Abs. 181-295.

Fedorov, E. [Ye.] P. Researches on the nutation in connection with some problems of the constitution of the earth. See Geophys. Abs. 181-147.

ISOTOPE GEOLOGY

181-323. Begemann, Friedrich, and Friedman, Irving. Tritium and deuterium content of atmospheric hydrogen: Zeitschr. Naturforschung, v. 14a, no. 12, p. 1024-1031, 1959.

The tritium and deuterium content of 24 samples of atmospheric hydrogen collected at ground level near Buffalo, N. Y., and Hamburg and Nuremberg, Germany, during 1954 to 1956 was measured. At the beginning of 1954 the tritium-hydrogen ratio was higher than in 1949 and 1951 by a factor of about 10 due to nuclear tests. In spite of other major nuclear tests in the spring of 1954, no further increase was found during 1954 and 1955. A seasonal variation was noted, with low tritium content in summer and about three times as much in winter. There is good correlation between tritium and deuterium concentrations. From 1956 the tritium content increased noticeably due to further nuclear explosions.

Although only a correlation factor between tritium and deuterium of "mean atmospheric hydrogen," rather than their absolute values, can be derived, it is obvious that atmospheric hydrogen and the water vapor of the atmosphere are not in thermodynamic equilibrium, as has been pointed out by Harteck and Suess (1949). — D. B. V.

181-324. Wilson, A. T., and Fergusson, G. J. Origin of terrestrial tritium: Geochim. et Cosmochim. Acta, v. 18, no. 3/4, p. 273-277, 1960.

The possibility of tritium being accreted by the earth from some extraterrestrial source, as has been suggested, has been considered and shown to be highly improbable. The production rate of tritium in the earth's atmosphere by cosmic rays has been calculated from data on the experimentally observed tritium content of meteorites ($0.63^{+0.4}_{-0.2}$ H^3 atom per cm^2 per sec), and also from cosmic ray flux data and nuclear evaporation theory (1.3 ± 0.5 H^3 atom per cm^2 per sec). These results are in reasonable agreement with the experimentally determined terrestrial accumulation rate of tritium of 1.0 ± 0.3 H^3 atom per cm^2 per sec. It thus appears that cosmic ray spallation reactions in the earth's atmosphere are the prime, if not the sole, source of terrestrial tritium. — Authors' abstract

181-325. Simpson, J. A. The production of tritons and C^{14} in the terrestrial atmosphere by solar protons: Jour. Geophys. Research, v. 65, no. 5, p. 1615-1616, 1960.

A new explanation is offered for the fact that the natural production rate of tritium atoms is greater than might be expected from production by cosmic-ray flux in the atmosphere: Intense fluxes of energetic solar protons could produce tritium in the terrestrial atmosphere at times near the maximum of the solar activity cycle (solar flares). The ratio of tritium production by solar protons to tritium production by cosmic radiation is computed as   3.5.

Terrestrial tritium production by solar protons must also be accompanied by additional carbon-14 production. Present carbon-14 production in the at-

mosphere, however, is roughly in agreement with estimates derived from neutron density and total cosmic ray flux. It is pointed out that the carbon-14 production may average out to a lower long-time production rate than estimates from the data in the present, unusually active solar cycle alone would indicate.

The existence of a well defined region in the atmosphere for production of tritons and carbon-14 atoms by solar protons (at an atmospheric depth less than 50 g per cm^2) may have interesting applications to the problems of atmospheric mixing in polar regions. — D. B. V.

181-326. Ault, Wayne U. Oxygen isotope measurements on Arctic cores: U. S. Air Force Cambridge Research Center, Geophys. Research Papers, no. 63, Scientific Studies at Fletcher's Ice Island, T-3, (1952-1955) v. 1, p. 159-168, 1959.

The oxygen-isotope composition of shells (Globigerina pacyderma) that were collected from cores of Arctic sediments taken along the path of Fletcher's Ice Island between the north coast of Ellesmere Island and the Pole was measured to determine the prevailing temperature of the sea in which these forms grew. The quantity of material obtainable from the Arctic cores was only about 10 percent of that normally used for paleotemperature work, and thus the precision of the measurements was limited. Samples from the North Atlantic and Caribbean were also measured as controls on the method and for further information on the oxygen-isotope composition of tests from high latitudes. Since the Arctic material was insufficient for radiocarbon age determination, it was not possible to know whether these cores were comparable in the length of history which they represent, or even the approximate length of the period which they cover. In calculating apparent isotopic temperatures it was assumed that Globigerina pachyderma lived close to the surface during glacial times and that the Arctic Ocean increased in 0^{18} by 0.4 per mil for the entire ocean during the glacial period. It is concluded that over the time range represented by these cores the surface temperature of the Arctic Ocean has not varied beyond the limits -1°C to 3°C. — V. S. N.

181-327. Dansgaard, W[illi], Nief, G., and Roth, E. Isotopic distribution in a Greenland iceberg: Nature, v. 185, no. 4708, p. 232, 1960.

The parallelism between deuterium and oxygen-18 content in snow samples from the Greenland icecap is retained in the ice for several hundred years. The samples used were all taken from one piece of ice emitted from the Ingnerit glacier in west Greenland. The deuterium content and deviation of the oxygen-18 content are plotted against distance of the sample from an arbitrary zero point; their relationship is linear within measuring accuracy.

The highest oxygen-18 contents are found in layers of clear ice that probably originated from summer melting at the time of formation of the ice; the light isotopic component is more volatile and is lost by evaporation from wet snow. — D. B. V.

181-328. Tudge, A. P. A method of analysis of oxygen isotopes in orthophosphate--its use in the measurement of paleotemperatures: Geochim. et Cosmochim. Acta, v. 18, no. 1/2, p. 81-93, 1960.

An analytical procedure is described for the determination of the $0^{18}/0^{16}$ ratio in orthophosphate and condensed phosphate. The method is quantitative, free from isotopic fractionation and exchange, precise to 0.15 permil, and therefore suitable for paleotemperature measurements. — D. B. V.

Vinogradov, A. P., Dontsova, E. [Ye.] I., and Chupakhin, M. S.   Isotopic ratios of oxygen in meteorites and igneous rocks. See Geophys. Abs. 181-60.

Fechtig, H., Gentner, W., and Kistner, G.   Spatial distribution of the noble gas isotopes in the Treysa iron meteorite. See Geophys. Abs. 181-57.

Vinogradov, A. P., Zadorozhniy, I. K., and Florenskiy, K. P.   Content of inert gases in the Sikhote-Alin iron meteorite. See Geophys. Abs. 181-58.

181-329.   Lal, Devendra, Goldberg, Edward D., and Koide, Minoru.   Cosmic-ray produced silicon-32 in nature: Science, v. 131, no. 3397, p. 332-337, 1960.

Silicon-32, recently detected in the marine environment, is thought to be produced from the nuclear spallation of argon by cosmic rays. Its half life is roughly 710 years. Because it decays by beta emission to phosphorus-32, which in turn decays by beta emission and has a half life of 14.3 days, it is possible to detect silicon-32 by milking and counting the phosphorus-32 daughter from large amounts of silicon. Silicon-32 was measured in this way in siliceous sponges from the Gulf of California; the experimental techniques are described, and results tabulated. It is estimated that the average global production rate of silicon-32 in the atmosphere is 2.0×10^{-4} atoms per cm^2 per sec; the corresponding inventory of silicon-32 on the earth is 28 kilocuries, or 1.75 kg.

Silicon-32 can be used as a tracer in studies of mixing times in the oceans, rates of accumulation of sediments, individual characteristics of water masses within oceans with respect to mixing, the silicon cycle in the continental hydrosphere, changes in cosmic ray intensity with time during the last few thousand years, and ages of the polar icecaps. — D. B. V.

181-330.   DeChow, E.   Geology, sulfur isotopes and the origin of the Heath Steele ore deposits, Newcastle, N. B., Canada: Econ. Geol., v. 55, no. 3, p. 539-556, 1960.

Sulfur isotope ratios have been determined for more than 150 sulfide and sulfate specimens from 5 of the 7 ore bodies and from the host rock at the Heath Steele mine in New Brunswick, Canada. The results indicate that there is no detectable fractionation during either the hypogene mineralization or the supergene processes. The spread (21.82-22.02) covered by the ratios is narrow and suggestive of a homogenized source of mineral solutions. An enrichment of sulfur-34 in the ore sulfides and the presence of graphite suggest reduction of original sulfates (known to be enriched in sulfur-34) by organic carbon at temperatures in excess of 600°C. A calculated base on the isotopic exchange reaction between sulfide and sulfate under equilibrium conditions and the spread of the ratios indicate a temperature of 700°C-800°C for the source. — J. W. C.

181-331.   Gerling, E. K., Levskiy, L. K., and Afanas'yeva, L. I.   O nakhozhdenii Ar^{38} v mineralakh soderzhashchikh kaliy [On the discovery of Ar^{38} in minerals containing potassium]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy, 5th sess., Trudy, p. 307-312, 1958.

This paper was previously published in Akad. Nauk SSSR Doklady, v. 109, no. 4, p. 813-815, 1956 (see Geophys. Abs. 177-253). — W. L. G.

Fireman, E. L., and DeFelice, J. Argon-39 and tritium in meteorites. See Geophys. Abs. 181-61.

181-332. Hurley, Patrick M., and others. Initial investigations leading to a study of Sr^{87} variations in the crust and mantle, in Variations in isotope abundances of strontium, calcium, and argon and related topics: Massachusetts Inst. Technology Dept. Geology and Geophysics, U. S. Atomic Energy Comm. 5th Ann. Rept. NYO-3938, p. 129-131, 1958.

The strontium-87 abundance at any point in the earth is proportional to the Rb/Sr ratio at that point. There is a strong enrichment of rubidium relative to strontium in the earth's crust as compared to that in the mantle, and it is probable that there is a general decrease in the Rb/Sr ratio with depth in the upper mantle.

This means that materials at the surface today will show strontium-87 abundances in accordance with the time integral of the Rb/Sr ratios in their past environments. This provides a means of determining the genesis of certain rock types, or, if the history is known, of determining the time during which the present system has remained intact. Results of four initial investigations are given to illustrate the technique: (1) eclogite xenoliths in the kimberlite pipes of South Africa to check the possibility that the xenoliths are ancient pieces of mantle from great depth; (2) genesis of the large belts of ultramafic rocks in the island arc areas; (3) the approximately cogenetic pair Ely greenstone-Soudan interbedded tuffaceous sediments, Keewatin age, Minnesota; and (4) anorthosite and red granite of the Bushveld complex for comparison of the strontium-87 abundances and consequent data on their histories. — V. S. N.

181-333. Starik, I. Ye., Sobotovich, E. V., Avdzeyko, G. V., and Lovtsyus, A. B. Novyy method opredeleniya isotopnogo sostava svintsov iz porod [A new method of determination of the isotopic composition of leads in rocks]: Akad. Nauk SSSR Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy, 5th sess., Trudy, p. 233-242, 1958.

Considering the importance of the isotopic composition of lead in rocks for clarifying the origin of particular isotopes and for age determinations of rocks and of the earth, a method is proposed for extraction of lead by sublimation. The validity of the method was confirmed by experimental data which showed an identical isotopic composition of lead sublimated from entirely different samples of rocks. The isotopic composition of lead from the Pitkyaranty and Terskey-Altan granites is given. — A. J. S.

Russell, R. D., and Farquhar, R. M. Dating galenas by means of their isotopic constitutions—II. See Geophys. Abs. 181-7.

181-334. Reynolds, J[ohn] H. Isotopic composition of primordial xenon: Phys. Rev. Letters, v. 4, no. 7, p. 351-354, 1960.

The carbonaceous meteorite, Murrey, shows a large excess of xenon-129. There appears to be an isotopic difference between primordial xenon and the xenon of the atmosphere. Xenon is apparently unique among the elements in exhibiting an effect of this kind and magnitude. The xenon in meteorites may have been augmented by nuclear processes between the time it was separated from the xenon now on earth and the time the meteorites were formed. — J. W. C.

181-335.   Young, B. G., and Thode, H. G.   Absolute yields of the xenon and
           krypton isotopes in U^{238} spontaneous fission: Canadian Jour. Phy-
           sics, v. 38, no. 1, p. 1-9, 1960.

The absolute abundances of the isotopes of fission-product xenon and kryp-
ton in six uranium minerals have been determined mass spectrometrically
using the isotope dilution technique. The fission products were resolved into
a uranium-238 spontaneous fission component, a uranium-235 neutron-induced
fission component, and a uranium-238 neutron-induced fission component.
Internal consistency in the analysis was achieved only when the xenon-129
yield used for the uranium-235 thermal neutron fission component was 20 per-
cent lower than that reported by Purkayastha and Martin at iodine-129. This
discrepancy in the mass 129 chain yield measured at iodine-129 and xenon-
129 has not been resolved.
Only 1 of the 6 minerals, Cinch Lake pitchblende, retained essentially all
of its fission product inert gases throughout geological time. Inert gas losses
from the remaining 5 minerals ranged from 20 percent to 70 percent. The ab-
solute yields of the stable xenon and krypton fission products in uranium-238
spontaneous fission were determined from an analysis of the inert gases from
the Cinch Lake mineral. This analysis showed that 95.9 percent of the fission
gas in this case resulted from the spontaneous fission and only 4.1 percent
from neutron-induced fission. — Authors' abstract

Mair, J. A., Maynes, A. D., Patchett, J. E., and Russell, R. D. Isotopic
evidence on the origin and age of the Blind River uranium deposits. See Geo-
phys. Abs. 181-36.

Blankov, Ye. B., and Blankova, T. N.   Experiences with the method of in-
duced radioactivity in oil wells. See Geophys. Abs. 181-424.

Peters, B.   Cosmic-ray produced radioactive isotopes as tracers for study-
ing large-scale atmospheric circulation. See Geophys. Abs. 181-417.

MAGNETIC FIELD OF THE EARTH

181-336.   Vestine, E. H.   The survey of the geomagnetic field in space: Am.
           Geophys. Union Trans., v. 41, no. 1, p. 4-21, 1960.

The history of mapping of the earth's magnetic field is reviewed, and meth-
ods of conducting the world magnetic survey proposed at the meeting of the
CSAGI in Moscow in July 1958 as a deferred item of the International Geo-
physical Year are discussed. Four approaches should be used simultaneously:
satelliteborne-magnetometer survey, airborne-magnetometer survey, ocean
measurement by nonmagnetic ship, and land-magnetic survey.   The field
should be specified both in magnitude and direction, especially at satellite
levels where the main field might be small.
A complete survey by means of an earth satellite can be made in a relatively
short period of time, so that serious problems from secular change will not
arise, but there might be other transient effects, such as those caused by polar
disturbances. Separate land and rocket measurements will be needed as con-
trols, and polar orbits are necessary to afford full coverage.
Surveys should be repeated to permit estimates of secular change.   There
is no fundamental difficulty involved in the problem of reduction of the results;
existing methods are adequate. A permanent service of some kind is impera-

tive in order to promote international cooperation and exchange, and publication and dissemination of data.

A symposium on the proposed world magnetic survey will be held at the 1960 Helsinki meeting of the International Union of Geodesy and Geophysics. ———— D. B. V.

181-337. Dessler, A. J., and Vestine, E. H.   Maximum total energy of the Van Allen radiation belt: Jour. Geophys. Research, v. 65, no. 1, p. 1069-1071, 1960.

The results of spherical harmonic analysis of the geomagnetic field place an upper limit on the energy that can be stored in the Van Allen radiation belt. Conservative figures indicate a maximum energy in trapped radiation of 6 $\times$ 10^{15} joules.

Some observed phenomena that may be explained in terms of the effect of this trapped radiation are the geomagnetic variation with the sunspot cycle and the annual variation of the geomagnetic field. — D. B. V.

181-338. Takeuchi, Hitoshi.   A contribution to the dynamo theory of the earth's main magnetic field [in Japanese with English abstract]: Zisin, v. 12, no. 3, p. 122-129, 1959. Reprinted in Tokyo Univ. Geophys. Inst. Geophys. Notes, v. 12, no. 2, contr. 16, 1959.

The dynamo theory of the earth's main magnetic field states that groups of magnetic fields can be maintained in a stationary position by fluid motions of certain magnitude. The first part of this paper deals with the time characteristics of these groups of magnetic fields when driven by motions of larger or smaller magnitude than those required to keep the fields stationary. It was found that when driven by motions of larger or smaller magnitude the fields develop or decay exponentially.   In the second part of the paper, the mathematics of induction of the $T_2°$ field from the $S_1°$ field by $T_1°$ motion are presented in a simplified form. — V. S. N.

181-339. Thellier, Émile.   Magnétisme terrestre [Terrestrial magnetism] in La Terre, Encyclopédie de la Pléiade: [Paris]   Librairie Gallimard, p. 529-625, 1959.

Earth magnetism is reviewed as a chapter of this long established French encyclopedia.   Measurement of the magnetic field of the earth is discussed first and is followed by a short section devoted to France.   Dirunal and secular variations are treated in moderate detail.   Finally, earth currents are discussed. —J. W. C.

Bossy, L., and De Vuyst. A. Relationships between the electric and magnetic fields of a wave of very long period induced in a medium of variable conductivity. See Geophys. Abs. 181-79.

181-340. Shapiro, I. R., Stolarik, J. D., and Heppner, J. P.   The vector field proton magnetometer for IGY satellite ground stations: Jour. Geophys. Research, v. 65, no. 3, p. 913-920, 1960.

By applying homogeneous bias fields to a proton precessional magnetometer, vector magnetic field measurements of exceptional accuracy can be obtained. A vector proton magnetometer that has been in operation at nine Minitrack stations since the spring of 1958 is described. —— Authors' abstract

181-341. Hurwitz, L., and Nelson, J. H.   Proton vector magnetometer: Jour. Geophys. Research, v. 65, no. 6, p. 1759-1765, 1960.

Z and H, as well as F, have been measured at the Fredericksburg Magnetic Observatory with a proton vector magnetometer, combining a proton-precession intensity magnetometer and a Helmholtz coil system mounted on a horizontal circle.

