

brates) and Invertebrate Embryology, by Professor Harold Heath; General Physiology and Research in Physiology, by Professors E. G. Martin and F. W. Weymouth; The Algae and an advanced course in Botanical Survey, by Mr. J. I. W. McMurphy.

President Wilbur has appointed W. K. Fisher, of the Department of Zoology, director of the station.

W. K. FISHER

### SCIENTIFIC EVENTS

#### THE BOMBARDMENT OF PARIS BY LONG-RANGE GUNS

PROFESSOR G. GREENHILL writes in *Nature* that the Jubilee long-range artillery experiments of thirty years ago were considered the *ne plus ultra* by the British authorities, and were stopped at that, as they were declared of no military value. But the Germans are said to have watched the experiments with great interest, and to have carried the idea forward until it has culminated to-day in his latest achievement in artillery of a gun to fire 75 miles and bombard Paris from the frontier. Professor Greenhill writes:

From a measurement of the fragments of a shell a caliber is inferred of 240 mm., practically the same as the 9.2 inch of our Jubilee gun, which, firing a shell weighing 380 pounds at elevation 40°, with a muzzle velocity nearly 2,400 feet per second, gave a range of 22,000 yards—say, 12 miles. This was much greater than generally anticipated, but in close agreement with the previous calculations of Lieutenant Wolley Dod, R.A., who had allowed carefully for the tenuity of the air while the shot was flying for the most part two or three miles high.

The German shell is likely to be made much heavier and very nearly a solid shot, better by its weight to overcome air resistance, the chief factor to be considered in the problem of the trajectory. If it was not for this air resistance a range of 75 miles with 45° elevation could be reached, on the old parabolic theory of Galileo, with so moderate a velocity as  $V = \sqrt{gR} = 3,200$  feet per second, with  $g = 32.2$ ,  $R = 75 \times 5,280$ ; in a time of flight of about  $2\frac{1}{2}$  minutes, an average speed over the ground of 30 miles per minute.

A velocity of 3,200 feet per second was obtained by Sir Andrew Noble in his experiments at New-

castle about twenty years ago with a 6-inch 100-caliber gun, with a charge of  $27\frac{1}{2}$  pounds of cordite and a shot of unspecified weight, so it may have been the usual 100 pound or perhaps an aluminium shot of half the weight.

Double velocity is usually assumed to carry twice as far; at this rate the velocity of our gun would require to be raised from 2,400 feet to about 6,000 feet per second to increase the range from 12 to 75 miles; such a high velocity must be ruled out as unattainable with the material at our disposal.

But in this range of 75 miles the German shot would reach a height of more than 18 miles and would be traveling for the most part in air so thin as to be practically a vacuum, and little resistance would be experienced.

So it is possible a much lower velocity has been found ample, with the gun elevated more than 45°, for the shot to clear quickly the dense ground strata of the atmosphere. Even with the 3,200 feet per second velocity obtained by Sir Andrew Noble a surprising increase in range can be expected over the 12-mile Jubilee range when this extra allowance of tenuity is taken into account, and a range of 60 miles be almost attainable.

#### SOME TUNGSTEN ORES IN THE NATIONAL MUSEUM

For some years the department of geology in the United States National Museum has been making a special effort to build up its collections of the so-called rare earths and rare metals, many of which have assumed exceptional importance since the outbreak of the war. These collections include a considerable range of substances which have proved of commercial value only within the past decade, one of the most important of which is the metal tungsten, invaluable in steel manufacture. During the past year the department has received, principally through the intervention of Mr. F. L. Hess, of the U. S. Geological Survey, three most remarkable specimens illustrating the three types of ore of this metal. In its own way, each of the three is unique and undoubtedly the largest of its kind ever mined.

The first is a mass of ferberite (iron tungstate) from the No. 7 lease of the Vasco Mining Co., at Tungsten, Boulder County, Colorado, which was presented by the Vasco Mining Co., and Messrs. Stevens and Holland. The specimen is roughly oval in form, 2 feet