degree of Doctor of Science was conferred upon him by the University of Michigan.

Mr. President: It is indeed a high privilege to present Frederick Eugene Wright as the recipient of the Washington A. Roebling Medal. In making this award both Dr. Wright and the Society are being honored.

ACCEPTANCE OF THE ROEBLING MEDAL OF THE MINERALOGICAL SOCIETY OF AMERICA

FRED E. WRIGHT, *2134 Wyoming Ave., N. W., Washington 8, D. C.*

It gives me real pleasure to receive the Roebling Medal of the Mineralogical Society of America and to realize that award was made on the basis of the recommendation by its Council.

You have heard from Doctor Kraus that, many years ago, he proposed to the Mineralogical Society that it should establish a Medal to be awarded in recognition of work done in the field of minerals. Our Society owes much to him for his interest and participation in its affairs over the years; as one of the recipients of the Medal, I am grateful to him for his proposal. In his Presentation Address he mentioned many details of my own efforts; I marvel at his aptitude for digging out events in my life that had long since passed down memory's flow and been forgotten. This is in keeping with his reputation, the world over, for accuracy of statement and for reliability.

For me it is a special honor to receive a Medal named after the builders of the Brooklyn Suspension Bridge. Both father and son were remarkable men and civil engineers of the highest grade. The father, John A. Roebling, died in 1869; he had then received the contract to build the bridge; but actual construction had not been started at the time of his death which was the result of a serious injury incurred during a survey of the work to be done. He had designed the bridge; the drawings had been completed as far as was possible at that stage. It fell to the son to build the bridge. This he did, although he became seriously ill with caisson disease (bends) contracted in the course of his work. He had, in consequence, to direct the construction from his bedroom. In this effort he was aided by his wife, Emily Warren Roebling, who served as liaison between him and his engineering staff. The bridge has stood the test of time. It has recently been modified, to meet modern demands, by D. B. Steinman, a distinguished builder of bridges, whose book on the Roebling family and its accomplishments has been an inspiration to many of us. It was the son, Washington A. Roebling, who constructed the bridge and who gave a sum of money to the Mineralogical Society; part of this

FRED. E. WRIGHT

Recipient of the Roebling Medal of the Mineralogical Society of America fund is devoted to the Medal Awards. The son died in 1926; he was an enthusiastic collector of minerals; his wonderfully complete mineral collection was given, after his death, by his son, John, grandson of John A. Roebling, to the National Museum of the Smithsonian Institution at Washington together with a large maintenance fund.

It is customary for the recipient of the Roebling Medal to refer briefly to a phase of his own work. I have chosen to discuss some of the results of our investigation of the materials exposed at the moon's surface. To one trained in geology and mineralogy, the first essential to progress is knowledge of the materials in the field and of their behavior toward agents that tend to modify them. Thus he asks: "What are the materials at the moon's surface?" and "what is the physical and chemical behavior of these materials under lunar surface conditions?"

Unfortunately we cannot visit the moon and learn at first hand about its rocks and their environment. The best we can do is to study the reflected and scattered sun's rays (moonbeams) and note the effects that lunar surface materials have on them; comparison of these effects with those produced by terrestrial materials may enable us to form an idea of their composition. The effects are of two kinds: (1) Changes in the relative intensity of light from the ultraviolet into the infrared; also the changes in the total intensity of light scattered at various angles of incidence; (2) Degree of polarization of the scattered rays for various angles between incident and reflected or scattered rays.

With the aid of a special eyepiece for measuring the amount of plane polarization in a beam of light, the percentage of plane polarization in the light from twenty-four selected points on the moon's surface was determined for various phases of the moon during eleven lunations. The relative accuracy of these measures is less than one-fifth of one per cent, plus or minus.

The problem is analogous to that of the determination of minerals under the petrographic microscope. In the one case, the changes produced in light on diffuse reflection and scattering are analyzed; in the second case, those resulting from transmission through mineral sections and grains are determined. With lunar materials the changes are unfortunately few and cannot be ascertained with the degree of accuracy possible in mineral plates. The observer has no choice but to infer the nature of its surface materials from the slight changes they produce in sun's rays on reflection and scattering. If satisfactory conclusions are to be drawn, the measurements should be made with high accuracy by independent methods and through complete lunations.