Formulas for the effect of various instrumental adjustments are given without proof; the only critical adjustment is the level of the horizontal circle (magnetometer base). The internal consistency of the observed values Z_P, F_P, and H_P is indicated by the smallness of computed values $H_P - (F_P^2 - Z_P^2)^{\frac{1}{2}}$; these values are less than 3 gamma in magnitude and have a mean of 0.4 gamma. Preliminary results of comparison with the observatory sine galvanometer and earth inductor are: PVM - SG (measurements of H) = 2.7 gamma, PVM - EI (measurements of dip) = 1". The source of the H difference is now being investigated. —Authors' abstract

181-342. Lucke, O., and Sparrer, H.   Die Geräteconstante des elektrodynamischen Theodoliten des VEB WTBG, Berlin und die Vermessung der Primärspule mit dem Messgerät des VEB Carl Zeiss, Jena [The instrumental constants of the electrodynamic theodolite of the VEB WTBG, Berlin, and the measurement of the primary coil with the measuring apparatus of the VEB Carl Zeiss, Jena]: Zeitschr. Geophysik, v. 24, no. 4/5, p. 284-298, 1958.

Reusche's description of the new electrodynamic theodolite (see Geophys. Abs. 181-343) is supplemented by an outline of the theory of the instrumental constants. To determine the constants of the new apparatus, an exact measurement of the primary coil is necessary. A special comparator has been developed to measure this coil so accurately that the constants can be calculated with a relative accuracy of 10^{-6}. The apparatus is described and illustrated by photographs and schematic diagrams. — D. B. V.

181-343. Reusche, Hans-Georg.   Ein absoluter magnetischer Theodolit [An absolute magnetic theodolite]: Zeitschr. Geophysik, v. 24, no. 4/5, p. 299-306, 1958.

A new electrodynamic theodolite for absolute measurement of the geomagnetic field is described, and photographs and schematic diagrams are presented. The instrument is an improvement on the Johnson apparatus; it is based on a new principle of measurement and incorporates some technical innovations that avoid some of the weaknesses of the other. Measurements of the geomagnetic field can be made with greater accuracy even in the presence of disturbing fields of 50 cycles per second. — D. B. V.

181-344. Svoboda, Karel.   Berechnung der magnetischen Deklination in der ČSR [Calculation of magnetic declination in Czechoslovakia]: Gerlands Beitr. Geophysik, v. 68, no. 5, p. 289-294, 1959.

Tables and diagrams are given for calculating magnetic declination anywhere in Czechoslovakia during the period 1850-1950. — D. B. V.

181-345. Conley, Joseph M.   Earth's main magnetic field to 152 kilometers above Fort Churchill: Jour. Geophys. Research, v. 65, no. 3, p. 1074-1075, 1960.

This letter is a report on quiet-field geomagnetic measurements made during rocket flights at Fort Churchill on Hudson Bay in Manitoba. The results indicate that the earth's main field at Churchill is represented by $F = F_0 [a/(a+h)]^3 \pm 20\gamma$, where $F_0 = 61,240\gamma$, $a = 6,065$ km, and h is altitude above sea level. This equation is meant only as an empirical relation for altitudes less than 150 km. This represents a difference of about -132γ per km altitude from a centered dipole field. — D. B. V.

181-346.   Dolginov, S. Sh., and Pushkov, N. V. Rezultaty izmereniya magnitnogo polya Zemli na kosmicheskoy rakete [Results of measurement of the magnetic field of the earth in a space rocket]: Akad. Nauk SSSR Doklady, v. 129, no. 1, p. 77-80, 1959.

The results of measurements of the intensity of the geomagnetic field out to some tens of earth's radii, obtained by a rocket launched on January 2, 1959, are presented graphically. The measured curve of intensity versus distance departs from the theoretical curve mainly in the interval of about $18\text{-}24 \times 10^3$ km. Variations in cosmic ray intensity, also measured by the rocket, show a quantitative relationship between corpuscular radiation and the anomalous part of the magnetic field. — D. B. V.

181-347.   Wilson, Raymond H., Jr. Geomagnetic rotational retardation of satellite $1959\alpha1$ (Vanguard II): Science, v. 131, no. 3395, p. 223-225, 1960.

Radio observations made during the battery life of Vanguard II showed that the satellite's rotation was being retarded exponentially at a rapid rate. Precise analysis of electromagnetic couples on the conducting and magnetic parts of the satellite indicates a mean ambient geomagnetic field of 0.158 gauss and confirms the eddy-current theory previously applied to Vanguard I. — Author's abstract

181-348.   Parkinson, W. D., and Cleary, J. The eccentric geomagnetic dipole: Royal Astron. Soc. Geophys. Jour., v. 1, no. 4, p. 346, 1958.

It is calculated from the Gauss coefficients, using 1955.0 values, that the eccentric geomagnetic dipole is displaced by 0.0685 earth radii (about 436 km) from the center towards a point at lat 15.6° N., long 150.9° E. (just east of the Marianas). This is 6.6°, or 730 km, north of the geomagnetic equator. The poles of the eccentric dipole are at lat 81.0° N., long 84.7° W. and at lat 75.0° S., long 120.4° E. (in Ellesmere Island and Wilkes Land, respectively). The axis of the eccentric dipole is not vertical at these points, but at two points that are farther from the geomagnetic poles (lat 82.4° N., long 137.3° W., about 1,200 km from the observed northern dip pole, and lat 67.9° S., long 130.6° E., close to the observed southern dip pole). — D. B. V.

Schmucker, Ulrich. Some results of geomagnetic depth sounding in north Germany. See Geophys. Abs. 181-80.

181-349.   Barta, György. Über die Säkularbewegung des magnetischen Zentrums und der magnetischen Pole der Erde [On the secular movement of the magnetic center and magnetic pole of the earth]: Zeitschr. Geophysik, v. 24, no. 4/5, p. 197-209, 1958.

Observations over the past 60-70 years show that the most important point of symmetry of the geomagnetic secular variation is in the Pakistan region.

Study of diagrams in various projections leads to the conclusion that a circular current with a radius of about 3,000 km flows at a depth of 3,000 km, with Pakistan as the center. The center point of the eccentric magnetic dipole in the earth is shown to be moving gradually toward Pakistan; a relationship between the two phenomena is inferred.

The position of the magnetic center, direction of the dipole, and magnetic pole positions in both hemispheres back to 1550 A. D. are calculated on the basis of the spherical harmonic expansions of Fritsche; results are in good agreement with observations made in the last century. (See also Geophys. Abs. 179-287.)— D. B. V.

181-350.   Bucha, Václav. Säkulare Variation der Vertikalkomponente Z des geomagnetischen Normalfeldes in der tschechoslowakischen Republik zwischen 1890 und 1955 [Secular variation of the vertical component Z of the geomagnetic normal field in the Czechoslovakian Republic between 1890 and 1955 (with Russian and Czech summaries)]: Československá Akad. Věd Geofys. Sborník, no. 89, p. 253-262, 1958.

The secular variation of vertical geomagnetic intensity in Czechoslovakia has been calculated on the basis of observations at secular stations and the Pruhonice and Hurbanovo observatories in Czechoslovakia and at three other central European observatories (Fürstenfeldbruch, Germany; Niemegk, Germany; and Vienna, Austria). Normal values calculated for individual epochs at 5-year intervals between 1890 and 1950 are tabulated and compared with values for epoch 1950.0. A small map of mean secular variation of the Z component in Czechoslovakia has been constructed for the period 1950-60. — D. B. V.

181-351.   Kertz, W[alter]. Tages- und jahreszeitliche Variationen des erdmagnetischen äquatorialen Ringstromes [Diurnal and seasonal variations of the geomagnetic equatorial ring current]: Zeitschr. Geophysik, v. 24, no. 4/5, p. 210-215, 1958.

Diurnal and seasonal variations in intensity of the equatorial ring current and their relationship to the angle between the geomagnetic axis and the line from the sun to the center of the earth are discussed. An observed temporal phase difference can be explained by distortion of the outer geomagnetic field. —— Author's abstract, D. B. V.

181-352.   Ingraham, R. L. Note on the tidal theory of the S_q magnetic field: Jour. Atmos. Terrest. Physics, v. 16, no. 3/4, p. 263-273, 1959.

The observed ratio of the diurnal to semidiurnal components of the S_q field is greater than unity and roughly a thousand times greater than expected from order of magnitude arguments based on the tidal theory of atmospheric oscillations. An exact calculation is made using a dynamo theory to see whether "accidental" features might arise; the anomaly persists, however. Possible explanations based on details of the tidal theory are presented. There may be a resonating diurnal mode besides the well-established semidiurnal one; or diurnal and semidiurnal motions may rise to high maximums around lat 30° N. and S. and in the polar regions as a result of rotation of the atmosphere, which has been ignored. The diurnal maximums should have much greater weight than the semidiurnal in the integral for the S_q field. — D. B. V.

181-353.   Hasegawa, M. On the position of the focus of the geomagnetic S_q current system: Jour. Geophys. Research, v. 65, no. 5, p. 1437-1447, 1960.

This paper reviews present knowledge about the S_q focuses, discusses the cause of changes in the S_q field, and describes problems concerning the determination of the S_q focus. It is concluded that the focuses in the potential fields of geomagnetic D_q variations may be taken as approximately indicating the positions of ionospheric S_q current focuses. — Author's abstract

181-354.   Akasofu, Syun-ichi.   The ring current and the outer atmosphere. Jour. Geophys. Research, v. 65, no. 2, p. 535-543, 1960.

It is shown that hydromagnetic propagation will enable the earth's field at ground level to be affected with a lag of less than 1 minute by changes in electric currents far above the earth--for example, by a changing ring current with a radius a few times that of the earth. It is shown that a system of trapped high-speed charged particles, such as those in the Van Allen belts, involves electric current flow; the deciding factor is the curvature of the guiding lines of the geomagnetic field. Thus an enhancement of the Van Allen radiation belts will decrease the horizontal geomagnetic component. Such a change is observed during the main phase of a magnetic storm. A suggestion is made about the origin of trapped high-energy particles from the analysis of two large magnetic storms during the IGY. — Author's abstract

181-355.   Hines, C. O., and Parker, E. N.   Statement of agreement regarding the ring-current effect: Jour. Geophys. Research, v. 65, no. 4, p. 1299-1301, 1960.

In an earlier communication (see Geophys. Abs. 180-258) Hines and Parker recorded discrepant views regarding the possible magnetic effects at the ground caused by a hypothetical ring current in the exosphere. They now reach agreement on the basis of a new model (see Geophys. Abs. 180-257) which seems to be more in keeping with the natural phenomenon. With this model the time required for blobs of solar gas in the geomagnetic field to merge with the general exospheric ionization could be fairly short and might correspond to the transition time between the initial and main phases of a magnetic storm. Once the excess matter has merged with the exospheric ionization, it would follow trapped orbits in the geomagnetic field and thus establish a sort of ring current of more complex nature than that of earlier concepts. The disturbance it produces would propagate rapidly to the earth and could produce there the main-phase decrease of a magnetic storm. — D. B. V.

181-356.   Francis, W. E., Green, M. I., and Dessler, A. J.   Hydromagnetic propagation of sudden commencements of magnetic storms: Jour. Geophys. Research, v. 64, no. 10, p. 1043-1045, 1959.

A curve for hydromagnetic wave velocity as a function of altitude has been computed from recent data to replace the one previously reported (see Geophys. Abs. 174-265). The difference in transit times for waves generated at 6 earth radii to reach the surface at noon meridian and at midnight meridian in the equatorial plane is found to be approximately 11 sec. The difference in delay times for waves originating between 2 and 10 earth radii is only a few tenths of a second; this seems to indicate that the delay times for the sudden commencements of weak and strong magnetic storms will not vary appreciably. — D. B. V.

181-357.   Akasofu, Syun-ichi.   Magneto-hydrodynamic waves in the ionosphere: Jour. Atmos. Terrest. Physics, v. 15, no. 1/2, p. 156-160, 1959.

The study is made of the magnetohydrodynamic waves in the ionosphere and the outer atmosphere. The dispersion relations of Alfvén waves are obtained, and it is shown that various types of geomagnetic micropulsations and ionospheric noises appear in the wide range from audio to very low frequency. The Alfvén waves with finite amplitude are also studied. It is suggested that the retarded-sound-type shock wave may be identified with the descending "cusps" on h'-f curve of ionogram. — Author's abstract

181-358.   Bless, R. C., Gartlein, C. W., Kimball, D. S., and Sprague, G. Auroras, magnetic bays, and protons: Jour. Geophys. Research, v. 64, no. 8, p. 949-953, 1959.

Various statistical and detailed studies of the relation between auroras and bays are presented. It appears that bays and auroras are manifestations of the same phenomenon.
Numerical estimates are presented which indicate that the bay can be caused by atmospheric winds operating on ionized particles produced by incoming 50-Kev solar protons. It is not necessary to postulate any dynamo action. — Authors' abstract

181-359.   Campbell, Wallace H. Magnetic micropulsations and the pulsating aurora: Jour. Geophys. Research, v. 65, no. 2, p. 784, 1960. Campbell, Wallace H. Magnetic pulsations, pulsating aurora, and ionospheric absorption: ibid., v. 65, no. 6, p. 1833-1834, 1960.

Records obtained at College, Alaska, reproduced in the articles show a relation between magnetic field micropulsations and pulsating aurora, and an increase in ionospheric absorption during such times of pulsation. A full report on these observations is in preparation. (See also Geophys. Abs. 181-360.) — D. B. V.

181-360.   Campbell, W[allace] H. Micropulsations in the earth's magnetic field simultaneous with pulsating aurora: Nature, v. 185, no. 4714, p. 677, 1960.

Records obtained at College, Alaska, are reproduced: these show nightly coincidence of geomagnetic micropulsations and auroral pulsations. On one occasion the two phenomena exhibited simultaneous oscillations. — D. B. V.

181-361.   Warwick, Constance S., and Hansen, R. T. Geomagnetic activity following large solar flares: Jour. Atmos. Terrest. Physics, v. 14, no. 3/4, p. 287-295, 1959.

Superposed epoch analysis of the geomagnetic index around the day of occurrence of large central solar flares shows a significant increase in geomagnetic activity following flares selected according to their area and "importance." The association does not extend to flares of lesser "importance" (class 2). During 1950-54 near sunspot minimums there was no tendency for geomagnetic disturbance to follow within 2 - 3 days after the 14 reported flares of class 3 and 3+. — D. B. V.

181-362.   Barsukov, O. M. Geomagnitnaya effektivnost' khromosfernykh vspyshek po materialam 1957 g [The geomagnetic effects of the chromospheric flares according to data of 1957]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 11, p. 1690-1693, 1959.

The relationship between solar flares and geomagnetic activity is discussed on the basis of 233 flares of 1957. The number of flares for eight longitudinal zones of the sun were tabulated, and a mean value was calculated for each zone. The relationship between this mean value and the maximum of geomagnetic disturbance shows that the magnitude of a disturbance is dependent on where the flares occur. — J. W. C.

Bernard, Pierre. On the mechanical balance of the solar influence on terrestrial phenomena. See Geophys. Abs. 181-146.

181-363. Matsushita, S. Studies on sudden commencements of geomagnetic storms using IGY data from United States stations: Jour. Geophys. Research, v. 65, no. 5, p. 1423-1435, 1960.

This report contains studies of geomagnetic storm variations recorded at a network of seven International Geophysical Year stations in the United States together with records for other observatories operated by the United States. The distance between adjacent stations of the network ranges from 360 to 510 km. Geomagnetic variations at these stations were usually quite similar, as would be expected. During magnetic storms, however, remarkable difference occurred even between adjacent stations.

About half of the sudden commencements of the horizontal component showed different shapes at adjacent stations for the same magnetic storm. From the data obtained from these results, and from observations at more distant stations, the behavior of sudden commencements is examined. The data also show that the variations of the vertical component of the sudden commencement differ in ways suggesting notable irregularities of the earth's conductivity in the central part of the United States. In addition, occasional examples of bay-shaped variations during magnetic storms, which are quite nonuniform over the closely spaced net, are illustrated and analyzed. — Author's abstract

181-364. Kato, Y[oshio], and Watanabe, T[omiya]. Studies on geomagnetic storm in relation to geomagnetic pulsation: Jour. Geophys. Research, v. 63, no. 4, p. 741-756, 1958.

The Chapman-Ferraro theory of magnetic storms can be improved hydromagnetically by taking into account the existence of the outer atmosphere. Sudden commencement is described as the compression of the outer atmospheric matter due to the corpuscular stream. The main phase might be due to hydromagnetic rotation of the outer atmosphere. The structure of the solar corpuscular stream responsible for the 27-day recurring magnetic disturbance can be modelled by the Pecker-Roberts "cone of avoidance," which is favored by both magnetic and cosmic-ray phenomena. The sporadically occurring magnetic storm (S type) corresponds to the corpuscular stream with shock front formed in interplanetary matter.

Determination of storm-time variation in activity of geomagnetic pulsations (pc type) should aid in determining the structure of the corpuscular stream. — D. B. V.

181-365. Burkard, Otto. Die Häufigkeit plötzlicher Sturmanfänge (S. S. C. s) in Abhängigkeit von der Weltzeit [The frequency of sudden commencements (SSC's) as a function of Greenwich time]: Gerlands Beitr. Geophysik, v. 68, no. 5, p. 280-282, 1959.

Statistical investigation of sudden commencements observed from 1950 to 1956 shows a maximum of frequency between 10^h and 11^h G. m. t. and a minimum between 19^h and 20^h, with a weaker maximum between 0^h and 1^h and a

suggestion of a minimum between 3^h and 4^h. This newly detected relationship of SSC's to G.m.t. should not be confused with the time relationship of the amplitude of these magnetic impulses found by Ferraro and Unthank (Geophys. Abs. 149-13573), which depends on local time. Both phenomena must be taken into account in theories of magnetic storms. — D. B. V.

181-366.   Abe, Siro.   Morphology of ssc and ssc*: Tokyo Univ. Geophys.
            Inst. Geophys. Notes, v. 12, no. 2, contr. 21, 1959.

This paper was published originally in Jour. Geomagnetism and Geoelectricity [Kyoto], v. 10, no. 4, p. 153-163, 1959 (see Geophys. Abs. 179-298). — D. B. V.

181-367.   Ellis, G. R. A.   Geomagnetic disturbances and 5 kilocycles per
            second electromagnetic radiation: Jour. Geophys. Research, v.
            65, no. 6, p. 1705-1710, 1960.

