for recurrence. The Hindus, by a stroke of genius, dropped the Greek trigonometry of chords and introduced the half-chord or sine function. With the shadow function of the Hindus, further developed by the Arabs and Europeans, one has a trigonometry adaptable to simple mathematical formulations, as Viète demonstrated in so masterly a fashion. This trigonometry leads back again to algebraic formulations employing the complex numbers; it is sufficient here to mention the names of Demoivre and Euler and Gauss. Progress in early mathematical science hinged upon this constant interplay between algebra and geometry. This was the path, also, that made possible the application to physical phenomena. It is for that reason that one can say that Viète, Descartes and Fermat, Newton and Leibniz created the modern world in which recurrent phenomena, not only the wave motion of the mathematician, but also "quantity production" made possible in industry by such phenomena, play so important a role.

In conclusion I must recur to a point of view mentioned by Professor Elie Cartan, *i.e.*, that there are those who deny to Descartes the invention of the analytic geometry. The opinion of Coolidge,[2] that the Greeks invented analytic geometry, is characterized, possibly by a slip of the pen, as "une des opinions les moins déraisonables."[3] I prefer to phrase it as "les plus déraisonables." This assertion by Coolidge is an absolute denial of progress in science. This is, it seems to me, of a piece with that madness that would characterize all science as Greek or as Aryan. If you say that the Greeks had the analytic geometry, what becomes of all that majestic work done by the Hindus, systematized and transmitted by the Arabs, and worked over again by generations of Europeans, culminating in Viète, Descartes and Newton. Science is progressive; mathematical science is the indisputable achievement of the human intellect of all the ages past and of all peoples, including Moslems and Jews and Christians and followers of other gods.

The modern world of electricity, of the aeroplane, of quantity production and of the wireless was made possible by the mathematical formulas of the literal algebra, the analytical geometry, the trigonometry and the calculus with their derivative sciences. The new mathematics made it possible not only to explain the observed phenomena but to create a new material world quite different from the old world. In the process of transition many have forgotten and some would even deny the mathematical creation. The progressive character of this creation has made it easy to forget the creator.

In mathematics one can not leap from the Greeks to Newton and Leibniz. There is only one intellectual highway to the modern mathematics and that leads, as I have indicated above, through the intellectual accomplishments of the Hindus and Arabs, by the way of the Jewish and Christian translators of the Arabic and the Greek, through Europe of the middle ages and the renaissance to those majestic men of science, Viète, Descartes and Newton. Their work crystallized the mathematical achievements of all past ages; no nation can claim them; in any age of reason these men belong to humanity.[4]

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[2] See J. L. Coolidge, *Osiris*, I, pp. 231–250, 1936.

[3] Elie Cartan, *Actualités scientifiques et industrielles*, 535: 146–153, 1937.

AUTHORITY CITATIONS IN NOMENCLATURE

THE discussion of authority citations raised by Donald Culross Peattie and continued by others seems, thus far, to have been confined to workers in modern biology. The problem is even more acute in the fields of paleontology and paleobotany where species are often necessarily established on form rather than on phylogenetic bases, as well as on fragmentary remains. Later evidence may require one or more subsequent changes to be made in the classification of a species, in which case a full citation of authorities becomes impossible.

A case in point is that of the Carboniferous fossil fern originally called *Staphylopteris sagittatus* Lesquereux, described and figured in the Report of the Geological Survey of Illinois, Volume IV, 1870. Ten years later Lesquereux himself had cause to refer this species to a new genus, and the change was published in the Report of the Second Geological Survey of Pennsylvania, Vol. 1, 1880. To be actually complete, the name and authority would have to be cited as *Sorocladus* (*Staphylopteris*) *sagittatus* (Lesquereux) Lesquereux. A further study of the species was next made in 1902 by Sellards, working in Kansas, who found that the species should be referred to the genus *Crossotheca* Zeiller. This change was published in the *American Journal of Science*, Vol. IV, 1902. Obviously, a complete citation of authorities after the name would be awkward. Consequently, the name is usually cited by paleobotanists merely as *Crossotheca sagittata* Lesquereux, credit being given to the original author without reference to the several authors of the generic changes. Examples of this nature are numerous, and it can be seen at once that a change in authority with every change in classification would lead to disassociation of a given species from its original description. This would lead to endless confusion, especially among younger workers in the field who have not had

[4] See also: B. de Kerékjártó, *Actualités scientifiques industrielles*, 535: 166–173; Casimir Wize, the same, pp. 144–146; M. Abel Rey, the same, 531: 27–32.

the opportunity of becoming thoroughly acquainted with the ever-increasing literature in the respective fields.

