physics by Dr. DuBridge and Dr. A. J. Allen, University of Pittsburgh. There will be a seminar in nuclear physics conducted by Dr. E. U. Condon, Westinghouse Research Laboratories. Further information can be obtained by writing to the head of the department of physics.

THE fourth national conference in recent years of Small Fruits Breeders was held on April 26 and 27 in Eastern North Carolina. April 26 was spent at the North Carolina Coastal Plain Station at Willard, studying selections, varieties, selfed lines and outcrosses of strawberries; crosses of a number of Asiatic species of raspberries, and crosses for thornless and high-flavored blackberries and dewberries. In the evening Dean I. O. Schaub, of the North Carolina Station, presided at a round table conference at Wilmington. April 27 was spent in visiting the blueberry fields and breeding work at the Huntington planting at Atkinson and at the Crabbe planting at Magnolia. The breeding work visited is cooperative between the United States Department of Agriculture and the North Carolina Experiment Station. About thirty-five workers attended the conference, representing states from Maine to California.

DISCUSSION

FUNDAMENTAL LAWS OF OPERATIONS IN MATHEMATICS

ONE of the primary facts in the history of mathematics is the late appearance in the literature of this subject of special names for the laws of the fundamental operations of mathematics which are now commonly called the associative law, the commutative law and the distributive law, respectively. No evidence of a name for any one of these laws before the beginning of the nineteenth century has yet been published, nowithstanding the fact that all of them relate to the elementary operations with positive integers and hence to our oldest extant mathematical literature. The associative law might with good reasons be called the parenthesis law, since it asserts that an arbitrary number of the terms or factors which are to be combined by the same operation may be inclosed within a parenthesis and the terms or factors within the parentheses may then be combined separately into single terms or factors without affecting the final result.

Without giving a special name to this law it was noted by A. M. Legendre in his well-known "Essay sur la théorie des nombres," page 3 (1798), and it was explained quite fully by another French writer, J. D. Gergonne, in volume 1, pages 52–58 of the influential early mathematical periodical entitled *Annales de Mathématiques,* which appeared in 22 volumes (1810–1831) and is sometimes still called Gergonne's *Annales.* In this article Gergonne directed attention to the now well-known fact that for real numbers the associative law can be explained by means of a rectangular parallelepiped, since the volume of such a figure is the product of its base into its altitude and the base can be selected in six different ways. Similarly, the commutative law can be explained by means of a rectangle. The *term* associative law was introduced by the noted Irish mathematician, W. R. Hamilton (1805–1865), who used it frequently in his writings on quaternions and emphasized its importance.

The now common terms commutative law and distributive law were frequently employed by F. J. Servois in an article published in Gergonne's *Annales,* volume 5 (1814), which its author called an extract, in substance, of works presented by him earlier to the French Institut, but which this Institut does not seem to have published. What may be of most interest in connection with these concepts is that they were named so recently. The commutative law and the distributive law in multiplication were noted already in Euclid's "Elements," but Euclid did not then use any special names in connection with these fundamental laws. His example was followed for more than two thousand years by later writers on mathematics. This is the more remarkable in view of the fact that the first proposition of Euclid's "Elements" relates to the equilateral triangle which is now commonly known to be transformed into itself by some non-commutative movements.

In the article under the entry "Number" in the "Encyclopaedia Britannica" (1938) it is stated that there are five fundamental laws of operation, *viz.,* two commutative laws, two associative laws and one distributive law. The commutative law of addition and the commutative law of multiplication are commonly regarded in the mathematical literature as the same law, but they are here regarded as two laws. Similar remarks apply to the associative law of addition and the associative law of multiplication. The nomenclature in this encyclopedia may be compared with the one employed in Zassenhaus's "Lehrbuch der Gruppentheorie," volume 1 (1937), in which the author lists one associative and one commutative law, but two distributive laws on page 62, *viz.,* a right distributive law and a left distributive law.