A comparison is made between variation of the geomagnetic field and bursts of 5-kc radio noise recorded at Camden, New South Wales, Australia, between June 1958 and October 1959. The 8 noise storms recorded occurred during the main phase of a geomagnetic storm. They began with an average delay of 3 hours after the start of the main phase. Of 97 isolated noise bursts of less than 4 hours duration, 43 were associated with positive bays in the record of the magnetic H component; no consistent delay between the noise burst and the bay was observed. Noise bursts were not, in general, associated with geomagnetic micropulsations of less than 1 minute periods, although some correlation with quasi-sinusoidal magnetic variations with periods between 10 and 60 minutes was noted. During the period of observation 30 sudden commencements were followed by noise bursts or storms after an average delay of 8.5 hours. On 4 occasions a noise burst started immediately after a sudden commencement that occurred between 1200 and 1800 G.m.t.

The small amount of evidence so far available supports the hypothesis that the 5-kc noise is generated in the outer atmosphere and that it is closely associated with both the acceleration of auroral particles and the main phase of the magnetic storm. The ring-current theory appears to be more consistent with the noise observations than is the ionospheric-heating theory. — D. B. V.

181-368.   Lowrie, J.   Rapid fluctuations during magnetic disturbance: Jour.
            Atmos. Terrest. Physics, v. 17, no. 1/2, p. 145-149, 1959.

A numerically simple coincidence ratio is defined and used to examine space relationships of rapid geomagnetic fluctuations during disturbance. Although the network of stations considered is a limited one, the following conclusions are drawn for fluctuations of 30-sec - 5-min duration: simultaneous impulses recorded over a distance of less than 500 km can usually be assumed to be related; a significant proportion of simultaneous impulses at all points at least near the same meridian are related; and over Europe any one-way propagation along the geomagnetic meridian must be faster than 3×10^4 m per sec, on the average. — D. B. V.

181-369.   Kimpara, Atsushi. Correlation of occurrence of whistlers with geo-
            magnetic activity: Nature, v. 186, no. 4720, p. 230, 1960.
            Kimpara, Atsushi. Sur une correlation entre les atmosphériques
            siffleurs et les perturbations géomagnétiques [On a correlation
            between atmospheric whistlers and geomagnetic perturbations]:
            Acad. Sci. [Paris] Comptes Rendus, v. 250, no. 14, p. 2596-
            2597, 1960.

Investigation of the relation between the occurrence of whistlers and geomagnetic activity recorded at Toyakawa and Wakkanai stations and Kakioka Observatory in Japan during the period July 1957 through June 1959 shows a definite seasonal influence.   Whistlers occur most frequently in winter, with a lag of two days after days for which the "effective K indices" are more than 6.   No similar relationship was found to exist in summer. — D. B. V.

181-370.   Benioff, Hugo. Observations of geomagnetic fluctuations in the period range 0. 3-120 seconds: Jour. Geophys. Research, v. 65, no. 5, p. 1413-1422, 1960.

Data are presented from a 5-year series of observations of geomagnetic fluctuations in the period range 0. 3-120 sec, approximately. These were carried on with flux rate variographs using pickup coils with 1-sec period galvanometers recording photographically at a trace speed of 1 mm per sec with maximum sensitivities of 0. 05 gamma per sec per trace mm. Four characteristic types of oscillations are included in this study.

Type A oscillations, approximately sinusoidal in form, range in period from 0. 3 to 2. 5 sec and in southern California occur at night only. They exhibit a negative correlation with sunspot numbers. Type B oscillations are nearly sinusoidal in form with periods ranging from about 3 to 8 sec. They appear to be associated with the local occurrence of auroras. Type C oscillations are nearly sinusoidal in shape with periods ranging from about 7 to 30 sec. In southern California they occur in daylight and exhibit a strong correlation with sunspot numbers. Type D oscillations are transients in the form of single or multiple pulses or trains of several oscillations. The pulse breadths or oscillation periods range from about 40 to 120 sec or more. They are strictly nocturnal in southern California with a sharp peak in the rate of occurrence at local midnight.

Some characteristics of sudden-commencement components in the observed period range are mentioned briefly. — Author's abstract

181-371.   Scholte, J. G. J.   On the theory of giant pulsations: Jour. Atmos. Terrest. Physics, v. 17, no. 4, p. 325-336, 1960.

The propagation of a magnetoionic disturbance originating in a small region of the exosphere has been investigated; it appears that only a rotational movement perpendicular to the geomagnetic field is propagated without any great loss of energy. The amplitude of a compressional movement perpendicular to this field decreases with increasing distance to the source, whereas a movement parallel to the magnetic field is propagated as a sound wave without any magnetic effect. Therefore, the observed giant pulsations, which are ascribed to standing waves along the lines of force, are mainly caused by the rotational part of the primary disturbance and the properties of these variations are closely connected with the properties of that part of the original movement. — Author's abstract

181-372.   Obayashi, T., and Jacobs, J. A. Geomagnetic pulsations and the earth's outer atmosphere: Royal Astron. Soc. Geophys. Jour., v. 1, no. 1, p. 53-63, 1958.

Hydromagnetic oscillations of the earth's ionized atmosphere along the geomagnetic lines of force are considered. The observational evidence of worldwide geomagnetic pulsations yields the distribution of ionic density in the outer atmosphere extending beyond the ionosphere. It is found that the ion density is about 10^3 per cm^3 at a distance of a few earth radii decreasing expo-

nentially to a value of the order of 5 per cm^3 in interplanetary space. A theoretical consideration of the temperature of the outer ionosphere is also discussed. — Authors' summary

181-373.   Kalashnikov, A. G., and Mokhova, Ye. N.   O variatsiyakh regional'nogo elektromagnitnogo polya malogo perioda [On variations of the regional electromagnetic field of small period]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 1, p. 50-54, 1960.

A study was made of small-period variations of impulse, train, and microbay types recorded simultaneously over a large area by four stations: "Borok" (ϕ = 58°2', λ = 38°58'), "Lovozero" (ϕ = 67°58', λ = 35°5'), "Petropavlovsk" (ϕ = 53°6', λ = 158°38'), and "Dusheti" near Tbilisi (ϕ = 42° 5', λ = 44°42') in the U. S. S. R.   Data from several American magnetic stations were also analyzed. Assuming that the frequency characteristics of the apparatus at the Russian stations are approximately equal, it was found that the values of H_Z of the observed variations are equal at these stations, and that the horizontal component of earth currents at these stations can be given by the expression $E = (E_{N-S}^2 + E_{E-W}^2)^{\frac{1}{2}}$. No explanation has been found for these regularities; however, various possibilities have been suggested. — A. J. S.

181-374.   Loughman, C. J.   Motion of geomagnetic field lines: Nature, v. 186, no. 4718, p. 33-34, 1960.

It is shown that the upper limit of the movement of auroral phenomena due to distortion of the earth's field is 0. 015 Δ km.   This equals 50 km only if Δ has the extreme value of 3, 300 γ; if Δ is less than 1, 300 γ, as in most magnetic storms when the K-index does not exceed 7, the displacement is less than 20 km.   The geomagnetic lines of force can be moved through great distances at low altitudes only by very slow changes, such as those with the period of the sunspot cycle. — D. B. V.

181-375.   Danjon, André.   Sur un changement du régime de la rotation de la Terre survenu au mois de juillet 1959 [On a change in the regime of the rotation of the earth observed in the month of July 1959]: Acad. Sci. [Paris] Comptes Rendus, v. 250, no. 8, p. 1399-1402, 1960.

About July 21, 1959, the earth's rotation changed its speed for the second time since the middle of 1955.   The length of the day suddenly increased by 0. 85 milliseconds and since then has decreased at a rate of 3. 7 microseconds per day.   There seems to be a correlation between this sudden change and the very intense magnetic storm of July 15, 1959.   It is suggested that solar eruptions responsible for magnetic storms can also affect the earth's rotation. Such an effect would be electromagnetic rather than thermal. — D. B. V.

181-376.   Duffus, H. J., Shand, J. A., and Wright, Charles [S.].   Influence of geological features on very low frequency geomagnetic fluctuations: Nature, v. 186, no. 4719, p. 141-142, 1960.

Geomagnetic measurements of the field fluctuations in the vertical (Z) and geographic north-south (X) and east-west (Y) directions have been made in western Canada and California in the hope that simultaneous records of these fluctuating elements made at stations separated by large and small distances and at different distances from the sea would give clues as to their origin and cause.   In the first few years the investigation was confined to the frequency

range between 0. 001 and 0. 1 cycles per second; more recently, a modification of the equipment permitted the recording of frequencies between 0. 3 and 3 cycles per second.

It was found that there are occasions even during magnetically quiet periods when frequencies between 0. 2 and 3 cycles per second occur. These disturbances can have a peak-to-peak amplitude approaching 1 γ; they may last an hour or so and may be preceded or followed by intermittent occurrence of the signals ("pearls") as if it were a matter of occasional transmission windows between the source and the earth.

Values of Z at Ralston, Manitoba, in an area of uniform geology, are very small compared to those at Albert Head, on the shores of the Strait of Juan de Fuca where there is a large horizontal gradient of conductivity. Correlation between two stations near Ralston (5$\frac{1}{2}$ miles apart) was very high for longer periods.

The fact that fluctuations of a frequency as high as one cycle per second can occur simultaneously at places hundreds of miles apart suggests that these signals originate beyond the ionosphere, or that the initiating system is of very large dimensions, or both. The times of maximums or minimums are simultaneous within less than 1 sec. Distance from the sea appears to be a factor of great importance.

Comparison of the fluctuations at two well separated stations, each situated in an area of geological uniformity and not too close to an auroral zone might show much better agreement in amplitudes and phases of the corresponding components than yet observed except at the two contiguous stations near Ralston. — D. B. V.

181-377. Jenkins, Alvin W., Jr., and Phillips, Charles A., Jr. Observed magnetic effects from meteors: Jour. Geophys. Research, v. 65, no. 5, p. 1617-1619, 1960.

Preliminary analysis of data recently available from the International Geophysical Year program concerned with subaudio fluctuations of the geomagnetic field seems to indicate that meteor activity and the average level of the fluctuations are related. Data from the Denver station show that for every major meteor shower in the interval October-December 1959 there was either a pronounced or a noticeable peak in the geomagnetic activity level in the 1-5 cps band. In addition, the spectral character of these peaks is different from that of other peaks. Comparison with Tucson 3-hr K indices for December shows little correlation with activity levels. — D. B. V.

MAGNETIC PROPERTIES AND PALEOMAGNETISM

181-378. Balsley, J[ames] R., and Buddington, A[rthur] F. Magnetic susceptibility anisotrophy and fabric of some Adirondack granites and orthogneisses: Am. Jour. Sci., Bradley Volume, v. 258-A, p. 6-20, 1960.

The magnetic susceptibility anisotrophy of about 150 specimens of granites and orthogneisses of the northwest Adirondack area has been determined. The maximum susceptibility of the orthogneisses is uniformly about parallel to the lineation, and the minimum susceptibility is characteristically about at right angles to the planar structure. A high ratio of maximum to intermediate magnetic susceptibility indicates a high intensity of linear structure. A high ratio of the mean of the maximum and intermediate to the minimum magnetic susceptibility indicates a high intensity of planar structure. Studies of magnetic susceptibility anisotropy have permitted the determination of lineation in many

rocks where it could not be determined in the field and have afforded quantitative bases for correlations with broad geologic structures. — Authors' abstract

181-379.   Green, R.   Remanent magnetization and the interpretation of magnetic anomalies: Geophys. Prosp., v. 8, no. 1, p. 98-110, 1960.

Lavas and intrusives are often premanently magnetized in a direction different from the direction of the present geomagnetic field, and this can make the interpretation of a magnetic intensity map difficult. However, the profiles over a permanently magnetized body are identical with the profiles over an inductively magnetized body of the same shape provided the direction and dip of the geomagnetic field in the induced case is appropriately changed. In which case, the shape of the body can be deduced by the well-known methods of interpretation of induced anomalies. Examples of the application of this method to Australian Cenozoic basalts, Tertiary basalts from Australia and Tasmania, and the classical Pilansberg dykes have been worked out. This article stresses the fact that the apparently confused patterns obtained by magnetic surveys over volcanic rocks can often be explained with little difficulty as the juxtaposition of normal and reversely magnetized rocks. — Author's abstract

181-380.   Frölich, Friedrich.   Zur magnetischen Stabilität von Erdkrustengesteinen [On the magnetic stability of rocks of the earth's crust]: Zeitschr. Geophysik, v. 24, no. 4/5, p. 228-239, 1958.

The effects produced by changes in direction of the geomagnetic field on internal conditions and processes in rocks are discussed, and experimental methods are suggested for examining the stability of samples for paleomagnetic purposes. — D. B. V.

181-381.   Wargo, Joseph G.   Magnetic susceptibility and fusion data for some volcanic rocks from southwestern New Mexico: Geol. Soc. America Bull., v. 71, no. 1, p. 87-92, 1960.

Magnetic susceptibility measurements have been made on five types of rhyolitic rocks from near Silver City, New Mexico, including pyroclastic rocks, flows, and welded tuffs. The susceptibility values range from 0 to 825×10^{-6} cgs units. In general, rhyolitic crystal tuffs and black vitrophyres have the lowest susceptibility, whereas gray flows, brown tuff breccias, and red welded tuffs show somewhat higher values. — D. B. V.

181-382.   Dianov-Klokov, V. I.   Izmeritel' maloy ostatochnoy namagnichennosti gornykh porod [Magnetometer for rocks of low remanent magnetization: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 1, p. 142-147, 1960.

A magnetometer for rocks of low remanent magnetization based on the rock-generator ("spinner") principle is described. The magnetometer has a sensitivity (I_{min}) nearly equal to 5×10^{-8} gauss for a sample $24 \times 24 \times 24$ mm, with a time constant (τ) nearly equal to 1 sec and a signal-to-noise ratio of 1. The small mass of the sample holder eliminates the necessity for the special modifications which Johnson, Murphy, and Michelson (see Geophys. Abs. 139-11483) used for compensation of systematic interference. The instrument is thereby simpler and more compact. A more effective rock generator is based on the impulse reception of the signal $\mathcal{E}_s = -w(\delta \phi / \delta t)$, with a duration Δt

(proportional to 1/r), where 1 is ½ of the edge length of the sample and r is the length of the sample holder. The proposed impulse rock generator is expected to have a signal-to-noise ratio $(r/1)^{\frac{1}{2}}$ times as great as that of the regular spinner. A multipolar stator that is equipped with a corresponding number of identical pairs of coils is also proposed to achieve the same improvement. — A. J. S.

181-383. Collinson, D. W., and Nairn, A. E. M. A survey of palaeomagnetism: Overseas Geology and Mineral Resources, v. 7, no. 4, p. 381-397, 1959.

This is a survey of the field of paleomagnetism for geologists who are unfamiliar with the new techniques. The text is divided into three sections: a brief review of the magnetic minerals and the ways in which a rock may become magnetized and a discussion on the selection, preparation, and measurement of rock samples; the methods of testing the significance of the measured magnetic directions, and the geophysical interpretations to be derived from significant measurements; and a description of some applications and suggested applications of rock magnetism. An excellent list of references is included. — V. S. N.

181-384. Irving, E. Palaeomagnetic pole positions, part 1. Pole numbers 1/1 to 1/144: Royal Astron. Soc. Geophys. Jour., v. 3, no. 1, p. 96-111, 1960.

Pole determinations available up to September 1959, with the exception of some Russian results, are compiled. A 19-column table gives all available information on location and age of the rock units; sampling data; magnetic stability, treatment (if any), polarity, and mean direction of D, I, and alpha for the samples; pole position and error; and reference to the original literature. This table includes 144 measurements.
The Russian results will be given in a future issue. Further lists will appear approximately every half year as new determinations become available. — D. B. V.

181-385. Khan, Mohammed Aftab. The remanent magnetization of the basic Tertiary igneous rocks of Skye, Inverness-shire: Royal Astron. Soc. Geophys. Jour., v. 3, no. 1, p. 45-62, 1960.

The stable remanent magnetization is reversed in the basic igneous rocks of Skye, the hypersthene gabbro of Ardnamurchan, and the layered gabbro of Rhum in Scotland. The pole position for part of the Lower Miocene is estimated from the magnetization of the Skye rocks to be lat 70.8°±3.8° N., long 159.6°±5.1° E., indicating relative movement between northwest Europe and the pole since Early Miocene time.
The directions of magnetization are used in an attempt to correlate some of the lavas and dikes of Skye. It is also tentatively suggested that the rocks of Skye, Rhum, and Ardnamurchan are of approximately the same age. — D. B. V.

181-386. Nairn, A. E. M. Paleomagnetic results from Europe: Jour. Geology, v. 68, no. 3, p. 285-306, 1960.

The results of investigations on a variety of Late Paleozoic and Mesozoic rocks from western Europe are described and are incorporated with previously published results predominantly from Great Britain (see Creer, Geophys. Abs. 163-32, 173-292, -296; and Clegg, Geophys. Abs. 157-39, 163-37).

Summaries of European paleomagnetic data are given in tables for each period from Devonian through Tertiary. For certain periods the directions of magnetization form a consistent pattern, and the mean pole positions have been calculated for the Triassic, Permian, and Devonian periods. Miocene and later results are coincident with the dipole-field assumption. Satisfactory mean pole positions for Cretaceous and Jurassic rocks are handicapped by a paucity of results. The scattered Carboniferous pole positions make interpretation difficult, although it is noticeable that the apparent "dislocation" of the curve linking pole positions is Carboniferous in age. The separation of North America and Europe appears to date from Permian time. — V. S. N.

181-387. Glangeaud, Louis, and Bobier, Claude. Morphotectonique et paleovolcanologie du Forez oriental et de la plaine de Montbrison [Morphotectonics and paleovolcanology of the eastern Forez and of the Montbrison plain]: Acad. Sci. [Paris] Comptes Rendus, v. 250, no. 1, p. 162-164, 1960.

The identification of three main volcanic cycles on the eastern flank of the Forez and in the Montbrison plain in France, established on the basis of four erosion cycles, is confirmed by paleomagnetic evidence. The Oligocene lavas, interbedded in Stampian deposits, are inversely magnetized. The Miocene dikes and necks that cut these are normally magnetized. Flows lying on the Aquitanian surface reflect the inversion of the magnetic field that occured at the end of the Pontian and beginning of the Pliocene, and the slightly younger flows occupying valleys cut in Ponto-Pliocene time are again normally magnetized. — D. B. V.

181-388. Makarova, Z. V. Polozheniya polyusa v Triase po ostatochnoy namagnichennosti basal'tovykh trappov Yeniseya [The position of the pole in the Triassic according to the remanent magnetization of the basalt traps of the Yenisey River]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 10, p. 1520-1521, 1959.

