Letters to the Editor

Effects of New Herbicides on Fish

During the course of some experiments to determine the effects of certain of the new herbicides on fish, we set up some tests, largely out of curiosity, using the new rodenticide 1080. In view of the extreme toxicity of this substance, as reported by E. R. Kalmbach (*Science*, 1945, 102, 232), we were certainly surprised to find that fingerling bream and bass would survive in concentrations of 1080 as great as 370 ppm for an indefinite period and with no apparent discomfort.

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Some Reflections on the Cause of Heat and Cold

Not many Americans know of M. V. Lomonósov, a noted Russian scientist, and very few are aware of the scope of his research. The writer of this article wishes to pay tribute to this great early Russian physicist, one of the first academicians of the Russian Academy of Sciences, for his research in the theory of heat.

M. V. Lomonósov's name has never been mentioned in the West-European and American scientific literature in connection with the development of our concept of heat, although he, as early as the first half of XVIII century, did not believe in phlogiston, but that heat is a kind of motion of constituent particles within a body.

In his dissertation under the title "Some Reflections on the Cause of Heat and Cold," read 21 and 25 January 1745 at a session of the Russian Academy of Sciences, Lomonósov had two paragraphs which I translate and quote (B. N. Menshutkin. *Works of M. V. Lomonósov in physics and chemistry.* Moscow-Leningrad: Academy of Sciences of the USSR, 1936. Pp. 109, 110).

"A body A which acts upon a body B cannot add to the latter a greater velocity than that which it itself possesses. If, therefore, the body B is cold and immersed in a warm gaseous body A, the heat movement of the particles of the body A brings the particles of the body B into a heat movement, but it cannot induce in the particles of the body B a greater speed than that which is present in the particles of the body A. Therefore, the cold body B being immersed in the body A cannot perceive a greater degree of heat than that which the body A has."

". . . Furthermore, one cannot mention some definite velocity, a such one that someone else could not visualize mentally another, a greater velocity. This, of course, should be referred to the heat motion also: therefore, the highest and the last degree of heat is not a thinkable motion. *Vice versa*, the very same motion can decrease to such an extent that finally a body reaches a condition of an absolute rest—and no farther decrease in motion is possible. Consequently, by necessity, there should exist the greatest and the last degree of cold expressed in the complete rest of the particles, in the complete absence of their spinning movements."

In the first quotation Lomonósov expresses the Second Principle of Thermodynamics which was rediscovered and established 85 years later.

In the second he points out that there is no higher limit for temperature and gives an inference about the necessity for the lower limit of temperature—the absolute zero—a concept introduced into science about 1870, *i.e.* 125 years later. Even still further this self-made scientific genius goes: he defines the absolute zero as absence of the spinning movements of particles. Therefore Lomonósov's absolute zero temperature excludes even null-point energy due to the spin of electrons, and the theory of null-point energy based on Fermistatistics is a development of recent years; the measurement of temperature under zero null-point energy is yet among achievements of the future physics.

Paying this tribute I wish to reinstate that Miháilo Vasílievich Lomonósov developed his mechanical concept of heat in which an impossibility of heat transfer from a colder body to a warmer one, and the idea of the absolute zero temperature as a cessation of any kind of motion in or between the constituent particles of a body were incorporated far ahead of those scientists to which the discovery and the development of these two cornerstones of the contemporary thermodynamics were credited.

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Science in the Albuquerque High School

I feel that Charles A. Gramet (*Science*, 1946, 103, 149) has made some good suggestions as to how science enrollments might be increased in secondary schools. He feels that his own school system of Brooklyn, New York, gives a pretty good science education and that it need not feel inferior to challenges which come from colleges. I feel the same way about our schools, out here in the deserts of New Mexico.

I would like to make a few additional remarks about the nationwide decline in science enrollment in secondary schools. Here in our own school (Albuquerque High School) we require only one unit of science for graduation, anything taken above that is strictly on an elective basis. Back in 1930 I felt that such a requirement was inadequate but there seemed no way to promote additional requirements. Our school decided to go out and get the students, requirements or not. We could not use legal requirements, so we used other means to popularize the classes. These included advertising campaigns, an assembly or two, and a crew of physics students that carried scientific shows to our city and county grade schools.

