as a fellow of the International Education Board, has accepted appointment as instructor in physics in the University of Michigan for the year 1926–27.

DR. I. S. FALK has been promoted to the rank of associate professor in the department of hygiene and bacteriology of the University of Chicago.

DISCUSSION

AN OUTDOOR OPTICAL EXPERIMENT

DISTANT landscapes, even in the clearest weather, are seen through a blue "haze" which is doubtless due to light scattered by the molecules of air. This effect is unusually conspicuous and remarkably beautiful in the Grand Canyon and the adjacent country. During a conversation with friends at the observatory it occurred to the writer that this blue light should be partially polarized and should therefore show variations when observed through a Nicol prism. Observations made on a trip to the Canyon and the Painted Desert show that this effect is remarkably conspicuous. As the Nicol is rotated the blue haze is alternately intensified and very greatly diminished. In the position of the greatest extinction the details of the distant landscape become much more conspicuous, while the sky between them is greatly darkened. The color scheme is strikingly changed, distant objects appearing more nearly in their true colors, while the whole landscape takes on a singular appearance, much resembling that which is observed a few minutes before or after totality during a solar eclipse, when the light, coming from the sun's limb, is deficient in the blue rays.

This polarization effect is at a maximum 90° from the azimuth of the sun (as might be expected) and is inconspicuous under the sun or opposite it, unless the sun is high in the sky. Distant clouds show it, as well as distant mountains, and have the advantage of being available from all stations. They are usually brighter than the sky in all positions of the Nicol, but most conspicuous when it is set for maximum transmission. A small wisp of cloud observed over the Grand Canyon appeared, however, bright on a dark sky when observed with maximum extinction, and dark on a bright sky with maximum transmission. This cloud was probably low in the atmosphere, so that the unpolarized light reflected from it, when diminished to half by the interposition of the Nicol, was less than the principal polarized component of the light scattered by the air behind it, but greater than the component polarized in the perpendicular direction. With the unaided eye, this cloud was just discernible, mainly by its color.

In general, it appeared that all details visible with the polarizing device could also be seen, though more faintly, with the unaided eye; but in some cases, among distant clouds, the Nicol prism seemed to show more than could otherwise be seen. This use of a familiar optical appliance must have been suggested before—perhaps many times—but it appears to be little enough known to justify this note. The effect under favorable circumstances is conspicuous enough to be of interest to the least informed spectator. In intimating the true colors of distant objects, and in detecting faint clouds, it may be of some value to the serious observer, and it should be of use to teachers of optics as affording a simple and striking demonstration experiment.

HENRY NORRIS RUSSELL

LOWELL OBSERVATORY

SEISMIC WAVE VELOCITY AND DENSITIES OF CRUSTAL MATERIALS

IN "A Seismological Note" in the issue of SCIENCE for March 19, 1926, Dr. Perry Byerly draws the conclusion that "the increased velocity of seismic waves beneath the Pacific can not be cited as an evidence of greater density beneath oceans than beneath continents."

It is true that certain writers have been guilty of incomplete statement when they have cited the increase of velocity in question as a proof of increased density. For it is well known that in general an increase in velocity from medium to medium may be accompanied either by an increase in density or by a decrease in density, or indeed by no change in density at all.

But in the case under consideration we are not dealing with elastic media in general, but with the crustal materials of the earth. Nor are we dependent solely upon the general considerations of elastic theory, for we have at hand experimental data of unquestionable reliability on the properties of a considerable range of typical crustal materials. I wish to point out on the basis of these data that an increase of velocity of seismic waves traversing a given portion of the earth's crust is indeed rather good evidence of greater density in that portion.

Adams and Williamson have shown[1] *that if typical crustal materials be arranged in the order of increasing velocities of seismic waves they will then also be in the order of increasing densities.* The only considerable exceptions are the heavy iron minerals pallasite and siderite, which are probably important only at considerable depths. Omitting pallasite and siderite from the list, as we pass from granite to dunite an increase in velocity of the P-waves from 5.6 to 7.3 and

[1] L. H. Adams and E. D. Williamson, "The Composition of the Earth's Interior," Smithsonian Report for 1923, page 250.

of the S-waves from 3.1 to 4.1 kilometers per second is accompanied by an increase in density from 2.61 to 3.38 grams per cubic centimeter.

Thus we see that there is a considerable experimental basis for citing the increased velocity of seismic waves beneath the Pacific as evidence of greater density of crustal materials there than beneath the continents. The retarding effect of greater density is more than compensated by the greater proportional increase in elasticity, as Angenheister has pointed out.