The direction of the natural remanent magnetization was determined for Triassic gabbros from the Lower Tunguska River valley in Siberia. The coordinates of the pole for these rocks are: $\phi = 88°$, $\lambda = 148°$. Comparison is made with data from rocks of similar age from England and Arizona. Agreement is close between Siberian and English localities, but these are quite divergent from the position indicated by the Arizona locality. — S. T. V.

181-389. Pecherskiy, D. M. Opyt vozrastnogo raschleneniya i vozrastnoy korrelyatsii effusivov basseynov rek bol'shogo Anyuya i Omolona [Experiment in age subdivision and age correlation of the effusives in the basins of Greater Anyui and Omolon Rivers]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1745-1754, 1959.

An attempt is made at subdivision and correlation of the extrusive rocks of the Omolon massif and the Oloy downwarp in northeastern U. S. S. R. according to geochemical and paleomagnetic data. It was found that the ratio of remanent magnetization (I_n) and susceptibility (χ) is different for the extrusive rocks of different geologic ages. As an example, I_n in Paleozoic extrusives remains practically unchanged with increases in χ, whereas in Mesozoic intrusives it rises considerably with increases in χ. — A. J. S.

181-390. Markhinin, Ye. K., and Pospelova, G. A. Nekotoryye dannyye paleomagnitnykh issledovaniy na Kuril'skikh ostrovakh [Some data from paleomagnetic investigations in the Kurile Islands]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 10, p. 1517-1519, 1959.

The magnetic properties were determined for rocks of the Kurile Islands. Rocks of Cretaceous, Miocene, Early Quaternary, and Late Quaternary age are included in the investigation. The position of the specimens was marked in place, and the remanent magnetization was measured with a Dolginov magnetometer. From this value the total vector (I_n) of the magnetization, the declination (D) and the inclination (J) were computed. The vectors of remanent magnetization of specimens taken from recent lava coincide with the vectors of the present magnetic field. The Early Quaternary and some Pliocene units show an inverse remanent magnetization, but the vectors differ considerably. The Miocene volcanic rocks give divergent results; some have an inverse direction, and others have the same direction as the present magnetic field. The results are, in general, unreliable, owing to the probability of tectonic activity having changed the position of the formations. — S. T. V.

181-391. Nagata, Takesi; Akimoto, Syun-iti; Shimizu, Yoshio; Kobayashi, Kazuo; and Kuno, Hisashi. Palaeomagnetic studies on Tertiary and Cretaceous rocks in Japan: Tokyo Univ. Geophys. Inst. Geophys. Notes, v. 12, no. 2, contr. 20, 1959.

This paper was published originally in Japan Acad. Proc., v. 35, no. 7, p. 378-383, 1959 (see Geophys. Abs. 180-290). — D. B. V.

181-392. Bull, C., and Irving, E. Palaeomagnetism in Antarctica: Nature, v. 185, no. 4716, p. 834-835, 1960.

The direction of the magnetization of 2 dolerite sills and 10 mafic dikes in Wright Valley, South Victoria Land, Antarctica, has been measured. Results are tabulated. As the ages of these rocks are not precisely known (the dikes are probably Paleozoic and the sills probably Mesozoic), only general conclusions can be drawn.

The results are consistent with the pole paths obtained from Europe, North America, India, and Australia, but the longitudes differ greatly from those of the poles obtained from those regions. This emphasizes for yet another continent the divergence that occurs between results from different continents for periods prior to the Tertiary. — D. B. V.

MAGNETIC SURVEYS

181-393. Kazinskiy, V. A. Approksimatsiya magnitnykh anomaliy i reduktsiy interpolyatsionnymi polinomami [Approximation of magnetic anomalies and reductions by the use of interpolation polynomials]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 10, p. 1502-1505, 1959.

The use of interpolation polynomials in approximate evaluation of the volume of disturbing magnetic bodies from data obtained by magnetic surveying over a plane surface is discussed. The simplest procedure is the case where a polynomial of the second degree is used for the presentation of the function to be evaluated. A table is given that contains the values of the coefficients to be used in such evaluation. Several figures and graphs are presented. The interpolation polynomials are especially useful where the disturbing body has a complicated shape, or where the magnetization is not uniform over the entire body. — S. T. V.

Tyapkin, K. F. Determination of the general angle of inclination of two-dimensional geologic objects from the results of gravitational and magnetic measurements. See Geophys. Abs. 181-255.

181-394. Fleming, H. W.   Magnetic and electromagnetic investigations in Paska township, District of Thunder Bay, Ontario, in Methods and case histories in mining geophysics: [Canada] Commonwealth Mining and Metall. Cong., 6th, p. 210-220, 1957.

The results of an exploration program designed to investigate aeromagnetic anomalies that indicated large extensions of the Onaman iron range are discussed and compared with predictions made from the aeromagnetic data.

A high apparent susceptibility of about 0.50 cgs units for magnetite was found necessary to satisfy the anomalies when compared to the true magnetite content of the iron formation. This susceptibility factor was adequate to satisfy even the larger variations in the anomalies where the overburden was heavy, but was inadequate where the overburden was light and extreme variations were encountered. It is concluded that normal and inverse remanent magnetization must play an important role, and that the apparent high uniform susceptibility in regions under heavy overburden is due to the integrated effect from relatively narrow zones having widely different values of remanent magnetization.

After geologic and photographic interpretations, reconnaissance ground electromagnetic and magnetic surveys were made in the regions adjacent to the iron formation.   These were followed by aeroelectromagnetic surveys for comparison with ground data. These data are discussed in relation to later drilling results. — V. S. N.

181-395. Jones, L., Mathieu, P. L., and Strenger, H.   Magnetisme [Magnetism]:   Mus. Royal Congo Belge Annales, Sci. Geol., v. 27, 30 p., 1959.

A magnetic survey was made of the Belgian Congo between 1952 and 1955 in conjunction with topographic, altimetric, and gravimetric surveys. Some 6,000 stations were occupied in an area of about 65 square degrees. The equipment and methods of calculation are described. The results are presented in the form of two 1:2,000,000-scale maps: one of the vertical component as of January 1954 with contour interval of 100γ, and the other of residual anomalies with contour interval of 50γ. The contours of the former show a strong east-west trend, with regional vertical intensity increasing to the south. The residual anomalies are weak over most of the area (between -100γ and +100γ). Most of the stronger anomalies (more than ±200γ) are situated south of the Kasai and Sankuru Rivers and a few are on the northeast and east margins of the mapped area where the basement is shallow. — D. B. V.

181-396. Schwab, R. F.   Einige Ergebnisse einer aeromagnetischen Studie im Gebiet des Waadtländerjuras [Some results of an aeromagnetic study in the Waadtland area of the Jura]: Ver. Schweizer. Petroleum-Geologen und -Ingenieure Bull., v. 26, no. 71, p. 31-32, 1960.

An aeromagnetic survey was made in February 1959 of parts of the French and Swiss Jura and adjacent areas of the Molasse basin. An area of 8,000 km^2 was covered, and the plane was flown at a height of 1,500-1,800 m. None of the known or supposed zones of disturbance appeared on the magnetic map; registration of anomalies was in fact so poor that a map of the basement could not be constructed. — J. W. C.

181-397. Krs, Miroslav.   Magnetická měření v okolí Bohutína u Příbrami [Magnetic measurements in the vicinity of Bohutín near Příbram (with German and Russian summaries)]: [Czechoslovakia] Ústřed. Ústav. Geol. Sborník, v. 25, p. 81-120, 1958(1959).

Very detailed magnetic surveys were made in the Bohutín area of the Příbram mining district, Czechoslovakia, in order to investigate the hydrothermal polymetallic veins. These veins occupy north-south trending faults through the Cambrian rocks and are mostly in association with earlier diabase filling the fractures. The types of anomalies depend on the relative magnetization of the mediums. The diabases give rise to three main types of anomalies; these correspond to veins in massive diabase, or diabase-porphyrite, to the contact aureole of the diabase, and to hydrothermally altered or mylonitized diabase.

In the Příbram district the intensity of magnetization decreases in the vicinity of the hydrothermal veins owing to two factors: mylonitization, which has destroyed the remanent magnetization of the surrounding diabase or Cambrian rock; and hydrothermal alteration, which has caused accelerated weathering and the oxidation of the ferromagnetic minerals to weakly magnetic compounds. This decrease of magnetization could be used as a criterion for the presence of ore veins in other regions where geologic conditions are similar.

Three series of vertical intensity profiles across the veins are presented. — D. B. V.

181-398. Běhounek, Rudolf. Magnetické anomálie ostrovního paleozoika choceradského a čerčanského [Magnetic anomalies of the Paleozoic "islands" of Chocerady and Čerčany (with German and Russian summaries)]: [Czechoslovakia] Ústřed. Ústav. Geol. Sborník, v. 25, p. 407-426, 1958(1959).

The Paleozoic "islands" of Chocerady and Čerčany are remnants of the sedimentary cover of the central Bohemian batholith in Czechoslovakia. The batholith was emplaced between the Devonian and Late Carboniferous. In the Chocerady "island" a small hematite bed was metamorphosed to magnetite as a result of the intrusion. The depth and extent of this magnetite deposit have been determined by a magnetic survey; profiles of vertical and horizontal intensity across the deposit are presented. The possibility of establishing the age of the intrusion by means of the intensity and direction of the remanent magnetization of the magnetite is suggested.

Magnetic measurements in the Čerčany "island" revealed the strongest anomalies yet known in Bohemia; an exploratory shaft showed that the anomalies are due to pyrrhotite impregnating hornstone. These rocks constitute natural magnets with marked bipolarity. The shallow position of the poles of these magnets and the rapid alternation of positive and negative anomalies suggest the effect of lightning. A map shows the horizontal magnetic anomalies in the vicinity of the shaft. — D. B. V.

181-399. Ochaba, Štefan. Rozloženie geomagnetického pol'a na Slovensku pre epochu 1952. 5 (magnetické mapovanie I. radu) [Analysis of the geomagnetic field in Slovakia for epoch 1952. 5 (magnetic mapping of the first order) (with English and Russian summaries)]: Československá Akad. Věd Geofys. Sborník, no. 92, p. 319-362, 1958.

A first-order geomagnetic survey was carried out in Slovakia in 1951-53. Ninety-four stations were occupied, an average of 1 per 520 km^2, with station density greater in magnetically disturbed regions. Stations of older surveys were reoccupied. Methods of measurement and data processing are described, and results are tabulated and presented in the form of seven maps of different magnetic elements reduced to epoch 1952. 5: declination (ΔD), inclination (ΔI), the H, X, Y, and Z components, and total intensity T. — D. B. V.

Airinei, Ştefan. Gravimetric and geomagnetic maps of the bend region of the eastern Carpathians and Ţara-Bîrsei. See Geophys. Abs. 181-283.

181-400. Shneyerson, B. L. O prichinakh intensivnykh magnitnykh anomaliy KMA [The causes of the intensive magnetic anomalies of the KMA (Kursk magnetic anomaly)]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 10, p. 1500-1501, 1959.

The possibility of incorrect interpretation of magnetic measurements made by different geophysicists in various parts of the Kursk magnetic anomaly is pointed out. Much lower values of K (the magnetic susceptibility) and of Z (the vertical component) of the magnetic field have been determined by some investigators. If the latter results are correct, the very optimistic conclusions on the commercial value of this anomaly must be essentially reduced. — S. T. V.

181-401. Horvath, J[osef], and Davidson, R. J. Geophysical survey of the Rye Park scheelite deposit, New South Wales: Australia Bur. Mineral Resources, Geology and Geophysics Rept., no. 36, 12 p., 1958.

Geological, geophysical, and drilling investigations of the Rye Park scheelite deposit north of Yass, New South Wales, indicate that the margins of a granite batholith are the most favorable areas for scheelite deposits. A magnetic survey made to delineate the main mineralized areas revealed five well-defined anomalies, the largest of which coincides approximately with an ore body exposed in an opencut. In general, drilling results showed good agreement with the geophysical indications and scheelite ore was found for the most part in the magnetically disturbed areas. — V. S. N.

Green, R. Remanent magnetization and the interpretation of magnetic anomalies. See Geophys. Abs. 181-379.

181-402. Glebovskiy, Yu. S. Aeromagnitnye issledovaniya pervoy Sovetskoy Antarkticheskoy ekspeditsii (Vostochnaya Antarktida) [Aeromagnetic investigations of the First Soviet Antarctic Expedition (eastern Antarctica)]: Sovetskaya Geologiya, no. 1, p. 94-115, 1960.

The results of aeromagnetic investigations by the First Soviet Antarctic Expedition in eastern Antarctica from 1956 to 1957 are outlined. The coastal areas between long 73° E. and long 110° E. were investigated; the area covered was 4,200 km^2. Several subglacial ridges were revealed. The presence of zones of fracture coinciding with the subglacial ridges supports the hypothesis that the relief of the bedrock, in eastern Antarctica is controlled largely by faulting. The ridges revealed by this survey are regarded as horsts. Several magnetic maps of small areas are presented. — J. W. C.

MICROSEISMS

181-403. Nanda, J. N. The origin of microseisms: Jour. Geophys. Research, v. 65, no. 6, p. 1815-1820, 1960.

A new theory to explain the origin of microseisms is presented. It involves the action of suitably oriented winds with a rough sea surface. Sea roughness has been shown to have a certain periodicity, which can be caused by means other than standing waves. For example, the amplitude of the progressive waves might be a periodic function of time, the period being the same as the

period of the corresponding microseisms. In such a case the interaction of the convergent winds under a storm, or of winds blowing parallel to a coastline, will cause oscillations in the sea surface that will be transmitted through the ground as microseisms.

The wind-interaction term is only about one-one hundredth of the standing-wave term, but this is still more than that required to account for the observed microseisms. The amplitude is inversely proportional to the depth of the sea, and is very sensitive to the speed of the oriented winds. — D. B. V.

181-404. Bukhteyev, V. G., and Andreyev, T. A. O vozbuzhdenii shtormovykh mikroseysm [Excitation of storm microseisms]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 10, p. 1510-1512, 1959.

The results of analysis of microseismic records of the Far Eastern Region seismic stations for the years 1954-57 are presented. A characteristic of these seismograms is a regular change of the period of the microseismic waves parallel with development of storms. As a rule a storm begins with waves of relatively short periods; subsequently, the periods become longer with the growing amplitudes. As the storm dies out, the periods of the waves remain almost constant. Several seismograms from three stations (Petropavlovsk, Vladivostok, and Kuril'sk) are given in the article. The changes in amplitude and in frequency are interpreted as an effect of the natural frequency of vibration of the upper stratum of the crust. It was also found that the period of the microseisms varies with the seasons of the year. Special features can be observed on the seismograms of the Uglegorsk station situated on the Tartar Strait. This narrow branch of water between the Asiatic continent and Sakhalin Island makes it impossible for sea waves of longer periods and corresponding height to develop; consequently, microseisms of especially short periods are recorded. — S. T. V.

181-405. Strobach, Klaus. Morphologische Untersuchung mikroseismischer Bodenbewegungen nach stereoskopischen Vektorregistrierungen [Investigation of the form of microseismic ground movements by means of stereoscopic vector records]: Zeitschr. Geophysik, v. 24, no. 6, p. 369-379, 1958.

Analysis of stereoscopic records of four microseismic storms registered at Hamburg shows that there are nine different types of ground motion. The frequencies of each type are plotted for the storm of January 17, 1958. Most (65 percent) of the particle motions are found to be linearly polarized and to have a vertical component, like SV and P waves. Elliptically polarized oscillations are both retrograde and rectograde in sign. The frequency distribution of inclinations of the linearly polarized motions is significantly different in microseisms from different azimuths; this may be an effect of geology. The results do not indicate any noteworthy proportion of first mode Rayleigh waves or Love waves, but rather, suggest that a considerable part of the oscillations observed at Hamburg are waves of SV type. — D. B. V.

Bernard, Pierre. On the mechanical balance of the solar influence on terrestrial phenomena. See Geophys. Abs. 181-146.

RADIOACTIVITY

181-406. Davidson, C. F.   Some aspects of radiogeology: Liverpool and
          Manchester Geol. Jour., v. 2, pt. 3, p. 311-340, 1960.

The important results of studies in recent years of the natural distribution
of radioactive elements are reviewed. The following are discussed: improve-
ment of geochronologic knowledge of the stratigraphic succession; the impor-
tance of radiogeologic studies in prospecting for ore deposits, and for coal and
oil fields, and in reworking of some ore deposits; and the significance of radio-
geology in evaluating health hazards arising from artificial radioactivity. —
V. S. N.

181-407. Aglintsev, K. K., Bochkarev, V. V., Grablenskiy, V. N., and
          Karaveyev, F. M.   Metody metrologii radioaktivnosti v SSSR
          [Metrology applied to radioactivity in the USSR]: Atomnaya En-
          ergiya, v. 8, no. 4, p. 354-359, 1960.

This is a survey of the radioactive sources currently used in the U. S. S. R.
and the methods by which they are standardized. The regular sources of al-
pha, beta, gamma, or neutron radiation are standard samples for calibrating
apparatus, and control samples for routine work requiring less percision. The
certified precision of a source may be between 0. 5 and 20 percent, depending
on the intensity and type of radiation emitted. Calorimeters, ionization cham-
bers, and 4 pi counters are used for the calibration. A master diagram sum-
marizes the type of radiation, range of intensity and precision, and method of
calibration of the various sources. The officially recognized units of radio-
activity are the curie, the milligram-equivalent radium, the roentgen, and the
rad. — A. B. T.

181-408. Bulashevich, Yu. P., and Khayritdinov, R. K. K teorii diffuzii e-
          manastii v poristykh sredakh [On the theory of diffusion of ema-
          nations in porous media]: Akad. Nauk SSSR Izv. Ser. Geofiz., no.
          12, p. 1787-1792, 1959.

The generalized equation for radioactive diffusion in the presence of con-
vection is analyzed. It was found that the usual equation for radioactive dif-
fusion, $\Delta c -(\lambda c/D) = -Q/D$, cannot be applied under the boundary conditions
$c_1 = c_2$ and $D_1 (\partial c_1/\partial n) = D_2 (\partial c_2/\partial n)$, but must be replaced by the correct-
ed formula, $\Delta c -(\lambda c \eta/D) = 0$, where c is the pore concentration of emanation,
D is the diffusion coefficient, Q is the rate of emanation in the pores per unit
volume, λ is the decay constant, and η is porosity. Errors were found in
previously determined values of diffusion coefficients, and the method for
elimination is shown. — A. J. S.

