was aroused by Professor W. Heisenberg's lecture, 'Wandlungen der Grundlagen der exakten Naturwissenschaften in jüngster Zeit,' in much the same field as that covered by Sir James Jeans's address at Aberdeen. An exhibition of apparatus, preparations and scientific books was held in the Ausstellungshalle, one of scientific films in the Tierärztliche Hochschule, and another, the traveling exhibition of the Dresden Museum of Hygiene, 'Leben und Gesundheit,' in the Künstlerhaus, while lighter moments were provided for by the Opera House and theater and the usual excursions to neighboring centers of attraction."

DISCUSSION

THE DISTRIBUTION OF FUNDS FOR RESEARCH

MY attention has been called to the possibility of misinterpretation of a phrase in which reference was made to the Land Grant Colleges in my article on "Science and Prosperity" published in the issue of SCIENCE for November 2. I was discussing the possibility of government support of scientific work on a national scale and the particular question of efficient administration of such funds if they were available. In this connection appeared the sentence: "Perhaps the worst way to carry on research is to distribute funds according to some formula such as that followed in the support of Land Grant Colleges, $50,000 to each State in the Union, or so much to every research laboratory."

Being myself an administrative officer of a land grant college, and believing that the land grant colleges are the backbone of our American system of higher education, I certainly did not intend to imply a criticism of the land grant colleges or of the basis on which they receive federal support. This support was intended to stimulate the program of higher education throughout the country, and particular reference was made to agriculture and mechanic arts. It is true that land grant colleges in less populous states receive the same federal aid as do those in the more populous states, but on the other hand their need of such support is generally greater. However this may be, my statement on the subject was not a criticism of the land grant method of supporting the educational programs in land grant colleges, but was a statement of my judgment that a similar basis would not be an efficient one for the support of a research program whose objective is to secure the maximum scientific and technical development for a given expenditure of time and money. The reasons for this are obvious to those acquainted with the geographical distribution of scientifically trained men.

Perhaps the point which I was trying to make would be illustrated by the following example: Suppose the objective were to shoot as many ducks as possible with a given amount of ammunition. The way to proceed would not be to fire so many volleys in each state of the Union or a volley over each lake in the country, but rather would be first to locate the ducks and then fire at them. Similarly, the objectives of a program like that which I was discussing would best be attained by first locating the big ideas wherever they may be, and then allocating the necessary funds to put these ideas to work.

The only reason for mentioning the land grant college situation explicitly was because some corresponding plan of geographical or proportional distribution of funds might be the first thought regarding its administration, and such a procedure would, I believe, be fatal to the success of any plan aimed at quick and efficient stimulation of scientific work.

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THE MOTION OF GLACIERS

IN SCIENCE for November 2, 1934, is a discussion by O. D. von Engeln, entitled "The Motion of Glaciers," to which objection should be raised. Its final paragraph reads:

> The above quotation, together with the one given in a preceding paragraph, are enough to permit appreciation of the correspondence of the two interpretations of glacier motion and of the special significance of the salt solution to the required lubrication for inter-grain shifts. They will also serve to make clear how different this concept is from the shear theory, in which it is postulated that glacier motion is: solid flow by idiomolecular exchange between ice crystals, solid shearing of aggregates of granules, intermittent slip along well-developed thrust planes and sliding of the whole body of ice over the rock beneath. Such shear concept Hess, now, and the present author, earlier, hold to be fundamentally and completely erroneous.

The last sentence contains a rather sweeping statement. Let us consider the four sorts of movement which are held to be "fundamentally and completely erroneous."

(1) Sliding of the whole body of ice over the rock beneath. What else could cause the striation, grooving and fluting found on the underlying rock surface? The length and depth of some of the individual scratches would seem to indicate that the rock frag-

ments which cut them were firmly held by the moving ice for considerable lengths of time.