If one would say that the commutative and the associative laws should be said to change with the subjects to which they are applied there would evidently be no upper limit to the number of these fundamental laws, but it is difficult to see that anything could be gained by the use of such an unnecessarily complex nomenclature. At any rate it would appear desirable that an author who deviates from the common nomenclature should give some reasons for this deviation so that the

reader might not be confused by the differences in the language. This seems especially true with respect to articles which appear in standard works of reference which are supposed to be largely consulted by those who do not claim to be experts on the various subjects on which they seek some information.

It would obviously be puerile to aim to direct public attention to all the definite errors which one may observe in the literature, but blemishes in works which are widely regarded as authoritative like the "Encyclopaedia Britannica" and which are frequently revised deserve wide publicity in order that their harmfulness may be mitigated and that the public may remain duly watchful as regards shortcomings. The careful study of errors is sometimes an attractive method for securing a clear insight into a subject. It may be added that by consulting the article under the entry "Quaternions" in the encyclopedia in question it will be seen that this encyclopedia is not entirely consistent with respect to the number of commutative and associative laws of operation in mathematics.

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STABILITY IN NOMENCLATURE

MANY plant taxonomists, in recent years, have contemplated the idea of a new series of beginning dates for botanical nomenclature; one of the latest of these proposals to appear in print is that of Wheeler.[1] The author of this proposal suggests that a series of uniform monographs should be executed with strict regard for the rules of botanical nomenclature and the type concept and thereafter accepted as a new starting date for the nomenclature of the group treated. Such a procedure, it is hoped, would produce stability in nomenclature and eliminate the present accumulation of useless synonymy.

That any international congress will seriously consider adopting such a proposal is extremely unlikely, but before the matter goes beyond its present nebulous stage it may be well to discuss the desirability of any such change in our present system, which accepts the publication of Linnaeus' "Species Plantarum" in 1753 as a beginning date for nomenclature of the higher plants. It is the opinion of the present writer that any such change in our system would increase, rather than reduce, the present confusion.

The most obvious objection to the proposed change is its utter impracticability. What "international body of systematists" is capable of passing judgment upon any modern monograph? In theory, at least, the author of such a monograph is the sole person capable of judging it; if his conclusions are to be questioned, such questioning can be done only by another monographer who has spent at least as much time and effort upon the group as the original author. Therefore, before any monograph is acceptable to the appointed committee on approval, the committee must go over the original sources available to the monographer. As these sources are diverse, comprising exhaustive herbarium, field and library study, the committee would in each case have to prepare its own monograph in order to be sure that the original was acceptable. And even after the second monograph had been finished, what sincere student would accept its conclusions without himself checking the sources of information?

But let us suppose that a monograph is approved by an international group of systematists whose approval is accepted as the final word. Now it becomes unnecessary for future students to examine the earlier literature of the group, at least in so far as nomenclature is concerned. The synonymy in the group has become frozen; all names thrown into synonymy by the monographer become essentially outlawed. This, in effect, is precisely what happens under our present system when a monograph obtains universal recognition. The casual student, who suspects that he has a new species, does not go further back than the best available monograph, and this casual student is not to be affected by the proposed change in the system. It is the future monographer who will find himself at a loss. In view of the more abundant material available to him than to the original monographer, or as a result of improved criteria, he may decide that a dozen species were lumped as one by his predecessor. Shall he give his own names to eleven of them, even if they all have earlier and outlawed names? In cases of changes in generic concept (and such concepts are certain to change from time to time) our future monographer will find himself in even more of a moral dilemma.

Wheeler admits that "there are many problems to solve before any plan for a new beginning date can be put into operation, but *now* is the time to begin." I question whether such a beginning should ever be made. What is fundamentally wrong with our present system? It is no hardship to the careful monographer to examine all previous work on his group and pass judgment upon it; in fact, any monographer worthy of the name will continue to do this in spite of legislation. It is no hardship to the casual student, who need not go beyond the best available monograph for his facts. If the next international congress wishes to appoint a committee to list the best available monographs in each group, such a list would certainly be useful, but in the opinion of the writer it should never, at whatever distant time, be legislated into a formal beginning date.

Perhaps the writer is too optimistic in believing that the present confusion in nomenclature will be decreased without legislation. But it seems to him that the situation is becoming clarified with every careful mono-

[1] L. C. Wheeler, *Am. Jour. Bot.*, 26. Suppl.: 25s. 1939.