181-409. Karras, M., and Nurmia, M.   Natural radioactivity of samarium
          and neodymium: Nature, v. 185, no. 4713, p. 601, 1960.

The discrepancy between the measured value of the alpha-decay half life of
natural samarium-147 and the theoretical half life calculated from its mea-
sured alpha energy has been investigated, using natural alpha-particle emit-
ters of lower energies than is customary in ion chamber measurements.
From these measurements the alpha energy of samarium-147 is calculated as
2. 20 ± 0. 03 Mev.   The specific activity was measured by counting the alpha
particles from 28. 9 mg of samarium, vacuum evaporated on a source plate
200 mm in diameter; the obtained value of 7. 00 ± 0. 3 counts per min per mg
yields a half life value of $(1. 14 ± 0. 05) \times 10^{11}$ yr.

An attempt to detect the natural alpha activity of neodymium was made by evaporating 36 mg on a 200-mm source plate. In spite of appreciable thorium contamination, a weak line was observed at 2.0 ± 0.01 Mev. This is in a-greement with investigations made by the emulsion method (see Geophys. Abs. 174-298). — D. B. V.

Young, B. G., and Thode, H. G. Absolute yields of the xenon and krypton isotopes in U^{238} spontaneous fission. See Geophys. Abs. 181-335.

181-410. Hamilton, E. The uranium content of the differentiated Skaergaard intrusion: Univ. Copenhague Mus. Minéralogie Géologie, Commun. Géol. no. 93, 35 p., 1959.

The distribution of radioactivity and uranium in the Skaergaard intrusion (East Greenland) is traced in detail by means of quantitative nuclear emulsion techniques, radioactivation, and fluorimetric analysis. There is no signifi-cant difference in the radioactivity from feldspar, pyroxene, and olivine, al-though feldspar is generally somewhat more radioactive than pyroxene or ol-ivine. At the silicic end of the intrusion the radioactivity of the major min-erals increases slightly. Quartz, which makes its appearance at this time, becomes the most radioactive mineral. The ore minerals are essentially in-active in the subsilicic rocks; in the silicic, however, their radioactivity is comparable to that of quartz. The most radioactive minerals are the acces-sory minerals such as zircon, epidote, and sphene. —J. W. C.

181-411. Telfair, David, Garrison, Robert, and Smith, Carl. Natural ra-dioactivity of Miami soils: Science, v. 131, no. 3402, p. 726-728, 1960.

The relation between gross gamma activity and soil depth for the Miami silt loam has been investigated. Laboratory measurements of samples with scin-tillation probe and scaler were found to be more accurate than direct measure-ments in the field with a survey-type gamma scintillator.

A close relation exists between total potassium content and gamma activity versus soil depth. An increase in the counting rate from the A through the B horizon is due partly to a greater concentration of potassium (and, therefore, of potassium-40) in the lower soil horizons and partly to a similar trend for radium. Radium was not expected, inasmuch as calcium, which radium re-sembles in chemical behavior, has been leached from the B horizon and occurs in higher concentrations in the underlying C horizon (glacial till). Adsorption of uranium leached from the A horizon on clay surfaces in the B horizon may be important here.

The gamma activity is found to be of about the same magnitude in silt and clay (5.40 and 6.95 counts per min per g, respectively, versus 1.38 for sand). This indicates that a substantial part of the radioelements are held in mineral form in the silt range; some adsorption on clay surfaces might also occur. — D. B. V.

181-412. Vincenz, S. A. Some observations of gamma radiation emitted by a mineral spring in Jamaica: Geophys. Prosp., v. 7, no. 4, p. 422-434, 1959.

The decay rate of gamma radiation emitted by a mineral spring in Jamaica, West Indies, has been measured by means of portable rate meters. The re-sults of the measurements, supported by auxiliary tests, suggest that the ra-dioactivity is due chiefly to radon-222. The intensity of gamma radiation is inverse to the rate of water discharge. Investigation of the effect of rainfall

and of earthquakes leads to the conclusion that the radon, or radon-charged water, is derived from appreciable depths by way of conduits. The source is probably a region containing disseminated uranium (perhaps in the Lower Eocene or Cretaceous shales) rather than a high-grade uranium deposit.—D.B.V.

181-413. Tanner, Allan B. Meteorological influence on radon concentration in drillholes: Mining Eng., v. 11, no. 7, p. 706-708, 1959; also in Am. Inst. Mining Metall. Petroleum Engineers Trans., v. 214, 1959.

The concentration of radon-222 in drill holes in uraniferous limestone near Grants, New Mexico, was observed to change markedly with different meteorological conditions. Continuous records of wind velocity, surface temperature, and atmospheric pressure were obtained for a 20-day period during which a series of analyses was made for the radon content of air collected at several depths in a 4 $\frac{1}{4}$ -inch diameter drill hole. More limited investigations were made of several other drill holes.

An inverse relation was inferred between trends in atmospheric pressure and the total amount of radon in a hole. Pressure changes of 10 mm of mercury over a period of about a day resulted in approximately two-fold changes in the total amount of radon in the hole. The relation is believed to be a manifestation of "earth breathing."

The effects of wind differed greatly for different holes. No significant effect was observed when a 14- to 16-mph wind blew over an open hole for 4 hr; a 25- to 35-mph wind, blowing over another open hole of the same diameter and approximately the same depth for 6 hr, caused a reduction in the total amount of radon in the hole by a factor of about 400. No correlation was noted between surface temperature and the behavior of radon in the drill holes. — A. B. T.

181-414. Gorshkov, G. V., Khormushko, S. P., and Tsvetkov, O. S. Sravneniye neytronnogo izlucheniya atmosfery i zemnoy kory [Comparison of the neutron emission of the atmosphere and of the earth's crust]: Akad. Nauk SSSR Doklady, v. 131, no. 4, p.933-935, 1960.

The intensity of cosmic neutron flux at sea level and of neutron flux from rocks was measured, using a specially constructed scintillation counter. The measurements were made in the city of Zelenogorsk about 3 km inland from the Gulf of Finland and on a wharf 2.5 m above the surface of the Gulf, and in the Leningrad subway 70 m below the surface (equivalent to a depth of 200 m of water). The results show that the intensity of neutron emission from the rocks is 5 percent less than that of cosmic neutrons at sea level, which agrees with results obtained by Eugster (see Geophys. Abs. 157-152), Mather (1956), and others. — D. B. V.

181-415. Plesset, Milton S., and Latter, Albert, L. Transient effects in the distribution of carbon-14 in nature: [U.S.] Natl. Acad. Sci. Proc., v. 46, no. 2, p. 232-241, 1960.

A prerequisite for carbon-14 dating is the existence of a steady state in the specific activity of the carbon in the atmosphere. This paper examines the problem of the disappearance of a disturbance in the absolute amount of carbon-14 in a natural reservoir, such as the atmosphere, through exchange with other reservoirs.

Fundamental transient solutions are presented from which the redistribution of the excess carbon-14 produced by nuclear explosions can be calculated

as a function of time. Craig's reservoir model (see Geophys. Abs. 170-218) is used with an extension that divides the atmosphere into two reservoirs, the stratosphere and the troposphere. — D. B. V.

181-416.   Latter, Albert L., and Plesset, Milton S.   Carbon-14 production from nuclear explosions: [U. S.] Natl. Acad. Sci. Proc. , v. 46, no. 2, p. 241-247, 1960.

The net result of all past nuclear explosions (for which intensity and date are given) is determined by a summation of transient solutions for instantaneous increments of carbon-14 introduced into the stratosphere or troposphere, as developed in the companion paper (see Geophys. Abs. 181-415). The results are presented in a series of graphs. — D. B. V.

181-417.   Peters, B. Cosmic-ray produced radioactive isotopes as tracers for studying large-scale atmospheric circulation: Jour. Atmos. Terrest. Physics, v. 13, no. 3/4, p. 351-370, 1959.

In the interval between two consecutive condensations of moisture, atmospheric air accumulates radioactive isotopes produced by cosmic ray particles in collision with nitrogen, oxygen, and argon. The production rates of these isotopes per gram of air depends strongly on altitude and latitude; the rate of removal depends, between rains, essentially on the half life of each isotope. These facts can be used to label air masses and to trace their trajectories.
The isotopes that seem to be most useful for such investigations are phosphorus-32 (half life 14 days), phosphorus-33 (25 days), beryllium-7 (53 days), and sulfur-35 (87 days). Their concentrations have been studied in India during 1956-57.   Preliminary results on isotope concentrations in tropical rains support the view that substantial intrusions of stratosphere air into the tropical atmosphere are rare or absent. The results also indicate a mean interval between successive removals of radioactivity of the order of 40 days. (See also Geophys. Abs. 173-261, -262; 177-264; 178-270.)— D. B. V.

181-418.   Philip, J. R. Atmospheric diffusion and natural radon: Jour. Geophys. Research, v. 64, no. 12, p. 2468, 1959.

Wilkening's attempt to deduce the daily variation of eddy diffusivity from his observations of diurnal and annual cycles of natural radon concentration near the ground (see Geophys. Abs. 177-324) is not entirely satisfactory. The most important objection to his analysis is that he applies a steady-state form of the diffusion equation to a demonstrably transient phenomenon. Therefore, little reliance can be placed on the quantitative estimates given in his paper. — D. B. V.

181-419.   Malakhov, S. G.   Vertikal'noye raspredeleniye radioaktivnykh emanatsiy v atmosfere [The vertical distribution of radioactive emanations in the atmosphere]: Akad. Nauk SSSR Izv. Ser. Geofiz. , no. 9, p. 1344-1352, 1959.

A theoretical solution of the problem of the vertical distribution of radioactivity in the atmosphere is presented. It is assumed that emanation from the earth's surface is homogeneous and that vertical turbulent intermingling of the atmosphere is constant for small distances but varies for greater intervals.   The solution presented coincides with experimental data of several investigators. The ratio between the concentration of radioactivity at ground level and that in the lower layer of the atmosphere is also determined. — S. T. V.

181-420. Lal, D[evendra]; Rama; and Zutshi, P. K. Radioisotopes P^{32}, Be^7, and S^{35} in the atmosphere: Jour. Geophys. Research, v. 65, no. 2, p. 669-674, 1960.

The concentrations of phosphorus-32, beryllium-7, and sulfur-35 in several rains collected at Bombay during the monsoon period of 1958 were measured. The observed annual deposition rates of the first two are found to agree within the expected meteorological fluctuations with those measured in the preceding years at Bombay and other Indian stations, but deposition of sulfur-35 has varied significantly outside normal fluctuations. It is concluded that nuclear weapons have not resulted in any appreciable contributions to the observed beryllium-7 and phosphorus-32 activities but have contributed sulfur-35 in appreciable quantities. In some rains, sulfur-35 concentrations amounted to as much as 35 percent of the observed strontium-89 concentrations.
The relative concentrations of the beryllium-7 and phosphorous-32 vary in a manner that would be expected for their production in the troposphere by cosmic rays and removal by wet precipitation with an average removal period of about 40 days. — D. B. V.

181-421. Kogan, P. M. Ob odnom sposobe vychisleniya moshchnosti vozdushnoy dozy γ-izlucheniya v odnorodnykh geologicheskikh sredakh [On a method of computing the intensity of the air portions of gamma-radiation in homogeneous geologic media]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 7, p. 988-994, 1959.

A method is presented for calculation of the intensity of the air portion of gamma radiation in uniform geologic media (rocks, air, water) based on simple energy considerations. The method is accurate for air-equivalent media. With an energy of primary gamma-quanta of 0.3-3.0 Mev, the method can be used for calculation of the intensity of the air portion in rocks, and in view of the simplicity and satisfactory accuracy (5-10 percent), it is recommended for practical calculations. — J. W. C.

RADIOACTIVITY SURVEYING AND LOGGING

181-422. Zaporozhets, V. M., and Sulin, V. V. Differentsial'nyye spektry γ-izlucheniya tsilindricheskikh izluchateley   [The differential spectra of gamma radiation from cylindrical emitters]: Razvedochnaya i Promyslovaya Geofizika, no. 26, p. 49-56, 1959.

Problems involved in determination of the intensity and spectrum of radiation in a borehole induced from a point source are discussed. Study of the spectrum of gamma radiation with an energy exceeding 0.3 Mev is possible using a scintillation counter protected by a steel housing with a wall thickness of 10 mm. If the radiation is of smaller energy, a distortion of the spectrum may take place due to the scattering of gamma quanta during their penetration through the rock, drilling mud, and wall of the housing. Integral spectrometers can be used for the evaluation of the character of the gamma radiation, if the measurements are continued during a longer period; however, use of differential spectrometers in this case is better. — S. T. V.

181-423. Blankov, Ye. B., Blyumentsev, A. M., and Blankova, T. N. Sravnitel'naya effektivnost' razlichnykh radioaktivnykh metodov opredeleniya polozheniya vodo-neftyanogo kontakta v obsazhennykh sk-

vazhinakh [Comparative efficiency of various radioactive methods of determination of the water-oil contact in cased drill holes]: Razvedochnaya i Promyslovaya Geofizika, no. 21, p. 82-90, 1958.

The results of the determinations of the water-oil contact in cased drill holes by neutron-gamma logging as well as by the method of induced activity with sodium and manganese made on different Devonian sandstones in the Ural River region are presented. The methods of induced activity give good results even where the neutron-gamma method proved ineffective due to great lithologic heterogeneity of the reservoir. — S. T. V.

181-424. Blankov, Ye. B., and Blankova, T. N. Iz opyta raboty metodom navedennoy aktivnosti v neftyanykh skvazhinakh [Experiences with the method of induced radioactivity in oil wells]: Razvedochnaya i Promyslovaya Geofizika, no. 21, p. 91-101, 1958.

Two isotopes of the same element may become activated by the neutron bombardment during radioactivity logging. One may have a short life and the other a long life. Formulas are derived for distinguishing the effect of different isotopes present in rocks, water, or the steel casing. This makes it possible to determine the presence of different elements in the formations. — S. T. V.

181-425. Galuzo, Yu. V. O vozmozhnosti kolichestvennogo opredeleniya bora v porodakh neytronnym gamma-metodom [Possibility of quantitative determination of boron in rocks by the neutron-gamma method]: Vyssh. Ucheb. Zavedeniy Izv., Neft' i Gaz., no. 1, p. 41-44, 1958.

Experiments were performed on a model in order to evaluate the neutron-gamma method for determining the boron content of rocks. Where boron is present in amounts exceeding 0.2-0.3 percent, the method is successful. These results were confirmed by tests in borate deposits. — J. W. C.

181-426. Sulin, V. V. Etalonirovaniye apparatury radioaktivnogo karotazha [The calibration of instruments of radioactive well logging]: Razvedochnaya i Promyslovaya Geofizika, no. 26, p. 57-91, 1959.

Methods of calibrating various instruments for radioactive well logging have been developed whereby the measurements are independent of the type of instruments and the power of the source. A comparison of logging curves obtained by different instruments and with different neutron activity is possible. The apparatus for calibration of instruments for gamma logging consists of a double walled metallic cylinder of a diameter of 250 mm and a length of 1,000 mm. The radioactive isotope cobalt-60 is evenly distributed between the walls. The activity of the gamma radiation is about 40 μ r per hr. A detailed procedure of calibration is described and illustrated by several curves and figures. A portable calibration station is also described. — S. T. V.

181-427. MacFarlane, R. M., and Ault, R. K. Nuclear logging in the Appalachian Basin: World Oil. v. 150, no. 7, p. 153-154, 160, 164, 1960.

Nuclear logging techniques are widely used in both wet and dry boreholes in the Appalachian Basin. The single neutron curve is used for determination of porosity and delineation of stratigraphic units, and the gamma-ray log is used for correction of the neutron response for porosity determination in shaly units. A caliper log should be run with the gamma-neutron combination because of the dependence of neutron response on borehole diameter.

The dual-spaced neutron curve is useful in determining whether the rock is filled with liquid or gas. The short spacing generally gives an approximation of the porosity of gas-bearing strata for cased and mud-filled holes.

Specific applications of nuclear logging in the Appalachian Basin include: delineation of salt beds in brine wells, determination of the gas-liquid contact within a given formation in gas-storage operations, quantitative determination of fluid saturation with the aid of focused logs, and detection of gas with the aid of acoustic logs. — J. W. C.

181-428. Moxham, R[obert] M. Airborne radioactivity surveys in geologic exploration: Geophysics, v. 25, no. 2, p. 408-432, 1960.

The value of airborne radioactivity surveys in guiding uranium exploration has been well established. Improved circuitry and development of semiquantitative analytical techniques now permit examination of more complex geologic problems. It is shown that the airborne technique can be used in exploration for thorium-bearing heavy-mineral deposits and for uraniferous phosphorites.

The observed radiation intensity and configuration of the gamma radiation field may be used to approximate the equivalent uranium content and extent of the surficial part of such deposits. The equivalent uranium content of infinite sources can probably be determined within a few thousandths of a percent and the boundaries fixed within a few hundred feet. As the areal extent of the source decreases, the accuracy of the analytical results likewise decreases. — Author's abstract

181-429. Laubenbakh, A. I., and Skosyreva, L. N. Ispol'zovaniye vozdushnoy radiometricheskoy s"yemki dlya izucheniya neftyanykh i gazovykh mestorozhdeniy [Use of airborne radiometric survey for study of oil and gas fields]: Geologiya Nefti, no. 2, p. 27-33, 1958.

Fieldwork was carried out for clarification of the possibilities of using aeroradiometric methods in oil and gas exploration. The studies embraced areas of known and possible oil and gas fields in several parts of the U. S. S. R. The aircraft was equipped for simultaneous recording of magnetic intensity and gamma-radiation; altitude was compensated automatically. The working altitude ranged from 40 to 50 m, and the average speed was 160 km per hr. A scale of 1:100,000 was used; the spacing of the profiles was 1 km.

Radiometric profiles are superposed on outline maps of known oil and gas deposits for four areas. As a rule there is a drop in the intensity of the gamma radiation over these deposits; the activity is higher beyond the productive areas. — J. W. C.

181-430. Serrano, Edwardo Sánchez. Minerales radiactivos [Radioactive minerals]: Madrid, Talleres Gráficos Cies, 139 p., 1956.

Radioactive minerals and ore deposits are described, and the various methods of their exploration are discussed. A map of the Iberian Peninsula shows localities where radioactive waters have been recorded and also a zone favorable for radioactive deposits. — J. W. C.