The campaign bore fruit in a hurry. We believe now

that we boast one of the largest science enrollments, on a percentage basis, in the Nation. Our school has an enrollment of a little more than 2,100 students, 1,300 of whom take science. It is seldom that we graduate a person without more than two years of science. We have 240 students in our physics classes, and we have had that great a per cent (11.4) for about 12 years. If the student wishes, he can satisfy his science requirement by taking biology as a sophomore. Almost 700 take the subject each year, but in addition we seldom graduate a student who has not taken, in addition, one of the other laboratory sciences such as chemistry, physics, or our year course in geology.

We have not popularized our courses just by making them easy. On standardized tests we consistently beat the medians, even though we do carry along a few poor students. We believe that we have gained support by supplying good courses as well as advertising. We have done some pioneering also. In 1935 we started a full-year laboratory course in geology. In 1937 we started semester courses in radio physics, air navigation, and meteorology. These three courses were "shots in the dark," but they paid off in numerous fighter pilots, radio technicians, weather observers, and navigators in the war.

I am not sure that we would now welcome any rules requiring more than one science for graduation. We do not need it, and under our present plan we get people who want to take the subjects without other pressure. Our school has about every sort of outside activity imaginable, and the classroom has plenty of competition for students. We have gained our large enrollment by rowing upstream, and we sort of like it that way. We are ever on the lookout for ways to make our courses more attractive and more useful, and we hope to go on competing with whatever other attractions arise.

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More Reversed Winter Flounders

In a recent article (*Science*, 1945, **102**, 672–673) E. W. Gudger described three specimens of "left-handed" winter flounders in some detail and stressed the rarity of their occurrence. Various members of the staff of the Atlantic Biological Station, St. Andrews, New Brunswick, have made similar observations in the Fundy area that may be of interest to readers of *Science*.

On 2 August 1945 a reversed specimen was brought to the station by the fisherman who took it the previous day on a trawl set in the St. Croix River, opposite Robinston, Maine. He apparently recognized the fish as being a winter flounder and stated that he had heard of such curiosities from other fishermen but had never seen one himself until then. This fish, a female, measured 369 mm. in total length, and 283 mm. to the end of the last vertebra. The numbers of fin rays, body proportions, and other characters conformed to the specific description given by Bigelow and Welsh (*Bull. U.S.B. Fisheries*, **40**, 472–507), and the fish appeared healthy and normal in all respects except for reversal.

Another reversed specimen of about the same size was on exhibit in the station museum, along with a normal one for comparison, for a number of years previous to the 1932 fire which destroyed the Biological Station.

Mr. E. G. Rigby, curator of the station, states that he has seen, in addition, several other specimens taken during the course of his 30 years service here. Dr. A. H. Leim, chief biologist, makes a similar report and refers to the capture of a "right-handed" specimen that was pigmented on both sides.

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A Circular Slide Rule

Science, 1946, **103**, 113, describes a slide rule made by William E. Morrell for solving problems such as $d = \sqrt{x^2+y^2+z^2}$ and $r = \sqrt{x^2+y^2}$, etc., using a pair of linear scales and a pair of square-root scales which differ from those of the ordinary slide rule in that they are graduated according to the square root of numbers on the linear scales instead of the square root of numbers on a logarithmic scale.

If two identical scales are used, graduated so that they show square roots of numbers on a linear scale, the operation of finding the square root of the sum of two squares is done more simply than on the slide rule described. The problem is solved as simply as performing a multiplication on a pair of logarithmic scales.

The Rotarule, a circular slide rule manufactured by this writer, has carried such a pair of square root scales since 1927, as well as a linear scale making it possible to solve $r = \sqrt{x^2+y^2}$ and $c = a^2+b^2$ with a minimum of effort.

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Reply to Prof. Chamberlain

Some years ago it was seriously propounded that all scientific research be banned in order to permit the world to catch up. All that would happen, of course, would be that we ourselves would remain stagnant, and the rest of the world would go ahead. Some such thought as this is suggested as a result of the reading of Prof. Katherine Chamberlain's article on "Another chain reaction" (*Science*, 1946, **103**, 158–160), in which she suggests that all atomic bomb research be abandoned until a definite world understanding is reached regarding the use of this most powerful form of energy. I would suggest instead that the research be stepped up to double its present rate. Power is a force for good when used in the right hands, and right today we need some organization of the good forces, as Prof. Chamberlain indicates. The time is fast approaching when those who, in a democracy, do not take an active interest in public affairs will be deemed negligent.

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