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 substraction 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. Nothwithstanding 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,[1] 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-

[1] 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."

cipitate was filtered off, dried and ground. The precipitate, dark green in color and with a grassy flavor, contained 58 per cent. protein on the dry basis, 6 per cent. ash and less than 1 per cent. of lignin and cellulose. It also contained 440 p.p.m. of crude carotene, but this amount decreased during laboratory storage. Based on a ton of dry grass the yield of this substance was about 285 pounds. The grass residue, yielding about 875 pounds per ton and still containing 44 per cent. of the original protein, appeared to be a fair quality stock feed.

Extraction of the protein concentrate with 95 per cent. alcohol removed about 20 per cent. of its dry weight but only 4 per cent. of its total nitrogen. This final product was dark in color and tasteless and contained over 72 per cent. protein on the dry basis. Its calculated yield per ton was 220 pounds.

It is suggested that either the crude or the extracted product could be made from surplus forage, or forage otherwise wasted, and if economically produced should be useful in supplementing present stocks of protein concentrates, particularly for poultry and hog rations.

J. T. SULLIVAN

U. S. REGIONAL PASTURE
RESEARCH LABORATORY,
STATE COLLEGE, PA.

WHY THE KILGORE BILL?

THERE are probably few leading men in science who would not, with minor qualifications, agree with the five major objectives set forth by Senator Kilgore in his article in SCIENCE of August 13, discussing "The Science Mobilization Bill." These may be abbreviated to read as follows:

(1) The need for a central independent agency of the Government devoted exclusively to the progress of expansion in Science and Technology.

(2) The need for integration of existing Government research and development facilities.

(3) The need for active Governmental support of fundamental research.

(4) The need for a uniform and effective policy to achieve the fullest utilization of scientific and technical manpower in wartime.

(5) The need to promote the use of Government patents in the interest of the public.

It is probably on the basis of such desirable objectives that Senator Kilgore, in his introductory paragraphs, ventures the rather broad statement "that the men of science favor the bill" (S. 702). From the discussions and comments that have come to my attention since the publication of my contribution to this discussion in SCIENCE of June 4, a large majority of the leading scientific men consulted have expressed strong opposition to the passing of S. 702. Unfortunately, a few have expressed violent opposition with words not always scientifically chosen. Unquestionably, however, all these men would find no contention over the objectives to be gained in the abbreviated statements quoted above. It is increasingly clear that a desirable objective is one thing and the method of obtaining such an objective is quite a different thing. It is not primarily a question of whether the ends justify the means but rather a question of whether the ends could be attained by the means proposed. This appears to be the basis and the only basis for a sound and intelligent discussion of the Mobilization of Science Bill.

No scientist can but be gratified as to the Senator's statement, "I have long realized the basic importance to the welfare of the country of a free science and an expanding technology." Perhaps Senator Kilgore over-compliments the scientist when he states that "Scientific and technical men hold in their heads and hands the collective knowledge of the ages." The free and copious publication in technical literature of the results of basic research in every conceivable branch of science shows the eagerness on the part of a scientific worker to give to the public the benefit of his findings and thus would appear to provide an adequate answer to the Senator's question, "Whose knowledge is it?"

It becomes obvious from a careful study of the Bill S. 702 that the proposed legislation would attempt to make impossible the repetition of certain unfortunate uses of technical knowledge by "vested" and "selfish interests." Such a problem is not specifically a problem of science and technology but a problem of society. As long as human nature is what it is, the scientific approach must take into consideration "selfish interests" as a specific entity in human behavior inherited through evolutionary processes as a means for the preservation of the individual and the species. The study of "selfish interests" presents a problem in social welfare that should be approached with the same order of scientific intelligence as one approaches the problems of instability in gravimetry or geomagnetism. Such can not be dismissed by legislation, nor does it appear certain that its dismissal would bring about an unmitigated Utopia in science.

No one proposes that rugged individualism should be fostered at the expense of public welfare. "Selfish interests" gaining the seat of authority have brought ruin to the Axis countries. It is, I think, the danger of the creating of an opportunity for "selfish interests" in high places that has caused the apprehension among those scientists who have expressed opposition to the Kilgore Bill. When we are willing to recognize that "selfish interests," however undesirable, is a potential entity that must be considered and accepted as a scientific fact, the question raised by the Mobilization of Science Bill resolves itself into the relative