181-431. Daly, J., Urquhart, D. F., and Gibson, M. R. Assaying of radioactive rocks and ores: Australia Bur. Mineral Resources, Geology and Geophysics Bull., no. 31, 43 p., 1956.

The information presented in this bulletin was designed to meet the needs of organizations employing physical methods of measurement in the search for and development of deposits of radioactive minerals without any particular interest in the purely scientific aspects. The following topics are treated: naturally occurring radioactive elements, with a brief note on isotopes; principles of the design of instruments for measuring radioactivity; radiometric assaying; and fluorimetric assaying. A brief bibliography cites literature that has been found useful. The technique of prospecting for radioactive minerals is not discussed in detail. — V. S. N.

181-432. Timofeyev, A. N. K teorii gamma-razvedki [On the theory of gamma-prospecting]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1873-1875, 1959.

Radon emanating from a uranium deposit overlain by porous nonradioactive material can move by diffusion and convection toward the surface and form a radon halo far above the deposit. This may cause a large increase in the intensity of the gamma field and lead to an incorrect interpretation of the uranium deposit. A mathematical analysis of diffusion and convection of radon under such conditions is carried out, and a formula derived for the variation of gamma radiation anticipated under such conditions. — A. J. S.

181-433. Strauss, Michael G. Transistor scintillation spectrometer: U. S. Argonne Natl. Lab. Rept., no. 6123, 28 p., 1960.

A description is given for a portable scintillation spectrometer, which operates on a-c current and consists of a preamplifier, a linear pulse amplifier, a single-channel pulse-height analyzer, a linear count-rate meter, a scaler, and a high-voltage power supply. The operation and performance of the circuits are also described. The instrument is accurate and reliable, light in weight, and consumes low power. — V. S. N.

181-434. Bowie, S. H. U., Bisby, H., Burke, K. C., and Hale, F. H. Electronic instruments for detecting and assaying beryllium ores: Inst. Mining and Metallurgy [London] Trans., v. 69, pt. 7, p. 345-359, 1959-60.

A portable electronic instrument for the detection of beryllium-bearing minerals in the field is described. It employs boron trifluoride counters to measure the neutrons emitted when beryllium is bombarded by gamma radiation of suitable energy. Similar equipment for laboratory use makes it possible to obtain accurate analyses of beryllium ores without costly and time-consuming chemical analyses.

In the field, observed count rates can be related to percentage BeO in the surface layers of rocks, and assays made on the spot with considerable accuracy and at little expense. The limit of detection for a counting time of 10 minutes with a 100μ c ^{124}Sb source is about 5 ppm BeO.

Appraisal of the laboratory apparatus shows that corrections are required for differences in density of samples, but only minor compensations are necessary where elements with a high neutron-capture cross section are present. The sensitivity of the laboratory gamma-neutron equipment depends on the source, strength, and counting time. The limit of detection is about 4 ppm BeO for a count of 10 minutes and 2 ppm for 60 minutes. — V. S. N.

SEISMIC EXPLORATION

181-435.   Koefoed, O.   Measurements of amplitudes of reflected seismic
           waves: Geophys. Prosp., v. 8, no. 1, p. 25-46, 1960.

Measurements have been made of amplitudes of reflected seismic waves,
in order to investigate their change as a function of the shotpoint-seismometer
distance and of the position of the reflection point. The change with shotpoint-
seismometer distance, after correction for geometrical divergence, was usu-
ally small.   This indicates either a rather strong difference between the val-
ues of Poisson's ratio for adjacent strata, or more likely, a rather small val-
ue of the absorption coefficient.   In one instance a very strong increase in
amplitude with shotpoint-seismometer distance was observed.   This may be
attributed to incidence near the critical angle.   In another instance a pronoun-
ced increase in amplitude with the position of the reflection point was observ-
ed over a very short distance.   This may be due to an elongated depression of
the reflecting boundary. — Author's abstract

181-436.   Rische, H[ans].   Geschwindigkeitsbestimmung aus reflexionsseis-
           mischen Messungen bei Anwendung von Luftschüssen [Velocity
           determination from seismic reflection measurements with appli-
           cation of air shooting]: Zeitschr. Geophysik, v. 24, no. 4/5, p.
           351-358, 1958.

The usual methods of determining velocity from traveltime curves cannot be
used with air shooting techniques.   A procedure is described for determining
velocity from seismic reflection measurements, using results obtained with
the profile arrays usually employed in air shooting (traveltime of sound in air
greater than that of reflected waves for shallow and medium depths).   Neg-
lecting refraction, a short, unbent, dipping reflector impinged upon from dif-
ferent shot points is assumed.   The formula is presented graphically, and its
use illustrated by an example.   Accuracy of an individual determination is
seldom better than ± 5 percent.   Values can be determined quickly and eas-
ily, however, and the expectable error is reduced because a large number
can be determined. — D. B. V.

181-437.   Pod"yapol'skiy, G. S.   Ob odnoy formule, svyazyvayushchey koef-
           fitsienty golovnykh voln s koeffitsientami otrazheniy i prelomleniy
           [On a formula connecting the coefficients of head waves with those
           of reflection and refraction]: Akad. Nauk SSSR Izv. Ser. Geofiz.,
           no. 11, p. 1560-1569, 1959.

This is a purely mathematical analysis of the correlation between the coef-
ficients of reflection and refraction of different media and the so-called coef-
ficients of head waves (Mintrop waves).   The possibility of deriving the coef-
ficients of head waves from known formulas of reflection and refraction is
pointed out, but preference is expressed for obtaining the coefficients of head
waves from a system of linear equations that is cited.   In this manner a more
general correlation for the waves of any kind are derived.   This is a continu-
ation of previous studies by Pod"yapol'skiy (see Geophys. Abs.181-156, -157).
— S. T. V.

181-438.   Chujo, Junsuke.   About the bubble effect of the seismic exploration
           [in Japanese with English summary]: Butsuri-Tanko, v. 11, no.
           3, p. 137-145, 1958.

The bubble effect which often occurs in marine seismic surveys is caused by oscillation of an under-water gas sphere produced by the detonation of explosives. These oscillations are particularly disturbing in the seismic reflection method. The radius of the gas sphere varies as a cycloid-like curve (Cole, 1948), and as the seismic wave is generated mainly from the cusp of this curve, results indicate two or more detonations rather than one.

The viscuous liquid equation of motion is solved in the case of a bubble effect, and observations of 54 bubbles are given. — V. S. N.

181-439. Kalinina, T. B., and Gol'tsman, F. M. Nomograficheskiy metod opredeleniya signalov na vykhode lineynykh fil'truyushchikh sistem [A nomographic method of evaluating the signals on the exit end of linear filtering systems]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 11, p. 1605-1618, 1959.

A nomographic method is given for evaluation of the convolution integral, $\int_{-\infty}^{\infty} F(t-\tau)h(\tau)d\,\tau$, encountered in geophysical investigations, such as determination of signals at the exit end of linear filtering systems when the function of natural oscillation of the filter is given; study of the dynamic theory of seismic-wave propagation; linear transformation of magnetic and gravity anomalies; determination of correlation functions in the grouping of seismographs, regulated directed reception, and wave displacement; and treatment of other interference systems. — A. J. S.

181-440. Brož, Václav, and Dymáček, František. Preobrazovaniye izonormaley v izovertikali s pomoshch'yu nomogrammy [The conversion of isonormals to isoverticals by means of a nomogram (with Czech and English summaries)]: Československá Akad. Věd Geofys. Sborník, no. 87, p. 217-232, 1958.

Two formulas of different degrees of accuracy are derived from Gamburtsev's graphic method of converting isonormals to isoverticals in seismic survey calculations. In both, the displacement of points of the isonormals with respect to points of equally graduated isoverticals is expressed in quantities that can be read from a map of isonormals. The isonormals can be converted directly into isoverticals without laboriously constructing cross sections in the direction of orthogonal profiles. Both formulas are valid for all cases observed in practice.

An alinement chart and network chart have been calculated for both formulas to facilitate the conversion; they give results that are more accurate than those obtained by means of the existing graphic procedure. — D. B. V.

181-441. Shneyerson, M. B., and Grodzenskiy, V. A. Ob odnom sposobe interpretatsii dannykh metoda otrazhennykh voln pri gruppirovanii na bol'shikh bazakh [On one way of interpretation of reflection data in large-base spreads]: Razvedochnaya i Promyslovaya Geofizika, no. 28, p. 16-21, 1959.

Recording of seismic impulses by geophone groups having their base 2-3 times greater than the distance between the centers of the groups is discussed. It is suggested that the cophasal axes be constructed according to the coordinates of the minimum point of the traveltime curve in order to avoid distortion of these axes and consequently of the position of the reflecting planes. — A. J. S.

181-442. Arkhangel'skiy, V. T.   Ratsional'nyy vid formuly chastotnoy kha-
          rakteristiki seismografa s gal'vanometricheskoy registratsiey
          [An efficient expression for the formula of frequency character-
          istics of a galvanometrically recording seismograph]: Akad. Nauk
          Turkmen. SSR, Inst. Fiz. i Geofiz. Trudy, v. 2, p. 195-201, 1956.

Formulas for amplification of the seismometric record and for frequency
characteristics are derived.   The frequency formulas are called efficient
when the physical meaning of each factor is explicitly and correctly expressed.
— A. J. S.

181-443. Richards, T. C.   Wide angle reflections and their application to
          finding limestone structures in the foothills of western Canada:
          Geophysics, v. 25, no. 2, p. 385-407, 1960.

Experimental and theoretical evidence is presented to show that a strong
seismic event occurring late in a record and at distances beyond the critical
distance is a wide angle reflection rather than a refraction from a high veloc-
ity limestone layer.   The effects of anisotropy on velocities along reflected
and refracted paths and variation of amplitude of the event with distance are
studied.
    Broadside wide angle reflection shooting may be combined with normal re-
flection shooting to map strongly dipping limestone structures.   An example
is given of the application of the method to a profile through a well in the foot-
hills of western Canada. — D. B. V.

181-444. Jensen, K. D.   Zur Spur- für Spur-Korrektur in der Seismik [On
          trace-for-trace correction in seismic surveying]: Geofisica Pura
          e Appl. , v. 44, p. 74-82, 1959.

Trace-for-trace correction, a graphic method which gives maximum accu-
racy of interpretation of seismic records, is described. It is applicable to all
seismic methods and can be handled by any lay draftsman or calculator. —
D. B. V.

181-445. Dennison, A. T. The response of velocity-sensitive well geophones:
          Geophys. Prosp. , v. 8, no. 1, p. 68-84, 1960.

The factors affecting the response of a velocity-sensitive well geophone are
discussed, and it is shown that the geophone movement in response to a seis-
mic pulse is primarily due to the pressure difference between its ends.   Sev-
eral practical examples are calculated to show that the first arrival waveform
recorded by a geophone depends on the distance from an interface and that
these changes in recorded waveform may give errors of up to 3 millisec in
well-velocity surveys.   These errors may be minimized by using pressure
geophones or by avoiding measurements at geological interfaces. — Author's
abstract

181-446. Mozzhenko, A. N.   Proverka polyarnosti seysmografov [Check of
          the polarity of seismographs]: Razvedochnaya i Promyslovaya
          Geofizika, no. 17, p. 5-12, 1957.

Two methods for controlling the polarity of geophones in seismic explora-
tion are proposed. — A. J. S.

181-447. Beránek, Břetislav.   Results of experimental tests with air-shoot-
          ing technique in the Mikulov-region [with Czech and Russian sum-
          maries]: Československá Akad. Věd Geofys. Sborník, no. 86, p.
          209-215, 1958.

Tests in the Mikulov region of Czechoslovakia showed that under favorable conditions the air-shooting technique can give as good results as the conventional shothole method. Interpretation is more difficult when reflecting horizons are discontinuous, as only parts of the traveltime curves can be interpreted and depths and dips may be questionable. The principal advantages of the air-shooting technique are the absence of multiple reflections, lower cost, and speed. — D. B. V.

181-448. Vetterlein, Pascal. How to do refraction work by remote control: World Oil, v. 150, no. 5, p. 114-116, 1960.

A new remote controlled refraction seismograph system has been developed and used in the field. Conventional spreads are employed, but the geophone groups are automatically cut in or out of the circuit by a transmitter located near the shotpoint. Any number of receiver stations may be combined. Various methods of transmission and receiving are described. — J. W. C.

181-449. Kurihara, Shigetoshi. On a setting of seismic refraction lines and the accuracy of refraction method [in Japanese with English summary]: Butsuri-Tanko, v. 11, no. 3, p. 121-130, 1958; continued in v. 12, no. 1, p. 39-44, 1959.

In setting seismic refraction lines, the accuracy of the final results depends on careful determination of detector spacing, shot-point spacing, length of lines, and spacing between parallel lines. Relationships are obtained by a probable error method. Errors of observations, first-break reading, fitting of time-distance curve, numerical computations, and errors of hypothesis are taken into account. — V. S. N.

181-450. Schwaetzer, T. Well surveys and the calibration of velocity logs (with discussion]: Geophys. Prosp., v. 8, no. 1, p. 85-97, 1960.

The effect of the traveltime in the mud and in the invaded or altered formations, responsible for the delay time in single receiver continuous velocity logs, is theoretically eliminated in double receiver continuous velocity logs. In practice it has been noted that even for double-receiver V-logs the intergrated times differ from the results of conventional well surveys. Some of the geometric, geologic, and instrumental factors that affect the time measurement of double-receiver V-logs are considered, as well as the possibility that the discrepancy could in some cases be due to faults, dip, folding, or presence of high-velocity layers near the well. Some examples are given, and the question of polarity of first arrivals in conventional well surveys is discussed.

At present the discrepancies are too great to permit elimination of the conventional well survey. Reorganization of well-shooting methods, however, has greatly reduced the cost of the conventional survey. These methods and related problems of surface corrections and choice of datum plane are outlined. — D. B. V.

181-451. Hardy, H. W. Continuous velocity logger yields excellent results: World Oil, v. 148, no. 5, p. 111-117, 137, 1959.

The operation of the continuous velocity logger is described. This technique represents a tremendous advance over the old technique of shooting a hole for velocity information. Integration of the continuous velocity log with the data of 1 or 2 shots yields accurate velocity measurements. An accuracy on the order of a fraction of one percent is expected.

Quantitative evaluation of porosity from velocity logs poses a problem in interpretation that is still unsolved. Laboratory tests indicate a relationship between porosity and velocity, and many empirical formulas have been proposed. The inability to match natural conditions, however, limits the accuracy of these observations. — J. W. C.

181-452.   Berry, James E.   Acoustic velocity in porous media: Am. Inst. Mining Metall. Petroleum Engineers Trans., v. 216, Tech. Paper 8085, p. 262-270, 1959.

This paper was previously published in Jour. Petroleum Technology, v. 11, no. 10, p. 262-270, 1959 (see Geophys. Abs. 180-373). — V. S. N.

181-453.   Oilweek.   Airborne geophysical systems time savers: Oilweek, v. 11, no. 2, p. 23, 1960.

The airborne magnetometer and gravimeter methods and marine geophysical methods offer the most economic means of conducting geophysical work in the far north. The gas-explosion method recently developed at the Woods Hole and Lamont Laboratories is most promising. A gas explosion from a mixture of oxygen, air, and propane is used to produce shock waves; these waves provide a continuous profile to a depth of 8,000 feet below the water surface. The cost of such operations is but a fraction of that of conventional land seismic surveys. The gas method is an improvement over the sparker survey, which has a maximum depth penetration of 1,600 feet.
This paper is a brief summary of a lecture by A. E. Pallister before a recent meeting of the Canadian Institute of Mining and Metallurgy. — V. S. N.

181-454.   Officer, Charles B. [Jr.].   Continuous seismic profiler aids marine exploration: World Oil, v. 148, no. 5, p. 107-110, 1959.

The sparker, or continuous seismic profiler, is a technique that uses a continuous sound reflection device; it can map geologic horizons to depth of 400-1,200 feet beneath the ocean bottom. Results are recorded directly in the form of a geologic cross section that shows the altitude of the sedimentary layers.
The device consists of two units, an acoustical source unit and a receiver-recorder unit. The acoustical source unit uses a simulated explosion in the form of a 10,000 volt spark fired under water. The receiver-recorder unit consists of either a single hydrophone towed astern the boat or an array of hydrophones for directional finding. The echo signals received by the detector are fed into a fixed gain preamplifier, a band-pass filter, a recorder amplifier, and finally into a high speed, high resolution facsimile recorder. Successive recordings from the repeated spark explosions produce the continuous geologic structure section in much the same manner as an echo sounder produces a profile of the ocean floor. — J. W. C.

181-455.   Gurevich, B. N., and Umperovich, N. V.   Ob uproshchenii sistem nablyudeniy pri issledovaniyakh metodom otrazhennykh voln v Zapadno-Sibirskoy nizmennosti [A simplification of the system of observations in the investigations made by the method of reflected waves in the West Siberian Lowland]: Razvedochnaya i Promyslovaya Geofizika, no. 26, p. 15-21, 1959.

Prior to 1954 the procedure of reflected waves used in most of the West Siberian Lowland consisted of continuous profiling with a shot-point spacing of 1,150 m and the geophones at 50 m. Since 1954 the geophone spacing has

been decreased to 30 m and the distance between shot points to 500-700 m. This has improved the results of seismic surveying but raised the cost per kilometer of investigated profile. In 1956 Gurevich and Umperovich suggested that the reflected waves be correlated not according to the reciprocity principle, or time equality of reflected-wave arrival at reciprocal points, but according to the equality of normals to the reflected horizon computed for adjoining traveltime curves of reflected waves. This method is substantiated by geometric analysis, although it is exact only where the plane reflecting boundaries do not dip more than 5°-6°. The formations in the West Siberian Lowland are almost parallel so that with a depth of a reflecting horizon of some 2 km and with an average seismic velocity of 2,300 m per second, the error in the computed values of depth in only ±15 m. — S. T. V.

181-456.   Zverev, S. M. Opyt seysmorazvedochnykh nablyudeniy na rekakh Zapadnoy Sibiri [Experience of seismic survey observations on rivers of Western Siberia]: Razvedochanaya i Promyslovaya Geofizika, no. 21, p. 16-23, 1958.

Tests were made during the years 1949-55 on rivers of Western Siberia to evaluate the use of river beds as profiles for seismic exploration. Seismic receivers were fixed to floating wooden beams tied together into a long line. Strings of piezoreceivers were placed on the bottom of the river. The best conditions for the transfer of energy to the ground are created when the explosive is suspended near the water surface over deep parts of the river. This method of seismic surveying is less expensive than ordinary operations on land. — S. T. V.

