tain the greatest possible advantages from the expenditures and efforts made.

6. Each special problem would be organized independently, the permanent secretary assigning such workers to it as at the moment were most available. All expenses, including salaries of workers, would be met by the interested parties in each case, either industries or governments. The only expense to the National Research Council would thus be the maintenance of the permanent secretary and his office force engaged in the fundamentally important work of tabulating and correlating existing knowledge of tropical conditions and resources; and of keeping in close touch with all of the many scattered institutions and workers either official or otherwise who are now engaged in any of the lines embraced in this vast field of effort.

As time went on and funds were available the institution could also take up on its own account such lines of investigation as were not being covered by any other initiative.

An organization such as is thus briefly outlined would certainly give the maximum of elasticity and breadth of view with a minimum of fixed charges. It is respectfully submitted for the consideration of the National Research Council.

F. S. EARLE

RIO PIEDRAS, PORTO RICO,
August 23

MILLS AND FISHWAYS

TO THE EDITOR OF SCIENCE: Apropos of the article by Professor Henry B. Ward entitled "Atlantic and Pacific Salmon" in SCIENCE for September 17, 1920, allow me to record some observations. Some years ago I stocked a stream running through my country place in Connecticut with rainbow trout. These trout later ran down to the estuary and could not return because of two mill dams in the way. Discussing the matter with old inhabitants I learned that in former years before the dams were built farmers living along the stream for a distance of fifteen miles or more were in the habit of catching many barrels of alewives and salting them down for winter food supply. These families are now deprived of one important kind of food.

Following up this concrete object lesson I made observations along the Atlantic coast from Connecticut to Labrador. My conclusions are as follows:

Along the New England coast mills are commonly the property of local stockholders and these represent the influential men in a locality. Their first interest is in the mill and its economical management. This excludes the idea of the expense of a fishway. Fish which formerly supplied large numbers of people in the vicinity and at a distance and which naturally would supply the people for all time are prevented from ascending streams for breeding purposes. When the matter is taken up for action by a large number of indignant people they find themselves in conflict with a few influential men personally interested in the dam. This minority has the largest degree of influence with legislators. Along the entire New England coast such appears to be the situation in relation to salmon, shad, and alewives.

Upon reaching the Maritime Provinces of Canada I found a somewhat different situation. The traditions of an older civilization in regard to maintaining large food supply prevail to some extent. They come into conflict with the mill owner and his stockholders to such a degree that some of the streams remain open to anadromous fish, with the aid given by fishways.

Leaving the Maritime Provinces on the way northward I found a third order of conditions prevailing. The men who own cod traps and large nets are the men most influential with legislators. Constituting a small but potent minority they are enabled to injure food supply for the public by their manner of using cod traps and large nets. On some of the runways to salmon rivers the cod traps appear to pick up a large part of the annual run of salmon and the net fisherman at the mouths of the river deplete the fish supply by unlawful obstruction to the run of breeding fish.

My comments do not relate to hearsay but

to personal observation and inquiry extending from Connecticut to as far north as Hamilton Inlet in Labrador. The biology of the subject relates not so much to the habits of *Salmo salar* as it does to the behavior of *Homo sapiens*—with his specific appellation self-chosen.

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EFFICIENCY IN THERMAL PHENOMENA

To the Editor of Science: Mr. Forbes's theory of something being wrong with the commonly accepted definitions of efficiency in thermal phenomena, is provocative of comment. The question of a definition being wrong depends, obviously, on how it is interpreted.

In general the efficiency of a machine or mechanical process, is defined as the ratio of output to input. It is assumed that the output will always be less than the input, hence the efficiency will be less than unity.

It is safe to say that the difficulties alluded to by Mr. Forbes can be traced to failure to distinguish between the quantities of energy called input and output, and the units in which they are measured. In the electric heater, the input, watts, is wholly converted into heat, with efficiency of 100 per cent. In the electric motor the input, watts, is converted into 95 per cent. work and five per cent. heat, giving 95 per cent. efficiency if work output is considered, and 100 per cent. efficiency for the entire output. In the steam engine the input, heat, is converted into ten per cent. work and 90 per cent. heat, giving an efficiency of ten per cent. based on work output, 90 per cent. efficiency based on the exhaust steam for heating, and 100 per cent. for the entire output. In the refrigerating machine the output is, logically, heat carried away by the condenser water. The input, on the same reasoning, is made up of two parts, the heat removed from the brine and the work of driving the machine. The sum of the two input quantities is equal to the output, giving 100 per cent. efficiency as in all the other cases.

The refrigerating engineer recognizes the difficulty of applying the term efficiency to his machine, and substitutes for it the term "coefficient of performance," the ratio of heat absorbed to the work required to drive the machine, both expressed in the same units.

If efficiency is defined by the input-output formula, it is true that the efficiency of all machines is 100 per cent. If only a portion of the input or output is considered, it is possible to have efficiencies of less or more than 100 per cent. In this case it would be appropriate to use the term "partial efficiency," since the entire output is not considered.

E. H. Lockwood

THE HELIUM ARC AS A GENERATOR OF HIGH FREQUENCY OSCILLATIONS

Helium as a conducting medium in a low-voltage arc may be of considerable utility as a convenient source for generating, from direct current, oscillations of moderately high frequency.

Due to its exceptionally low sparking potential arcs may be readily started from a hot tungsten cathode by 110 volts even when the gas is at atmospheric pressure. In fact it is easy to start the arc across a centimeter gap between cold electrodes by means of breaking a parallel circuit with a series reactance common to both. Perhaps a more convenient method of starting, however, is the heating of the filament by the source of supply and then a commutation of the connection to the positive terminal from the filament to the anode.

When the proper inductance and capacity are connected across the arc high frequency oscillations are produced which may be utilized in the usual way with a coupled circuit. Hitherto, hydrogen and compounds of hydrogen have been used in areas to produce high frequency and it is very difficult to produce oscillations by the use of other gases at atmospheric pressure. Helium, however, probably due to its high heat conductivity, being inferior only to hydrogen in this respect, from the rapid rate of energy dissipation in the arc, gives the type of volt ampere