DR. G. R. LYMAN has been appointed dean of the College of Agriculture of West Virginia University. Dr. Lyman is at present in charge of the Plant Disease Survey of the United States Department of Agriculture and will assume his new position on January 1. Dr. N. J. Giddings has been acting dean of the West Virginia College of Agriculture since the resignation of Dr. John Lee Coulter on September 15, 1921.

PROFESSOR ALFRED TENNYSON DELURY, head of the department of mathematics, University of Toronto, has been appointed dean of the faculty of arts. Sir Robert Falconer called a meeting of the council of the faculty of arts and announced that, while the appointment of a dean was by statute in his hands, he would like to receive nominations from the council. Nominations were then made and balloting was carried on by mail during the next week. The result was that Professor DeLury was the choice of the council and he was appointed by the president.

DR. BOWMAN C. CROWELL, formerly connected with the Oswaldo Cruz Institute of Rio de Janeiro, and with the Bureau of Science of the Philippine Islands, has been appointed professor of pathology at the medical college of the University of South Carolina.

DISCUSSION AND CORRESPONDENCE

SOME SEISMOLOGICAL EVIDENCE THAT IS NOT EVIDENT

IN the June number of the *American Journal of Science* an article appeared under the title "A Critical Review of Chamberlin's Groundwork for the Study of Megadiastrophism."[1] In it a number of statements are made in regard to seismological facts which would seem to require experimental proof.

In the early part of the article the author sums up what he considers the evidence of seismic transmission for a viscous liquid state of the core of the earth at depths below 0.6 of the earth's radius. Describing the types of waves sent out by an earthquake, he says: "Seismic disturbances send out vibrations of two types, compressional and distortional. These are called the primary and secondary waves respectively. The former waves are dependent on the elasticity or compressibility of the transmitting medium, while the latter waves are dependent both on the rigidity and the elasticity of the transmitting medium for their propagation." In the first place, it is not clear what the author means by elasticity. He would seem to use it as synonymous with compressibility, whereas it is usually taken as a generic term including both volume elasticity and rigidity as species. But, passing over that point, does not the author's statement require both mathematical and experimental proof, since it is in direct opposition to the accepted theory of elasticity,[2] borne out as the latter is to a great extent by observations on earthquake records? As is well known, the theory of elasticity teaches that compressional, or dilatational, or longitudinal waves involve not only the modulus of compression or bulk modulus of the medium but also its shear modulus or coefficient of rigidity; and on the other hand, that the distortional, or shear, or transverse elastic waves involve the modulus of rigidity of the medium but not its modulus of compression. Thus the formula for the velocity of the longitudinal waves is

$$V_1 = \sqrt{\frac{\lambda + 2\mu}{\rho}}$$

ρ being the density of the medium, λ Lamé's compression constant, and μ the modulus of rigidity. In the case of transverse waves, the formula for the velocity is

$$V_2 = \sqrt{\frac{\mu}{\rho}}$$

Another statement that would seem to be far from evident is the following: "The two types of waves travel at different velocities but can only become distinctly separated out in a

[1] Art. XXXVII, "A Critical Review of Chamberlin's Groundwork for the Study of Megadiastrophism" by William F. Jones. *Amer. Journ. Sci.*, Fifth Ser., Vol. III, No. 18, June, 1922.

[2] *Cfr. e. g.* A. E. H. Love: "A Treatise on the Mathematical Theory of Elasticity," Rev. Ed., 1920, Cambr. U. Press.

homogeneous medium; that is, homogeneous as to stress effects or, in other words, isotropic. The resultant vibrations which travel circumferentially from the shock center pass through what we know is a heterogeneous medium." Rudzki[3] has shown that a disturbance in a heterogeneous but stratified elastic solid will send out distinct types of waves. These waves will be propagated through the stratified medium at different velocities and will appear in separate groups. First a nearly longitudinal phase will arrive at a given point, then a double, approximately transverse phase, and finally a group of surface waves will travel on the free surface.

But when the author of the article goes on to say: "The wave types are not separated in the earth's surficial shell. At a minimum distance of 700 miles, or 10 degrees of arc, from the epicenter a three-phase record becomes decipherable," he is unfortunately allowing himself to be betrayed into statements at variance with a great and ever-increasing mass of observed and published facts. The reports of any of the better seismographic stations, equipped with modern damped apparatus, would have furnished him with examples to the contrary. So, too, would any of the bulletins that are being issued by the Seismological Committee of the British Association[4], or Angenheister's[5] recent study on Pacific earthquakes and the upper layers of the earth's crust. The Chittenden,[6] California, earthquake of July 24, 1921, was an unusually beautiful example of clean-cut separation of the three phases at very short distances. As published in the Bulletin[7] of the Seismographic Stations of the University of California, the epicentral distance obtained from the Berkeley seismograms was only 125 km. (78 mi.) and that measured on the Lick records was but 46 km. (29 mi.), both of which agree very well with the location of the epicenter at Chittenden on macroseismic evidence.

There is another argument in the paper that is open to controversy. Relying on the statements of Professors Knott and Oldham that compression waves are transmitted through the core of the earth while shear waves are not, the author argues to a viscous fluid state of the interior. Now it is by no means certain that the transverse waves do not pass through the core of the earth. Neither, on the other hand, is it an observed fact that the longitudinal waves do so penetrate. In fact, the evidence seems rather strong to the contrary. Weichert and Zoeppritz,[8] Zeissig[9] and Mohorovičic[10] were not able to trace the direct longitudinal waves much more than half way to the antipodes. Gutenberg[11] in 1914 followed them up to about 106° and thought he had evidence for their reappearance between 143° and 180°.