181-457.   Merlini, E. A new device for seismic survey equipment: Geophys. Prosp., v. 8, no. 1, p. 4-11, 1960.

A new summarizing device has been developed in Italy that uses reflected energy collected by several groups of seismometers to provide on a single trace an indication of the total energy level. This indication is controlled in time according to an exponential characteristic, thus compensating for attenuation in the ground. The apparatus enables indications of successive energy levels to be obtained for different shots, thus furnishing a time section even during routine fieldwork. (See also Geophys. Abs. 180-364.) — D. B. V.

181-458.   Obukhov, V. A. Usovershenstvovaniye seysmoskopa UZS-2 (31) [Improvement of the UZS-2 (31) seismoscope]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 10, p. 1513-1516, 1959.

A new wide range frequency amplifier has been added to the UZS-2 (31) seismoscope, thereby increasing the frequency range of the instrument from 14-70 to 14-760 kc. The amplification of the seismoscope is increased to 350,000 in the frequency range of 20-400 kc. The wiring diagram of the improved instrument is given. — S. T. V.

181-459.   Richards, T. C. The evolution of the geophone: Bur. Central Séismol. Internat. Pubs., Sér. A, Travaux Sci., no. 10, p. 169-180, 1959.

The first practical electromagnetic seismometer, or geophone, was developed by Karcher and used successfully to locate salt domes in 1926. This was followed by Benioff's reluctance type, which was used until 1939 when it gave way almost entirely to the moving coil type. Developments in miniature geophones, very low frequency refraction moving coil types, instruments for

swamp and marine conditions, and pressure, piezoelectric, and borehole geophones are discussed individually. Present design trends are summarized. Requirements are becoming more and more specific and exacting as oil-bearing structures become increasingly ellusive. — D. B. V.

181-460. Zel'tsman, P. A. Skvazhinnyy seysmopriyemnik malogo diametra [A borehole geophone of small diameter]: Razvedochnaya i Promyslovaya Geofizika, no. 29, p. 55-56, 1959.

In the laboratory of the Ukrneftegeofizika, Zel'tsman and Gozak designed a small-diameter seismic receiver for use in 65-mm drill holes. The diameter of the instrument is only 48 mm, and the total length is 1,400 mm. Three magnetic coils connected in series are used; this assures a high degree of sensitivity of the receiver and makes reduction of the explosive charge possible, particularly at great depth. The housing of the receiver is a steel tube designed to withstand a pressure of 300 kg per cm^2, which corresponds to a depth of about 2,500 m. A sketch of the instrument is shown. Two instruments of this design were fully satisfactory in field tests. — S. T. V.

181-461. Mozzhenko, A. N. Usiliteli, primenyayemyye v KMPV i GSZ [Amplifiers used in KMPV and GSZ]: Razvedochnaya i Promyslovaya Geofizika, no. 18, p. 34-40, 1957.

An improved amplifier circuit for the PSS-60M-55 seismic station is described. Seismometers with the proposed improvement were used in basement surveying by the correlation method of refracted waves (KMPV) and deep seismic sounding (GSZ) carried out by the VNIIGeofizika during the 1956 Tuymazy expedition. — A. J. S.

181-462. Aksenovich, G. I., Gal'perin, E. I., Zayonchkovskiy, M. A., and Kulikov, S. A. Otmetka momenta vzryva pri rabotakh po glubinnomu seysmicheskomu zondirovaniyu [Recording the time of a shot in deep seismic sounding]: Razvedochnaya i Promyslovaya Geofizika, no. 23, p. 21-30, 1958.

The time of the shot during deep seismic sounding is recorded by a wireless signal. It is important to have an electronic relay free of inertia. A mechanical relay introduces a certain lag and can be used only if this lag can be taken into account in computations. Simultaneous and identical recording is accomplished by all observing stations from a single contact chronometer giving signals from the shot point. Wiring diagrams for different possible arrangements of the elements of observation are presented. Several reproductions of seismograms are also given, followed by detailed instructions to be followed in various operations. — S. T. V.

181-463. Khokhlov, A. K. O proverke identichnosti kanalov seysmicheskoy stantsii [On the checking of channel identities of a seismic station]: Razvedochnaya i Promyslovaya Geofizika, no. 16, p. 67-70, 1956.

A periodic check of the stability of parameters of a seismic field station is discussed, and methods of shortening the adjustment time are suggested. Instead of checking the stability of station parameters by comparison with records of check shots, Khokhlov recommends the comparison of seismic records of the apparatus at each stage. In a footnote the editor of the journal warns readers that the check-shot method is required by Glavneftegeofizika's regulations. — A. J. S.

181-464. Frost, H. H. Unique magnetic tape playback system: World Oil, v. 148, no. 5, p. 123-126, 1959.

A magnetic-tape playback system is described which consists of a multi-channel time sifter, a television-type monitor, and a variable-area type cross-section writer. The time sifter eliminates distortions due to normal move out and to weathering. This unit consists basically of a magnetic coated drum with 12 fixed-position record heads and 12 variable-position playback heads. By rotating the magnetic drum, an adjustment of the position of any playback head will shift the corresponding seismic trace either earlier or later, thus making it possible to eliminate errors due to weathering. By moving each playback head in a programmed manner in synchronization with the passage of the seismic energy through the time sifter, it is possible to eliminate the distortion of normal move out. The 12 corrected traces are viewed on a television monitor to see whether the corrections have been made satisfactorily. The output of the time sifter is recorded on a fresh magnetic tape, which is used to make the final variable-area cross section. Lineups of peaks and troughs on this record blend to produce a "picture" of a cross section of the earth. — J. W. C.

181-465. Alekseyev, A. M. Pristavka dlya promezhatochnoy magnitnoy zapisi PPM3-2 pri seysmorazvedochnykh rabotakh [An attachment for intermediate magnetic recording during seismic exploration operations]: Razvedochnaya i Promyslovaya Geofizika, no. 22, p. 3-76, 1958.

A description is given of an intermediate seismic-recording instrument designed as an attachment to be used with standard seismic stations. Seismic waves produced by artificial explosions can thus be recorded with very broad range amplifiers with no regulation of amplitudes and with no filters. The intermediate attachment makes it possible to reproduce the original seismogram any number of times selecting the best filtration and any mode of mixing the seismograms. This eliminates the necessity of returning to the point of the original shooting for the extension or repetition of the observations. The initial recording is made magnetically on a ferromagnetic tape using a high-frequency current (5, 000 c). This instrument operates 25 channels that record the vibrations of the seismographs, one channel for time marking (100 c), and one channel for marking the moment of explosion. Visual observation of vibrations is made on one of the 25 channels. The dynamic range is greater than 40 db; the frequency range at 3 db volume is 15-300 cycles per sec. The described installation is valuable for work in the almost inaccessible areas of Siberia. — S. T. V.

181-466. Suzuki, Ziro, and Ishigaki, Akira. On the shielding effect of various types of canals [in Japanese with English abstract]: Zisin, v. 12, no. 3, p. 130-136, 1959.

The shielding effect of a narrow canal, used to shield a platform holding a delicate instrument from the disturbing vibrations caused by ground noises, was examined in a model experiment using an ultrasonic technique. When the canal is as deep as 3/4 of the wavelength, the maximum amplitude of an elastic pulse decreases to 1/3 of that in the case without a canal. Increasing the width or the number of canals does not improve the shielding noticeably. In actual cases, however, no canal effectively serves the purpose of shielding. — V. S. N.

181-467. Conselman, Frank B. Helicopters move all gear, men in seismic survey: World Oil, v. 148, no. 7, p. 146-147, 1959.

A detailed seismograph survey of about 10 sq mi of the Mississippi River delta marsh country in Louisiana was made successfully in the summer of 1958 with helicopters providing all the transportation. This included moving a crew of 12 men, drilling and recording equipment, and explosives. — J. W. C.

181-468. Bullen, K. E. Seismology in our atomic age: Union Géodésique et Géophysique Internationale, XI Assemblée Général de l' U. G. G. I., Toronto, September 3-14, Comptes Rendus, p. 29-39, 1957.

The history of seismology is first reviewed, and then the subject of seismic recording of nuclear explosions is discussed. The very first atomic bomb of July 16, 1945, was seismically recorded; the seismic data, in fact, yielded the most reliable origin time. Subsequent nuclear explosions have been recorded with varying degrees of success, and some information of scientific value has been derived. Nuclear explosions planned specifically for seismic research should yield precise knowledge of the earth's deep interior. — J. W. C.

181-469. Bonini, William E., and Woollard, George P[rior]. Subsurface geology of North Carolina-South Carolina coastal plain from seismic data: Am. Assoc. Petroleum Geologists Bull., v. 44, no. 3, p. 298-315, 1960.

Sixty new refraction measurements on the coastal plains of North Carolina and South Carolina were made to fill the gaps in existing well and geophysical data and to make a more comprehensive study of the nature and structure of the coastal-plain floor, and 39 measurements were made in the adjoining Piedmont province to determine the seismic velocity of specific types of rock in order to aid in the interpretation of basement velocity.

The velocity in gneiss, schist, slate, and granitic rocks is 15,900-19,200 ft per sec (4.8-5.8 kmps), that in diabase averages 22,500 ft per sec (6.8 kmps), and that in Triassic sediments is 10,400-14,500 ft per sec (3.2-4.4 kmps); the highest velocity in the Cretaceous coastal-plain sediments is 9,600 ft per sec (2.9 kmps).

The studies show that the Piedmont complex extends under the coastal-plain sediments as far east as the present coast. The Carolina slate belt, an eastern slate belt, the Florence Triassic basin, and a new Triassic basin extending from near Raeford into Johnson County, North Carolina, were traced beneath the coastal-plain sediments. The Cape Fear arch is a prominent basement structure with a seaward slope of 13 feet per mile along the axis. The pre-Cretaceous erosion surface has a relief of about 200 feet. The break in the basement slope in eastern North Carolina must be projected east of Cape Fear and the South Carolina coast. There is a suggestion of an east-west syncline superimposed on the steeper basement slope in eastern North Carolina. — D. B. V.

181-470. Snow, Leland. Seismic exploration in the Appalachian region: Tulsa Geophys. Soc. Proc., v. 5, p. 23-30, 1957-58.

The seismic objectives, methods, and problems principally in the eastern part of the Appalachian province are summarized. Seismic information has proved valuable in locating gas fields that were missed when structural interpretations were made entirely on surface geology. It is probable that important deeper oil traps are present in the Appalachian area but have not been tested because of the present demand for gas. — V. S. N.

181-471. Warrick, R[ichard] E., and Winslow, J. D. Application of seis-
          mic methods to a ground-water problem in northeastern Ohio:
          Geophysics, v. 25, no. 2, p. 505-519, 1960.

Test surveys in Portage and Summit Counties, Ohio, show that seismic re-
flection and refraction methods can be used to determine depth to bedrock and
thus are applicable to the study of the water-bearing, drift-buried valleys of
northeastern Ohio. — D. B. V.

Pakiser, L[ouis] C., Press, Frank, and Kane, M[artin] F. Geophysical in-
vestigation of Mono Basin, California. See Geophys. Abs. 181-274.

181-472. Kuhn, Paul J. Seismic work in the Delaware, in Delaware Basin
          oil: San Angelo, Tex., Petroleum News Co., p. 21-23, 1959.

Uniform seismic reflections are difficult to obtain in the area of the Dela-
ware Basin of Texas and New Mexico. Sharp contrasts in seismic velocities
throughout the Quaternary fill and the post-Delaware sediments have made it
almost impossible to correlate data. Some improvement in records has been
obtained by use of the weight-drop seismic method, the "Thumper." With this
method much of the noise cancels out, and the recorded reflections are at a
somewhat lesser frequency than in the more conventional seismic method; this
produces results that are more adaptable to interpretation. — V. S. N.

181-473. International Geophysical Year Bulletin (No. 33). Seismic crustal
          studies during the IGY, pt. 1, Marine program: Am. Geophys.
          Union Trans., v. 41, no. 1, p. 107-113, 1960.

Marine seismic measurements of crustal thickness were made as part of
the International Geophysical Year program. The refraction method was used
mostly; reflections were employed where only bottom sediments were being
investigated.   Details of results are summarized briefly for the following
areas: South Pacific, Caribbean Sea (see also Geophys. Abs. 177-248), Ar-
gentine coast, Scotia Sea-Falkland Islands, South Georgia Island vicinity,
southern coast of South Africa, Gulf of Aden-Indian Ocean, Red Sea, and
Mediterranean Sea. — D. B. V.

181-474. Förtsch, O[tto]. Ergebnisse seismischer Untersuchungen auf Glet-
          schern der Ostalpen [Results of seismic investigations on glac-
          iers in the East Alps]: Zeitschr. Geophysik, v. 24, no. 4/5, p.
          161-167, 1958.

The results of seismic measurements on five glaciers in the Austrian Alps
are reported. Longitudinal and transverse wave velocities vary considerably,
probably because of the heterogeneous structure of the ice.   The acoustic
wave velocity in the ground moraine which usually underlies the ice ranges
from 4,000 to 5,000 m per sec, suggesting that the subglacial material is ei-
ther frozen or very densely packed. Glacier dynamics can be inferred from
the seismically determined form of the bedrock and ground moraine surfaces.
— D. B. V.

181-475. Beránek, Břetislav, and Zounkova, Milada. Average and effective
          velocities of longitudinal waves in the Little Danubian Plain [with
          Czech and Russian summaries]: Československá Akad. Věd Geo-
          fys. Sborník, no. 84, p. 171-189, 1958.

Longitudinal wave velocities in the Little Danubian Plain, in the northwest-
ern part of the Great Pannonian Tertiary Basin in Czechoslovakia, have been

determined by means of seismic velocity logging in deep boreholes and, in some parts of the basin, by means of reflected wave traveltimes (effective velocities). The results of these studies are given.

The curves obtained by both methods are compared for four regions. The greatest deviation is in the Kolarovo region, where average velocities exceed effective velocities by about 70 m per second, but on the whole agreement is good between the results by the two methods. — D. B. V.

181-476. Zav'yalov, V. D. Massovyye prostranstvennyye seysmozondirovaniya v Karpatakh [Mass areal seismic surveying in the Carpathians]: Geologiya Nefti, no. 12, p. 53-59, 1958.

The subsurface in a portion of the Russian cis-Carpathians is masked by a thrust fault and therefore not decipherable by geological surveying methods. Further, the structure is complicated and cannot be studied by reflection profiling. The only satisfactory method is that of mass areal seismic surveying, which consists of carrying out observations on 2 or 3 short (300-500 m) intersecting profiles occupying an area of not more than 0.25 km^2. The data derived from this type of survey can be used to determine direction and angle of dip. The error in such determinations increases with decreasing angle of dip. Experience in the Carpathians showed that the method is reliable where the angles of dip are not less than 10°-15°. — J. W. C.

181-477. Viktorov, B. N. Geologicheskiye rezul'taty geofizicheskikh issledovaniy levoberezh'ya r. Kumy [Geological results of geophysical investigations of the left bank of the Kuma River], in Geologiya i nefte-gazonostnost' yugo-vostochnykh rayonov Russkoy Platformy: Leningrad, VNIGNI, Gostoptekhizdat, p. 35-40, 1958.

This is a general discussion of the structures revealed by seismic exploration in the area north of the Kuma River, just west of the Caspian Sea. — J. W. C.

181-478. Ulomov, V. I. Nekotoryye osobennosti stroyeniya zemnoy kory Sredney Azii po zapisyam moshchnogo vzryva [Some features of the structure of the earth's crust in central Asia according to the recording of a powerful explosion]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 1, p. 131-134, 1960.

Analysis of seismograms of 29 seismic stations in central Asia obtained from a powerful explosion 100 km from Tashkent on December 19, 1957 made it possible to construct a 1,000-km profile of the crust. The profile was constructed according to the transverse traveltime curves of P* and P head waves related respectively to the basalt and Mohorovičić discontinuities for a distance of more than 300 km. The high sensitivity of the seismographs VEGIK, SGK, and SVK, the high speed of the recording tape (120-240 mm per min), and the radio signal of the moment of the explosion made it possible to determine the depth of the discontinuities with an accuracy of ±5 km. A gravity-geological map covering an area of about 1,000 km by 200 km was compiled. — A. J. S.

181-479. Quadir, M. A. A measurement and study of the velocity of seismic waves in rocks of Quetta and around: Pakistan Jour. Sci., v. 11, no. 4, p. 192-199, 1959.

The seismic refraction method was used to determine the velocity of seismic waves in the major rock formations of Quetta, the Dunghan and Jurassic limestones. The following is a summary of the velocities determined: 12,000

feet per second in the Dunghan limestone at Hirok Railway Station; 16,950 feet per second in the Jurassic limestone at Kohi-Murdar but only 5,000 feet per second in these limestones at Chiltan Hills. Velocities for gravels at the Murree Brewery are 2,440 and 4,780 feet per second. The low velocity of the Jurassic limestone at Chiltan Hills was found to be a result of the shattered and deformed structure of the formation near a major fault line; this causes the material to act as a gravel and not as a typical example of the Jurassic limestone. — V. S. N.

181-480. Robin, G. de Q. Geophysical studies in polar regions. The Antarctic ice sheet: Royal Astron. Soc. Geophys. Jour., v. 1, no. 4, p. 347-351, 1958.

This is a progress report on International Geophysical Year studies of the Antarctic ice sheet during 1957-58. Ice thicknesses measured by reflection shooting ranged between 100 and 4,200 m, with an accuracy of 2 percent. Complications were encountered in the form of a waveguide close to the surface of the cold inland ice. Refraction techniques were also used for thickness and velocity measurements. A scattered network of seismic stations recorded many shocks from the southern hemisphere, but no major earthquake activity was reported within the Antarctic continent.

Gravity surveys were used for ice thickness measurements where reflecting properties of the glacier bed were poor. Results of magnetic measurements were not yet available. Traverse parties collected vast amounts of data pertaining to the mass and thermal balance of the ice sheet. — D. B. V.

STRENGTH AND PLASTICITY

181-481. Brace, W. F. Behavior of rock salt, limestone, and anhydrite during indentation: Jour. Geophys. Research, v. 65, no. 6, p. 1773-1788, 1960.

