

November 1. The fund will be expended only in grants in aid for investigation or scholarships for research in bacteriology or sanitary science and may be made for securing technical help, aid in publishing original work and the purchase of necessary books or apparatus. Additional information may be obtained from Dr. Wilson G. Smillie, chairman of the fund, 1300 York Avenue, New York City.

PROFESSOR LEONARD WING, of the department of zoology of the State College of Washington, Pullman, has received a special grant for the study of the biology of human population. The work will be based on data of 15,000 Quaker families from the monthly meeting records, beginning in 1650. The records have been made available for study by Dr. W. W. Hinshaw, Washington, D. C. The project parallels a study of animal population made by Professor Wing which is now nearing completion.

THE daily press reports that Bernard M. Baruch plans to establish an institution for the study and teaching of physiotherapy. He has appointed a committee of specialists, with Dr. Ray Lyman Wilbur, chancellor of Stanford University, as chairman, to survey the field and advise with him on the project. The establishment of a school to select the best from the various phases of physiotherapy was suggested to him by Dr. Walter Belknap Jones, who was for many years an associate on the faculty of the College of Physicians and Surgeons of Columbia University. Serving on the committee with Dr. Wilbur will be Dr. W. T. Sanger, president of the Medical College of Virginia; Lieutenant-Colonel Benjamin A. Strickland, Jr., Army Medical Corps; Dr. Charles F. Behrens, head of the x-ray department at the Naval Medical Center, Bethesda, Md.; Dr. Carl R. Comstock, of Saratoga Springs, N. Y.; Dr. John Coulter, medical director of the School of Physical Therapy, Northwestern University; Dr. Kristin G. Hansson, medical director of the School of Physical Therapy at the Hospital

for Special Surgery, New York City, and Dr. Frank Krusen, medical director of the Mayo Clinic and School of Therapy, Rochester, Minn. The committee will have \$25,000 at its disposal for this study. Whether the institution to be founded should be an entirely new organization or one established in conjunction with an existing institution is one of the matters to be decided by the group.

THE Dominion Government has, according to the Ottawa correspondent of *The Times*, London, approved expenditure for the establishment of plants and equipment in Montreal and Toronto for the production of penicillin. An appropriation has been made to cover the cost of establishing the industry and of the production of the first 26,000,000,000 units of penicillin for use by the Canadian armed forces. This constitutes the largest single order for medical supplies which has so far been placed by the Department of Munitions Supply. According to C. D. Howe, the Minister of Munitions, the new industry will employ 250 men and women, and will come into operation next February; by the middle of April it will be producing a weekly average of 500,000,000 units of penicillin.

THE Soviet Academy of Sciences recently sent an expedition headed by Professor Alikhanyan, a Stalin prize winner, to the summit of Mount Ararat to study cosmic rays. The group spent several weeks on Mount Ararat last year and collected valuable data on cosmic rays. These materials were the subject of study during the winter by experts of the Physico-Technical Institute of the Academy of Sciences. It is reported that in the composition of the cosmic rays a considerable quantity of proteins, nuclei of hydrogen atoms, were discovered, the exact nature of which has not yet been investigated. The further examination of this question is one of the most important tasks of the present expedition.

## DISCUSSION

### ELEMENTS OF THE GENERALITY OF THE GROUP CONCEPT

ONE of the most instructive brief statements relating to group theory is that the first four fundamental operations of arithmetic, *viz.*, addition, subtraction, multiplication and division, are combined into one operation in group theory. This one was at first usually called multiplication, but in the recent literature it is also frequently called addition. It represents the combination of the elements of a group in pairs so as to obtain a single element of the group

for each such pair and it is commonly denoted by the same symbol as is used for the corresponding operation in arithmetic. The possibility of combining the said four fundamental operations of arithmetic into one in group theory suggests that the concept of group is more general than the concept of number, notwithstanding the fundamental importance of number in the development of mathematics throughout the entire period of this development up to the present time.

