

uniform requirement of two years of college work before entering the dental course. As a result the data for 1941 show no entering students with less than two years, 53 per cent. with two years and 47 per cent. with more than two years of college training. Almost half of the entering students in 1939-40 have educational qualifications beyond the minimum recommended in 1935 by the Curriculum Survey Committee of the American Association of Dental Schools (two years) and in excess of the two-year requirement of the Council on Dental Education of the American Dental Association as announced for the year 1941-42.

UNDER the Australian federal system, public education is a function of the state governments, and the six universities look to these bodies for financial support. Five years ago, however, the Commonwealth Government undertook a share of this responsibility by providing £30,000 a year to meet costs of research in the natural sciences and in economics, and of training young graduates in research technique. The funds are administered by the Council for Scientific and Industrial Research in consultation with the Vice-chancellors' Conference. The Commonwealth has now announced, according to *Nature*, its intention to raise its contribution to £40,000 a year, beginning this year, on condition that at least £9,000 a year be de-

voted to social science studies bearing on problems of post-war reconstruction.

ACCORDING to *Nature* a new step in the rationalization of the British fine chemical industry has been taken by the formation of the Therapeutic Research Corporation of Great Britain, Ltd., the directors of which are Lord Trent, of Boots Pure Drug Company, Ltd.; C. A. Hill, of the British Drug Houses, Ltd.; H. Jephcott, of Glaxo Laboratories, Ltd.; T. B. Maxwell, of May and Baker, Ltd.; and T. R. G. Bennett, of the Wellcome Foundation, Ltd. Although each of the directors of the new corporation is managing director of his own concern, it is not an amalgamation of these five firms. Each will retain its freedom of action in its special field, but will contribute to the common research pool; in effect, a much extended research team now becomes available for work on new drugs, and overlapping effort should be eliminated. It is also hoped to secure the interest and cooperation of research workers in academic institutions. The corporation will have at its command in the various chemical, physiological and bacteriological laboratories the choice of many different lines of approach to its problems and the call on the extensive scientific personnel and equipment of the five companies which are collaborating.

DISCUSSION

A GROUP THEORY DILEMMA OF SOPHUS LIE AND FELIX KLEIN

THE study of group theory as an autonomous subject began with the development of the theory of permutation groups which were then more commonly called substitution groups and are still sometimes denoted by this name. This development was mainly actuated by the usefulness of these groups in the study of the theory of equations as is indicated by the title of the first book on group theory, viz., "Traité des substitutions et des équations algébriques," by M. Camille Jordan (1870). Since the only non-intrinsic condition which a set of distinct permutations must satisfy in order to be a group is that it contains the product of every two and the square of every one in the set it resulted that many people at first assumed that this is the only condition which an arbitrary set of distinct elements must satisfy in order to be a group. This assumption was supported by the fact that many other sets of well-known elements which satisfy this condition intrinsically satisfy the other necessary conditions in order to be a group in the modern sense of this term.

This circumstance throws light on various early remarks relating to group theory and, in particular, on what we call here a group theory dilemma of Sophus Lie and Felix Klein, two of the most widely known

names in the history of group theory as well as in the history of modern mathematics. On page 163 of volume 1 (1888) of his work entitled "Theorie der Transformationsgruppen," in three large volumes, Sophus Lie (1842-1899) said that the transformations $x' = ax$, where the absolute value of a is less than unity, constitute a group which contains neither the identity nor the inverse of any one of its elements. It is clear that the same conclusions might have been reached for similar reasons by assuming that the absolute value of the number a in the given transformations is always greater than unity since these transformations also include the product of every two of them irrespective of whether they are equal or unequal.

As definite evidence of the common inadequate notion of group at that time from the modern standpoint it may be noted that about five years later Felix Klein (1849-1925) stated on page 66 of volume 43 of the *Mathematische Annalen*, of which he was then editor, that Sophus Lie had first pointed out that for groups of infinite order it was not a consequence of the group concept that the inverse of each element of a group appears in the group. He acknowledged then that in his now well-known Erlangen Programm (1872) he tacitly made this assumption but that it should have been explicitly stated as a part of the particular groups then considered by him. It is a very interesting fact in the history of group theory that less than

fifty years ago there was still such a wide-spread lack of clarity as regards the notion of group on the part of some of the most eminent mathematicians of the day. The same volume which contains the mentioned remarks by Felix Klein contains also the modern postulates with respect to an abstract group by H. Weber (1842-1913) so that darkness and light relating to this concept are here closely associated.