It may be of interest to call attention to another case where an increase in velocity of transmission of elastic waves is associated with increasing density. At 0° C. and for a salinity of $35\frac{0}{00}$ the velocity of sound waves in sea water increases from 1,450 meters per second at the surface to 1,591 meters per second at a depth of 4,700 fathoms,[2] the density increasing from 1.02813 to 1.06649 grams per cubic centimeter. The velocity undergoes this considerable increase *in spite* of the density increase because the bulk modulus of the water increases from 2.16×10^{15} to 2.70×10^{10} dynes per square centimeter.

JERRY H. SERVICE
U. S. COAST AND GEODETIC SURVEY

FIELD TRIPS IN GEOLOGY

THE recent announcement concerning the establishment of a "summer school of geology and natural resources" by the Department of Geology, of Princeton University, and more especially of a "travelling course" to be given as a part of the work of this school, is of such general interest to all students of geology that an account of a very similar course given in 1924 by the department of geology of the Mississippi Agricultural and Mechanical College may be of interest also to readers of this journal. The points of similarity may be readily seen by a summary of the itinerary of the two tours.

The travelling course described in the Princeton announcement is to be offered in 1926, beginning July 1 and lasting seven weeks. The party, consisting of Professor Field and Professor Buddington and twenty students, will travel in a specially constructed sleeping, dining and lecture Pullman car. According to the itinerary, "the principal localities to be visited this year will be the Silurian Section at Niagara Falls; Mesabi Iron Ranges; Yellowstone National Park; Glacier National Park; Butte Copper Mines and Anaconda Smelter; Columbia River Basin and lava flows; Mt. Rainier; Crater Lake; Yosemite National Park; Los Angeles oil fields; Grand Canyon; Flagstaff volcanic fields; Petrified Forest, Arizona; Appalachian Coal Fields; Appalachian Province and the Coastal Plain Province." Truly a wonderful education in itself.

After an Appalachian field trip in 1922 in two Ford trucks and a more extended one in 1923, the department of geology of Mississippi A. and M. College conducted a Pacific field trip for eleven weeks in 1924 under the direction of the writer, travelling in three Dodge cars, two touring and one commercial body. Such mode of travel is far more fatiguing than in a Pullman car, but it is more flexible and permits of almost exclusive daylight travel. The itinerary was very similar to the proposed one of Princeton University, west of the Mississippi, but more detailed. The principal places visited were the Arkansas Bauxite mines; Eastland-Ranger oil fields; Carlsbad Cavern; Petrified Forest; Crater Mound; Walnut Canyon Cliff Dwellings; Flagstaff volcanic fields; Grand Canyon; Mohave Desert; San Bernardino Mountains; Los Angeles oil fields, and Rancho La Brea deposits; Catalina Island; Mariposa Grove; Yosemite; Placerville, Coloma, and Nacoma past and present gold mines; Crater Lake; Mt. Shasta; Columbia River gorge and Mt. Hood; Mt. Rainier; Vancouver; Columbia River lava flows; Coeur d'Alene mines; Anaconda and Butte mines; Yellowstone National Park; Great Salt Lake; Bingham copper mines; Dinosaur National Monument; and Joplin zinc mines.

It would be interesting also, perhaps, to compare the results of these two trips taken under such different modes of travel, so far as comparison is possible of tours under different leadership. And, speaking from experience, one would probably feel impelled to say that it takes a courageous heart to plan, besides the field work, three hours six days a week of lectures, conferences and quizzes.

W. C. MORSE
MISSISSIPPI AGRICULTURAL AND MECHANICAL COLLEGE

SPECIAL CHARACTERS FOR THE TYPEWRITER

I WAS interested in the suggestion of Mr. Hulse for adding a few characters to the typewriter, as published in SCIENCE for March 26, and also in the proposal of "Ad Infinitum," as published on page 477 of the issue for May 7.

The wavy underscore is certainly a good suggestion, although it may not accomplish much more than can be done by the colored ribbon. In some cases a writer may find it convenient to make use of both devices, and in any case he may use the one which serves his purpose best. But instead of the pair of brackets as used by Mr. Hulse, it seems that one might get along with a single vertical line, adding the horizontal portion at top and bottom by hand.

It seems like a rather hopeless undertaking to meet

[2] N. H. Heck and Jerry H. Service, "Velocity of Sound in Seawater," U. S. Coast and Geodetic Survey Special Publication No. 108.