The fact that the group concept is more general than the number concept is also suggested by the use

of numbers for the elements of a group in special categories of groups. Moreover, the definitions of abstract groups have always been so formulated that our ordinary numbers are included among the possible elements which may be involved in these groups. In particular, these numbers obey the associative law when they are combined either by addition or by multiplication, and this law has usually been assumed either explicitly or implicitly in the definitions of an abstract group. It is a fundamental fact in the history of mathematics that this law did not receive a special name in the mathematical literature until about the middle of the nineteenth century when it was thus named by the Irish mathematician, W. R. Hamilton (1805-1865), the first two volumes of whose "Mathematical Papers" were published by the Royal Irish Academy in 1931 and 1940, respectively.

Since subtraction is the inverse of addition and division is the inverse of multiplication two of the said four fundamental operations of arithmetic disappear if an operation and its inverse are regarded as belonging to the same more general operation and these four operations thus become only two fundamental operations of arithmetic. The fact that the subtraction of a positive number is equivalent to the addition of the corresponding negative number was noted in the *Arithmetica integra* by M. Stifel (1544), who used these numbers just as we do now, without, however, giving a satisfactory theory for this use. On the other hand, the ancient Babylonians already regarded the division by positive integers as the multiplication of the dividend by the inverse of the divisor and constructed extensive tables of the inverses of integers. Notwithstanding the fact that the use of negative numbers and common fractions theoretically reduced the said four fundamental operations to two such operations, mathematicians usually continued to speak of them as four operations even in algebra where the use of negative quantities is commonly considered from the beginning of the subject in our schools.

It has frequently been emphasized that in group theory the elements are usually undefined and only the laws of the combinations of these elements are considered, but it is not so commonly noted that in arithmetic the numbers employed are also usually undefined. Efforts to define the term number have been made in many instances, but it is questionable whether any of them have been actually successful. Such statements as that number is the property of a set of individuals which is independent of the nature of these individuals and is common to all sets of individuals which can be placed in a ( | , | ) correspondence are in reality not a definition of the term positive integer, but merely a statement of some of

the assumed properties of such integers. It is, however, true that for thousands of years it has been found convenient to combine positive integers in pairs so as to obtain other such integers, according to two fundamental laws of combination called addition and multiplication while the elements of a group are combined according to only one such law. This is further evidence of the fact that the group concept is more general than the number concept.

This greater generality of the group concept, while the number concept has been the more important of the two in the development of mathematics, emphasizes the need of distinguishing between generality and importance in mathematical theories. It also tends to explain why the group concept received growing attention in the latter half of the nineteenth century and the early part of the present century, for it was then when generality received growing attention on the part of mathematicians. It is only natural that there are occasional reactions with respect to recent increased emphasis and some of the current mathematical writings exhibit evidences of such reactions,<sup>1</sup> but growing generality can be observed throughout the entire history of mathematical developments, and these temporary reactions should not seriously disturb the modern students of our subject, who realize that it is not free from changing fashions even if it has always made a relatively strong appeal to the male members of society.

G. A. MILLER

UNIVERSITY OF ILLINOIS

## PROTEIN CONCENTRATES FROM GRASSES

THERE is at present a marked shortage of concentrates high in protein value available for consumption by farm animals. One of the most abundant sources of protein is grass, only part of which is used for pasture, hay or silage. If the remainder could be converted economically into a concentrated non-perishable form of protein it might be valuable in relieving the present shortage of protein concentrates.

Methods of extracting protein from biological substances may be found in the literature, but to the author's knowledge none has been made use of in preparing proteins from forage crops on a large scale. The author has made a number of preparations on a laboratory scale and the details will be published elsewhere. An example is given here.

Dried ground grass was extracted overnight at room temperature with 0.25 normal sodium hydroxide and then filtered through cheesecloth. The filtrate was brought to pH 3.6 with hydrochloric acid and a pre-

<sup>1</sup> For instance, on page 168 of "What is Mathematics?" by Richard Courant and Herbert Robbins (1941), it is asserted that "in geometry, perhaps, the importance of the group concept has been a little exaggerated."