[3] M. P. Rudzki: 1. "Parametrische Darstellung der elastischen Welle in anistropen Medien," *Bull. Acad. d. Sciences de Cracovie*, 1911, pp. 503-536.

2. "Sur la propagation d'une onde élastique superficielle dans un milieu transversalement isotrope," *Ibid.*, 1912, pp. 47-58.

[4] "The Large Earthquakes of 1917," Oxford, 1921.

[5] G. Angenheister: "Beobachtungen an pazifischen Beben. Ein Beitrag zum Studium der obersten Erdkruste," *Nachr. d. Ges. d. Wiss. zu Göttingen, Math.-Phys. Kl.*, 1921.

[6] Located at Chittenden, Santa Cruz Co., Cal., by Wm. J. Kemnitzer. See: William J. Kemnitzer, "The Chittenden Earthquake of July 24, 1921," *Bull. Seism. Soc. Am.*, Vol. XI, pp. 189-191, September-December, 1921.

[7] James B. Macelwane: "The Registration of Earthquakes at the Berkeley Station and at the Lick Observatory Station, April-September, 1921," *Univ. of California Publ., Bull. of the Seism. Stat.*, Vol. 2, No. 2, 1922.

[8] E. Wicchert und K. Zoeppritz: "Über Erdbebenwellen I u. II," *Nachr. d. K. Ges. Wiss. zu Göttingen, Math.-Phys. Kl.*, 1907.

[9] K. Zeissig: "Tabelle," Akad. Nauk, St. Petersburg, Comptes rendus des séances de la Commission sismique permanente, Tome III, Liv. III.

[10] S. Mohorovičic: "Die reduzierte Laufzeitkurve. II. Mitteilung: Die Ausbreitung der Erdbebenstrahlen in den tiefen Schichten der Erde," *Gerlands Beiträge zur Geophysik*, Bd. XIV, Heft 3, 1916.

[11] B. Gutenberg: "Über Erdbebenwellen VII A. Beobachtungen an Registrierungen von Fernbeben in Göttingen und Folgerungen über die Konstitution des Erdkörpers (mit Tafel)," *Nachr. d. K. Ges. d. Wiss. zu Gött., Math.-Phys. Kl.*, 1914.

But Rudolf and Szirtes[12] and Angenheister[13] have since shown that the latter belong to a branch of the first reflected waves. However, Angenheister was able to follow the direct compressional waves to about 145°, which is a great achievement. Beyond this we have no proof for their existence as yet. Hence it will be seen how weak is the author's argument for a viscous fluid state of the earth's core. If it is a viscous fluid, the longitudinal waves should be transmitted and the transverse waves should not. If it is an elastic solid, both the longitudinal and the transverse waves should be able to traverse it along some path, not necessarily a straight one. Do they? Future investigation may tell us. For the present, modern seismologists and geophysicists[14] suppose the core of the earth to be a rigid solid.

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THE BEGINNING OF AMERICAN GEOLOGY

TO THE EDITOR OF SCIENCE: I have been reading with very great pleasure Dr. J. M. Clarke's interesting account of the beginnings of American geology in his life of James Hall, which has recently been published.

On page 218 he refers to the statement that Charles T. Jackson "drew a plan for the New York Survey, a statement repeated in Appleton's Cyclopedia of American Biography" but concerning which he (Clarke) has "never seen documentary evidence."

Without in any way desiring to dispute Dr. Clarke's contention it may be worth while to say that the sketch in the Cyclopedia referred to was written by me and that a proof of the sketch received the approval of one member of Jackson's family. The circumstances are quite clear in my memory. Owing to Jackson's death I did not know to whom to send the proof until, telling my trouble to Henry Carrington Bolton, he called my attention to the fact that Jackson's son or nephew had been with him in the class of '62 in Columbia. This information resulted in my submitting the sketch to some proper person who not only approved the article but sent me a portrait of Jackson showing him seated on a chair with both hands on his knees extending outward holding medals.

It is possible that the item about the New York Survey came from the younger Silliman's masterly article on the "Contributions of American Chemists" that he delivered at the Centennial of Chemistry held in Northumberland in 1874, and which was published in the *American Chemist*. If so, then the information came to Silliman directly from Jackson.

May I add for the information of students of the history of chemistry in America that Jackson received pupils in his laboratory in Boston, just as Booth and Garrett did in Philadelphia, and that it was in his laboratory that Charles A. Joy, who later held professorial appointments in Union and Columbia, received his early knowledge of chemistry before going to Göttingen.

Dr. Clarke persists in writing O. M. Mitchel's name with two l's. Mitchel was a very remarkable man and like Jackson was conspicuous for not being able to carry out the great things that he had in his mind. He died of yellow fever during the Civil War, and, while holding important commands, so persistently pestered Halleck with plans and recommendations to cut the Confederacy in two that he was removed and sent to Hilton Head.

If Dr. Clarke should issue a second edition of his valuable contribution to the history of science, I would suggest that Newberry's connection with the Sanitary Commission was rather administrative than medical, as can be seen by his printed report of which a digest appears in the article on Newberry in the "Cyclopedia of American Biography."

The unfortunate experiences of many of the early State surveys has been very fully told by Merrill in his valuable "History of Ameri-

[12] E. Rudolf und S. Szirtes, *Phys. Zeitschr.*, August 1, 1914.

[13] *Op. cit.*, pp. 11, 24, 27.

Also: G. Angenheister: "A study of Pacific Earthquakes," *The New Zealand Journal of Science and Technology*, Vol. IV, No. 5, 1921, pp. 216-217, 224.

[14] *Cfr.* A. Sieberg: "Aufbau und physikalische Verhältnisse des Erdkörpers unter besonderer Berücksichtigung der Erdrinde," *Geologische Rundschau*, Band XII, Heft 6/8, 1922, pp. 346-359.