Neither Sophus Lie nor Felix Klein ever adopted the modern postulates for an abstract group in their writings and in volume 1 (1926), page 335, of his "Vorlesungen über die Entwicklung der Mathematik" the latter remarked that the definition of group based on such postulates is very well suited for instruction and for a clear development of the subject but not for the discovery of new ideas and new methods. He stated on the same page that both he and Sophus Lie in their early work in group theory assumed only that the product of every two of a given set of elements is in the set in order that the set is a group but that Sophus Lie found it necessary in his later work to explicitly assume also that the set includes the inverse of each of its elements as a part of the definition of the term group.

On the contrary, the group theory postulates of H. Weber, or their equivalents, were at once taken very seriously in America, largely on account of the very successful works on algebra which he published and which contain these postulates. Various attempts were made in America to obtain more useful sets of postulates. As regards group theory these efforts were conducive to caution so that the laws or commandments as regards the concept of group were not transgressed but they did not lead to any great advances within the subject itself. The dilemma of Sophus Lie and Felix Klein to which we referred above was due to the fact that in their early work they had tacitly assumed that it is unnecessary to restrict the group concept to sets of elements which always include the inverse of each element but that they later abandoned this idea.

It is questionable whether any publication contributed more than Felix Klein's Erlangen Programm towards making the subject of group theory widely known and highly appreciated. It was translated into Italian (1890), into French (1891), into English (1893), into Polish (1895), into Russian (1896) and into Hungarian (1897). Nevertheless, according to Felix Klein's own statement it contains an inadequate definition of the group concept but one which includes its most effective elements. Those who later refined this definition also made valuable contributions towards the advancement of this subject, but their work naturally received less extensive attention. Great mathematical progress was frequently made by

those who failed to observe pitfalls which their successors carefully labeled and which too frequently engrossed their attention.

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PENTHESTES AND CALOPHYA

THAT black-capped chickadees are making a substantial part of their winter diet on "jumping plant-lice" along the Connecticut shore may interest zoologists; that the psyllids are found upon sumac may interest botanists; and that *Calophya flavida* in its present nymphal stage abounds on *Rhus glabra*, while *Calophya nigripennis* abounds on *Rhus copallina* may interest ecologists. The two species of sumac, growing in close admixture, carry only their proper species of psyllid, never the other one. Dr. Oman, who determined the psyllids for me, informs me that only these two species of *Calophya* are known to occur in eastern United States.

Early this winter, 1941-42, I observed chickadees feeding freely on the very abundant sumacs of this region, interested not only in the fruit clusters but also picking minute objects from the stems of these shrubs, both low down near the ground and higher up. With field-glasses permitting very close-up work I saw that they took these from areas surrounding leaf-buds also from areas close to forks in the branches primarily. With a hand lens I examined the areas the birds had just worked, and found plenty of the beautifully sculptured nymphs. Those of *C. flavida* are darker and larger and have more marginal setae than nymphs of *C. nigripennis*. The numbers of both species are diminishing, under the attacks of the chickadee, as winter progresses. The birds are also feeding on many other animal and plant foods. Had their stomach contents been examined the nymphs might never have been recognized and determined, except as pulp of animal origin.

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DEGREES AT ANY TIME: BRAIN CONSERVATION

IN a recent number of SCIENCE¹ the writer discussed the importance of a twelve-month college year to insure earlier completion of curricular requirements. This was prompted by the frequently expressed desire in various quarters that students have the opportunity to complete their collegiate education before reaching draft age. It was pointed out that the plan was desirable not only in war-time, but that it was a good peace-time idea. Just as the article on the twelve-month college year was a long postponed sequel to a post-World War I article,² so the present discussion

¹ A. Silverman, SCIENCE, 95: 192, 1942.