The greatest burden to the research worker is the necessity of tracing a species through the maze of national, local and foreign literature bearing upon a particular subject. Only at very large institutions is most of this literature available for use. The worker in smaller institutions or remote localities is handicapped by not having thousands of publications readily accessible to him. A step toward the solution of the problem was made by David White, who maintained a private catalogue of paleobotanical nomenclature covering the Paleozoic Era during his lifetime. The work was never published; however, specialized catalogues of similar natures have been published by various authors in the past, but these soon become out of date. The time and cost of such work does not allow for private revision as often as desirable.

It seems that the establishment of a national or international bureau of registration for nomenclature of biological and paleontological names is necessary for the satisfactory conclusion of the problem. When once established, it should be made mandatory for every author to register at this bureau his new species or generic changes, together with references to the publications in which they appear. Failure to register would invalidate the work. In this way, authors could continue to publish their works in various well-known or obscure publications, as at present, but all references to such works would become readily available to other workers by reference to the central bureau acting as a "clearing house." Workers in remote localities, where vast amounts of literature are not available, could obtain pertinent references by application to the bureau; and on the other hand, work which they accomplish would become recognized elsewhere immediately upon publication. Needless to say, countless hours of work would be saved the research worker who, under present conditions, must spend the greater part of his time tracking down references.

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POLYCHAETE ANNELID WORMS IN THE GREAT LAKES

A NUMBER of years ago, O. L. Meehean[1] reported finding a minute (2.9 mm), transparent polychaete annelid worm in Duluth Harbor. In the summer of 1936 I found a single specimen of what is very probably the same worm in Lake Erie at a depth of 55 feet, in the open lake approximately 30 miles due east of Put-in-Bay, and during this past summer I obtained additional specimens from the same locality. Since these worms have been found in both Lake Superior and Lake Erie, it is highly probable that they are quite generally distributed throughout the Great Lakes. Needless to say, the occurrence of a polychaete annelid in these lakes is a matter of interest, since the Polychaeta compose an almost exclusively marine group, of which very few species have been reported from North American fresh waters. In 1858, Leidy[2] described a sabellid polychaete from the Schuylkill River at Philadelphia, which he named *Manayunkia speciosa*. Later, with additional specimens from Egg Harbor River, N. J., he gave a more complete description. Early in the present century, Johnson[3] described nereids from California, and more recently Olga Hartman[4] has added others from the same region.

Comparison of my Lake Erie polychaetes with Meehean's description of his Lake Superior specimens leads me to think the worms are the same, an opinion with which Meehean agreed in conversation. He had previously referred his specimens tentatively and with some doubt to Leidy's species. The Lake Erie worms agree sufficiently with Leidy's description and figures to warrant placing them in the genus *Manayunkia*, but they differ so sharply in certain important features that it appears very doubtful whether they belong to the species Leidy described. For instance, he mentions and figures a pair of haemal loops in each segment which do not occur in the specimens from the Great Lakes. At the anterior end of these latter specimens there is an open collar which surrounds the base of the tentacles. Leidy states that the border of the head "projects dorsally into a rounded process," but he makes no mention of an open collar. The arrangement of the tentacles also differs. Leidy describes a pair of lateral lophophores, each of which bears a double row of tentacles. In the Lake Erie specimens there is a pair of lateral lophophores on each side of the head, the tentacles of which are not arranged in two regular rows in the manner described and shown by Leidy.

Leidy's well-sustained reputation for accuracy in observation and description lends weight to the significance of the discrepancies between his description of *Manayunkia speciosa* and the conditions found in the specimens from the Great Lakes. In view of the discrepancies and pending a more detailed description which is being prepared, I propose to designate the worms from Lake Erie as *Manayunkia eriensis*.

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[1] O. Lloyd Meehean, SCIENCE, 70: 479, 1929.

[2] Jos. Leidy, *Proc. Phila. Acad. Nat. Sci.*, 1858, 90; 1883, 204.

[3] H. P. Johnson, Mark Ann. Vol.: 205, 1903.

[4] Personal letter.