The indentation-hardness test is being investigated as a means of studying the behavior of rock under stress sufficiently great to be of geologic interest. In this study the indentation and compression strength of limestone, marble, anhydrite, and artificial rock salt are compared. Within the roughly hemispherical deformed zone beneath the surface indentation, produced by a 136° pyramidal indenter, the average microscopic character of the rock is found to be similar to that produced in compression tests by low- to-moderate confining pressure and room temperature. In rock salt the deformation is predominantly due to gliding; in the other rocks it is due to a combination of gliding and microfracturing. Inasmuch as translation during gliding occurred in the calcite in spite of abundant fractures formed at the same time, large frictional forces must have resulted at surfaces of fractures and along grain boundaries.

Approximate stress and strain fields were found for the deformed zone, from which average values of stress difference, confining pressure, and strain could be determined. These three quantities agreed fairly well with a point on a stress-strain curve obtained from a confined compression test of a cylinder of the same material. Vickers hardness is 3±0.3 times the compressive stress difference, which is taken at a confining pressure of one-sixth of the hardness for a strain of 7 ± 5 percent.

At present the results of this study are applicable mainly to comparative studies of the strength of nonporous crystalline, relatively isotropic rocks. — D. B. V.

181-482. Jaeger, J. C. Shear failure of anisotropic rocks: Geol. Mag., v. 97, no. 1, p. 65-72, 1960.

The two-dimensional theory of two simple generalizations of the Coulomb-Navier criterion for shear failure is described. For a material with a single plane of weakness, which has a shear strength and coefficient of internal friction that are different from the remainder of the material, failure may or may not occur in the plane of weakness. For a layered material, the shear strength of which varies continuously from a maximum in one direction to a minimum in the perpendicular direction, there is apparently only one possible plane of failure; it lies between the plane of minimum shear strength and the nearest of the two Coulomb-Navier planes. Numerical results are given for tests using uniaxial compression, and experimental results are shown to be in reasonable agreement with them. — V. S. N.

181-483.   Kataoka, Akeo, and Oguri, Mikio.   Some dynamic properties of rocks at room temperatures [in Japanese with English summary]: Zisin, v. 12, no. 3, p. 91-100, 1959.

The dynamic properties of marble and granite at room temperatures were investigated by using bars of the rocks vibrating transversely at audiofrequencies in free-free modes with the following results: (1) Up to a critical strain amplitude, internal friction and resonant frequency are almost independent of strain amplitude, but when the strain amplitude exceeds this critical value, the internal friction increases and resonant frequency decreases; (2) the break point, that is, the strain at which the internal friction becomes independent of amplitude, shifts to lower strain amplitudes as the relative humidity increases; (3) previous thermal and static stress (cold work) histories were found to have a large effect on the internal friction of the test samples; and (4) the internal friction and longitudinal wave velocity are almost independent of frequency in the range between 300 and 5,000 cycles per second. — V. S. N.

181-484.   Vinogradov, S. D.   O raspredelenii chisla razryvov po energii pri razrushenii gornykh porod [On the distribution of the number of ruptures from the energy needed for breakdown of rocks]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 12, p. 1850-1852, 1959.

An analysis of rupture in rocks in the laboratory and field due to unilateral compression is reported. The elastic impulses generated during the rupture process in coal, granite, and diabase were recorded by a piezoelectric device on a magnetic tape, and from it by an oscillograph onto a photographic film. The purpose of the study was to establish whether the correlation between the number of earthquakes and their energies established by Gutenberg and Richter (see Geophys. Abs. 139-11517) holds true for earthquakes only, or whether such a correlation is true for any breakdown of rocks regardless of the scale of the phenomenon. It was found that the statistical correlation between the number of ruptures and the amount of energy liberated by them is the same both for earthquakes and for tests of rock samples in the laboratory. — A. J. S.

181-485.   Parasnis, D. S.   The compaction of sediments and its bearing on some geophysical problems: Royal Astron. Soc. Geophys. Jour., v. 3, no. 1, p. 1-28, 1960.

Experiments were undertaken to verify under high pressures the linear relation postulated by Terzaghi between the equilibrium void ratio of a sediment and the logarithm of applied pressure. Samples of Gault, Oxford clay, Keuper marl, Globigerina ooze, and terrigenous mud were subjected to maximum pressures between 250 and 840 kg per cm^2.

Certain departures were found from Terzaghi's relation, although some sediments followed the relation up to several hundred kg per cm^2; however, the departures are not such that large errors would arise in assuming the validity of the relation up to pressures of about 1,000 kg per cm^2. The void ratio at unit pressure is proportional to the compression index, suggesting that the pressure at which the state of no voids is reached is the same for all sediments; this pressure is estimated to be of the order of 2,500 kg per cm^2, corresponding to a depth of burial of about 10,000 m. It is possible to find the stress to which a given clay sample has been subjected, and therefore, it should be possible to estimate the thicknesses eroded from the present tops of clayey sediments.

Theoretical calculations of heat conductivity of a mass of porous sediments are given. It is shown that the conductivity of the first 10 m of Globigerina ooze, a typical deep-sea sediment, should be reduced to two thirds that of the constituents grains owing to the presence of water-filled voids. — D. B. V.

181-486.   Tabata, Tadashi, and Ono, Nobuo. Studies on mechanical properties of sea ice. 1. On the static visco-elasticity of sea ice [in Japanese with English summary]: [Hokkaido Univ.] Low Temperature Sci. , ser. A, no. 17, p. 135-145, 1958.

The approximate values of visco-elastic constants in sea ice obtained from static loading experiments were $E_1 = 10^9 \sim 10^{10}$ d cm^2, $E_2 = 10^9 \sim 10^{10}$ d cm^2, $\eta_1 = 10^{11} \sim 10^{12}$ d-min per cm^2, $\eta_2 = 10^{10} \sim 10^{11}$ d-min per cm^2, where E_1 and η_1 are Young's modulus and viscosity respectively under relaxation conditions, and E_2 and η_2 are Young's modulus and viscosity under retardation conditions.   These elastic constants were much smaller than those obtained by means of a vibrational method. Tentatively this discrepancy is attributed to the fairly large deformation due to bending of the ice under static loading. — V. S. N.

SUBMARINE GEOLOGY

181-487.   Revelle, Roger R. Some aspects of deep-sea exploration, in Symposium on the physical and earth sciences: Berkeley, Calif. , Univ. of California Printing Dept. , p. 53-65, 1958.

The remarkable similarities between different parts of the ocean floor and the importance of comparative studies is illustrated by a discussion of the shape and structure of the sea floor with emphasis on the exploratory work of the Scripps Institution of Oceanography of the University of California. Three phenomena characteristics of the Pacific—trenches, fracture zones, and guyots—are described and their location, size, shape, possible origin, and significance discussed. — V. S. N.

181-488.   Cromie, William J. Oceanographic and geophysical investigations at Arctic Drifting Station Charlie, in Proceedings of the second annual Arctic planning session, October 1959: U. S. Air Force Cambridge Research Center, Geophys. Research Directorate Research Notes no. 29, p. 16-21, 1959.

Drifting Station Charlie in the Arctic Ocean was occupied on April 13, 1959, at lat 75°02' N. , long 158°30' W. and had drifted north and west about 800 nautical miles to lat 78° N. , long 174° W. on October 1, 1959. The program of marine geophysics carried out by the Lamont Geological Observatory consisted of submarine geology, seismology, and magnetics. Continuous soundings of the Arctic Ocean floor were made from June 24, 1959, with a new type

Precision Depth Recorder, and 25 deep sea cores were recovered. Approximately 110 underwater photographs were made of the bottom at depths ranging from 150 to 1,400 fathoms. Muds collected from 5 locations have yielded carbon-14 dates. Daily seismic reflection shots were made from late August through September, and a vertical seismometer, a new microvariobarograph, and an Askania variograph were installed on the ice island. A full scale seismic refraction program is planned for the spring of 1960. — V. S. N.

181-489.   Fisher, Robert L., and Norris, Robert M. Bathymetry and geology of Sala y Gomez, southeast Pacific: Geol. Soc. America Bull., v. 71, no. 4, p. 497-502, 1960.

Sala y Gomez is a low volcanic islet 415 km east-northeast of Easter Island and 3,500 km west of northern Chile. Recent soundings by the U. S. Navy show that a ridge, here designated the Sala y Gomez ridge, extends from near the island to at least long 90° W. This ridge is similar to the Clipperton Ridge in the northeastern part of the Pacific Ocean. The island itself is the subaerial peak of a very large seamount that extends more than 50 km southeast and 30 km southwest of the island. The extension of the seamount to the west, north, and northeast is not known. The rock units of the island are two andesite-basalt flows separated by a discontinuous calcareous marine sedimentary unit. — D. B. V.

181-490.   Ewing, Maurice, and Heezen, Bruce C. Continuity of mid-oceanic ridge and rift valley in the southwestern Indian Ocean confirmed: Science, v. 131, no. 3414, p. 1677-1679, 1960.

The existence of a continuous rifted midoceanic ridge in the southwestern part of the Indian Ocean, predicted earlier by Ewing and Heezen (1956), has been confirmed by soundings taken during cruise 16 (now in progress) of the research vessel _Vema_. The median rift coincides exactly with the belt of earthquake epicenters. The midoceanic ridge and rift valley have the same characteristics as those in the Atlantic Ocean. The ridge branches near Rodriquez Island; the southwest branch extends through Prince Edward Island to the Atlantic Ocean, whereas the southeast branch continues through the Amsterdam and St. Paul Islands toward the Pacific Ocean. Apparently the form of the ridge changes before Easter Island is reached, and it is of interest to find how far the characteristics found in the Atlantic and Indian Oceans continue. — D. B. V.

181-491.   Lisitzin, A. P., and Zhivago, A. V. Marine geological work of the Soviet Antarctic expedition, 1955-1957: Deep-Sea Research, v. 6, no. 2, p. 77-87, 1960.

From 1955 to 1957 the Marine Antarctic Expedition of the Academy of Sciences, U. S. S. R., conducted two surveys of the Antarctic waters of the Indian Ocean and made two traverses of the Indian Ocean. The topography of the Davis Sea bottom, of the Antarctic continental shelf, and of an extensive area of recent volcanic activity west of the submarine range extending between Kerguelen and Gaussberg was determined by echo soundings over tens of thousands of miles. Cores up to 16 m long were recovered, samples of bottom sediment were collected, and a study was made of the distribution and composition of particles suspended in the sea water. Preliminary study of seismic reflections reveals several layers of sediments down to depths of 100-1,200 m below the sea floor. — V. S. N.

181-492.   McBirney, A[lexander] R.   Factors governing emplacement of vol-
            canic necks: Am. Jour. Sci., v. 257, no. 6, p. 431-448, 1959.

Previously advocated processes are found inadequate to explain the rise of
volcanic necks from magmatic sources to shallow levels where they can erupt
on the surface. Comparisons of heat conduction of wall rocks with heat trans-
fers of corresponding convection systems show that circulation of fluid mag-
ma is likely to take place. Rocks in the apex and walls of the intrusion can be
disrupted by thermal stresses and removed as inclusions in downward flow-
ing currents to provide space for the volume of rising magma. Quantitative
estimates, though inexact, indicate that emplacement of volcanic necks is a
process which, if it is to function at all, must proceed at a rapid rate. Fac-
tors controlling activity of volcanoes after their initial eruption on the surface
must be considered apart from the intrusion of the necks because they involve
radically different conditions. — V. S. N.

Pakiser, L[ouis] C.   Transcurrent faulting and volcanism in Owens Valley,
California.   See Geophys. Abs. 181-240.

181-493.   Vlodavets, V. I.   Passivnaya i aktivnaya zashchita pri katastrofi-
            cheskikh izverzheniyakh vulkanov [Passive and active protection
            from catastrophic eruptions of volcanoes]: Akad. Nauk SSSR Vul-
            kanol. Sta. Byull., no. 28, p. 79-91, 1959.

The characteristics of different types of volcanic eruptions (hawaiian,
strombolian, vulcanian, plinian, ultravolcanic and bandansan, pelean, and
katmaian) are outlined, and premonitory indications of eruptions are discus-
sed.
    Passive protection of people and human works from the consequences of
eruptions consists of working out a system of volcanic regionalization (anal-
ogous to seismic regionalization) based on analysis of the following factors:
(a) classification of the volcano as active or dormant; (b) the present state of
the volcano (erupting, fumarolic, solfataric, mofettic, showing only hot
springs, or without gaseous or thermal manifestation); (c) structure and com-
position of the constituent rocks of the volcano; (d) character of past activity;
(e) geophysical data (seismic, magnetic, and other); (f) relief of the volcano
and its surroundings; and (g) climatic conditions. Zones of relative danger
can be mapped on the basis of these data; the map might also show probable
routes of lava or mud flows and glowing clouds or avalanches.
    Active protection is necessary where danger zones are inhabited.   The
main methods are bombarding moving lava flows or crater walls from the air
or with artillery, building dams or other obstructions, and tunneling to drain
water away from craters. — D. B. V.

181-494.   Bellair, Pierre.   L'éruption du Kilauea (Hawaii) de novembre 1959
            et janvier-février 1960   [The eruption of Kilauea (Hawaii) of No-
            vember 1959 and January-February 1960]:   Soc. Géol. France
            Comptes Rendus, no. 4, p. 79-80, 1960.

In November 1959 Kilauea's Iki crater erupted with a spectacular lava foun-
tain 200 m high and emitted an estimated 50 million m^3 of lava.   On January
13, 1960, a "curtain of fire" erupted from a fissure 1,200 m long near Kapo-
ho village 35 km away. Along with violent steam explosions about 160 million
m^3 of lava poured from this fissure. On February 7 the level of the solid lava
floor of Halemaumau crater suddenly lowered, probably as a result of the
withdrawal of lava, and continued to drop until Febraury 25, by which time the
Kapoho lava fountain has been virtually inactive for 3 or 4 days. — D. B. V.

181-495. Simpich, Frederick, Jr.   Fountain of fire in Hawaii: Natl. Geog.
Mag., v. 117, no. 3, p. 303-327, 1960.

This is an account of the early days of the Hawaiian eruption that began in
Kilauea's Iki crater on November 14, 1959, illustrated with numerous color
photographs of lava fountains and flows. The fountains reached record heights
of 1,900 feet.   On January 13, 1960, a flank eruption near Kapoho forced e-
vacuation of two villages. — D. B. V.

181-496. Tazieff, Haroun.   L'éruption sous-marine de Faial (1957-1958)
[Submarine eruption of Fayal (1957-1958)]: La Nature, no. 3288,
p. 145-151, 1959.

A submarine eruption of Capelinhos at the northwestern end of Fayal Island
in the Azores began on September 27, 1957 and lasted until July 1958.   Two
successively alternating phases of activity were distinguished.   A pseudovul-
canian stage was marked by a cauliflower cloud produced by fall of incandes-
cent material back into the sea.   This type of activity alternated with a more
violent vesuvian (ash) phase. (See also Geophys. Abs. 178-429.) — J. W. C.

181-497. Vlodavets, V. I.   V strane vulkanov [In the country of volcanoes]:
Priroda, no. 10, p. 74-81, 1959.

Volcanic activity and economic utilization of volcanic heat in Iceland are
described.   This is a popular article accompanied by color plates. — A. J. S.

181-498. Cavallero, Carmelo.   Un ciclo effusivo dello Stromboli (1-14 gen-
naio 1956; 16 gennaio - 16 marzo 1956) [An effusive cycle of
Stromboli (January 1-14, 1956; January 16 - March 16, 1956] :
Stromboli, [no. 6?], p. 33-39, [no date].

The eruptive activity of Stromboli in early 1956 was divided into two dis-
tinct phases.   The first phase, from January 1 to 14, was more intense than
the second, which lasted from January 16 to March 16.   The several lava e-
missions are described.   Earthquakes from the vicinity were recorded on
February 16, 19, and 24 and March 2 and 6.   A brief petrographic descrip-
tion of the lava is given. — D. B. V.

181-499. Sato, Hisashi. Distribution of volcanoes in Japan: Internat. Geog.
Union Regional Conf. in Japan 1957 Proc., p. 184-188, 1959.

It is proposed that the distribution of volcanoes in Japan is more closely
correlated with recently developed small-scale features of the surface relief
than with tectonic structures of the more remote past. Minor faults are char-
acterized by numerous volcanoes, whereas, the major faults that govern the
important tectonic and morphologic structures of the Japanese arc have not
been associated with volcanism in recent geologic time.   It has been calcula-
ted that the depth to the tops of magma reservoirs of several volcanoes in Ja-
pan is but about 10 km, and it may be presumed that surficial faults are a pre-
requisite for an initial eruption.
Activity of deeply rooted great faults or crustal movement sometimes pro-
motes the formation of magma reservoirs; it cannot be said, however, that
where such a reservoir exists a volcano will always erupt. Rather, the exist-
ence of fresh passages through which the magma can ascend to the surface
from the still active reservoir determines the distribution of each volcano. —
V. S. N.

181-500. Sprigg, R. C. Presumed submarine volcanic activity near Beach-
          port, south-east South Australia: Royal Soc. Australia Trans.,
          v. 82, p. 195-203, 1959.

Three, or possibly four, submarine ridges transverse to the general con-
tour of the continental platform opposite Beachport, South Australia, are prob-
ably lava flows erupted in Cenozoic times. As the epicenters of the 1897 and
1948 earthquakes correspond closely to the heads of these flows, they are pre-
sumed to represent the latest phase of volcanism in this part of Australia. —
D. B. V.

181-501. Nakamura, Hisayoshi. Study on thermal mine water in Joban coal
          field: Geol. Soc. Japan Jour., v. 65, no. 769, p. 582-594, 1959.

Mine water in the Joban coal field is discharged at the rate of 3,800 cfm;
of this 2,800 cfm is thermal water and the remainder is shallow cold water.
North-south trending faults in the mines are accompanied by thermal water
without exception. Thermal water also issues from cracks in the bottom of
deep adits at a rate of 100 cfm. Chemical analysis indicates that the thermal
water issuing from depth is of the Cl^{-1} type. Two possibilities are suggested
for the origin of this type of water: It may be sea water or fossil water heated
by an unknown magmatic source, or it may be residual magmatic water that
has been cooled by ground water and heat radiation during its passage along
fractured zones. The water shows a notably high value for distribution of
temperature and Cl^{-1} along the north-south trending faults.
The relationship between discharge and water level suggests that the ther-
mal water in the Joban coal field comes from porous Tertiary beds and from
cracks and fissures related to north-south trending fracture zones in base-
ment rocks. — V. S. N.

INDEX