(2) Intermittent slip along well-developed thrust planes. These thrust faults have been photographed by many observers on many glaciers. Intermittent slip along some of them has been shown by automatic instrumental records and is homologous with slips on thrust faults in other rocks.

(3) Solid shearing of aggregates of granules. This small-scale faulting is found to be more prevalent and general than the larger slips on well-developed thrust planes and is a characteristic feature of glaciers.

(4) Solid flow by idiomolecular exchange between ice crystals. This type of movement involves the growth of ice granules together with movement and adjustments (sliding and rotation) between the granules, and is considered to be the underlying basic process in glacier motion. The granules are small in a névé region; they are larger near the glacier terminus, and particularly large in the longer glaciers. In some places near the terminus of the Allen glacier in the Copper River district of Alaska and probably fifteen to twenty miles from the upper snowfields, they average from three to four inches in diameter and locally have been observed up to six inches. It is believed that the névé granules gradually grow as the ice moves down the glacier, the larger crystals at the expense of the smaller, by transfer of molecules. In the process the granules change their positions with respect to one another under changing conditions of pressure and melting, as explained in various text-books in the last thirty years. "The summation of slight adjustments between innumerable granules is general movement of the mass in lines of least resistance. . . . This . . . appears to be the fundamental mechanism by which the motion is accomplished." Rather strange it is that Dr. von Engeln should characterize the concept, which puts first in importance this movement between the granules, as "fundamentally and completely erroneous," when he takes over the idea of intergranular movement as the basis of his own view of glacier motion. His particular addition is the postulate of a liquid film of salt solution which, by lubrication, aids this movement between granules.

Dr. von Engeln has designated this composite picture of glacier motion outlined under headings (1) to (4) as the "shear concept." Shearing plays its part in the complex phenomenon of ice moving down a valley, and its recognition is important for the light which it throws upon the nature of the ice, but it is only one phase of a complicated process. To name the whole concept after but a single factor where other important factors are strongly involved seems open to protest.

Dr. von Engeln states "that a glacier consists of an outer and terminal crust of rigid ice, carried along and shoved forward by a core of interior ice flowing viscously under the pressure of the exterior shell and existing at essentially the pressure-temperature melting point of ice, a temperature which declines with depth (because of the increase of pressure) to the bottom of the glacier. The viscous flow of the interior ice results from the presence of a liquid film of salt solution surrounding and separating the glacier grains. This film acts as a lubricating medium to facilitate the movement of the grains one past the other."

In so far as there may be a small amount of salt between granules of purer ice, melting at such places obviously would be aided and movement of the granules, as discussed above under heading (4), would be facilitated. Thus the salt would seem to act as an additional auxiliary agent increasing the effectiveness of the other processes already mentioned. Careful chemical analyses should reveal how much salt actually is present in the upper part of a glacier starting from a lofty snow summit far inland, how much lowering of the melting point may be expected, and consequently how important an auxiliary factor salt may be.

At the other extreme, J. V. Harrison delights in twitting his friends about a "glacier" in Persia which is all salt, or salt mixed with gypsum. The salt has come up from below as a salt plug and "spills over the alluvium of the plain, where it forms a long tongue-like sheet stretching southwards for fully three miles."[1]

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A TROPICAL FISH CROSS

VARIOUS attempts at experimental crossing of two tropical fishes, the swordtail (*Xiphophorus helleri*) and guppy (*Lebistes reticulatus*) have proved unsuccessful, and there is quite a general belief that these two species are too unrelated or have too dissimilar chromosome formulae for successful mating. To be sure, some aquarists claim to have crossed them successfully, and there are alleged hybrids which are more or less generally discredited as such.

As the matter is of considerable theoretical interest, we wish to record a more successful attempt; and will first summarize what seem to us the important and reasonably certain results obtained; second, discuss the possibilities of error, and, finally, touch briefly on the experiment's significance.

Early in 1933 by crossing with guppy, broods of

[1] James Vernon Harrison, *Quart. Jour. Geol. Soc.*, lxxxvi, 476–85, 1930.