The phenomena observed are chiefly those of scattered (diffracted) light combined with absorption and internal and external reflections;

under these conditions the character of the surfaces which scatter the light plays an extremely important role and gives rise to phenomena that reflection and refraction alone do not explain. When the angle between the incident and the radiated beam is small, between 10° and 30° depending on the substance and on its surface, the amount of polarized light in the scattered is zero. For still smaller angles the scattered beam is again polarized, but the plane of its vibration is in the plane of incidence, rather than normal thereto.

Lyot, the first to observe this phenomenon in moonlight, called it negative polarization. It appears about two days before full moon and continues for an equal period after full moon. Terrestrial materials exhibit the same phenomenon and about the same variation. The percentage amount of negative polarization rarely exceeds one per cent. In terrestrial materials it varies with the substance and with the scattering surface. As a diagnostic feature negative polarization has been of little value; it is an important element in the theory of the scattering of light and is being investigated further.

The visual measurements have been made with an eyepiece which consists of a tilting-plate compensator together with a detector for ascertaining the exact point of compensation. The field of the eyepiece is a divided photometric field in which two factors, namely, equality of illumination and exact alignment of Savart fringes, are the criteria used in making a measurement; it is the combination of these two factors that renders the method so accurate. With this eyepiece the percentage amount of polarization can be determined to 0.2 per cent. The plate of the compensator can be tilted to 70°; for this angle of tilt the percentage amount of plane polarization introduced by a single glass plate or film of celluloid of refractive index, 1.505, is about 26 per cent; at a 60° angle of tilt it is 18 per cent; with a compensator of two plates mounted in parallel and tilted at 60°, the percentage amount is increased to 30 per cent; with 4 plates in parallel, to 46 per cent; with 6 parallel plates, to 56 per cent; with 12 parallel plates, to 71 per cent.

For observations on the moon the single-plate compensator suffices; the maximal polarization in moonlight from the dark areas or Mare is approximately 17 per cent; from the bright lunar mountain areas it rarely exceeds 8 per cent. For observations on terrestrial materials more than one tilting plate is needed to compensate the much higher amounts, exceeding 60 per cent, of plane polarization produced by dark colored rocks, such as basalts and peridotites.

With the polarization eyepiece, equipped with tilting compensators of one, two, and six parallel plates, polarization measurements have been made on fifty selected terrestrial substances illuminated by sunlight incident at different angles and viewed from different directions.

The results of visual measurements of polarization in light scattered by the moon's surface and by terrestrial materials have been plotted on graphs and indicate that basalts and other rocks low in silica are not exposed on the surface of the moon. To judge from the results the rocks are in the form of pumice and range in composition from rhyolites high in silica to trachytes and andesites lower in silica, but above 55 per cent. The surmise that a thin layer of dust due to migration of alumina and other components of the underlying substances to the surface and to atom and molecule disintegration through bombardment by electrons and neutrons emanating from the sun weakens this conclusion which rests solely on polarization measurements. The results do not prove the existence of silicate rocks at the surface. Silica and the silicates show metallic reflection in the region of 8 to 10 mμ in the infrared; but the intensity of solar radiation in that region is so low that Pettit and Nicholson at Mt. Wilson were unable to detect it in the presence of planetary heat, namely heat absorbed at short wave lengths and radiated at much longer wave lengths. The rate of cooling during a lunar eclipse, as measured by Pettit, proved that an excellent heat insulating material covers the lunar surface, such that during a lunar eclipse the fall in surface temperature approaches several hundred degrees centigrade. If the material is finely divided dust, it in turn is fairly transparent to rays in the visible spectrum; were the layer dark, it would show a much greater percentage of polarization than is now the case. It has long been known that the Lambert cosine law of scattering of light does not hold accurately, thus indicating the presence of pumiceous material. Furthermore as result of a recent work on microwave observations, Jaeger and Harper and others have shown that there is possibly a thin crust of dust only a few millimeters thick covering the pumice. In no case has evidence been found of solid rock, such as granite, syenite, or diorite, outcropping at the surface. Even the inner slopes of craters give no clue to the presence of solid crystalline rock.

This work is fascinating in part because of the distance at which the lunar surface materials have to be studied; this factor alone adds much to the difficulties of the problem; in part because of our limited knowledge of the behavior of the materials exposed to conditions existing at the lunar surface. To us it is a strange world in which our background of terrestrial experience avails but little and may even be a hindrance.

Permit me again to emphasize the gratitude and pleasure at the award to me of the Roebling Medal. It will ever be an inspiration to me to be reminded of the courage, the tenacity, and the thoroughness of the giver, Washington A. Roebling.