technical industries located throughout the country. Heretofore this testing required about three days for a single instrument on account of the difficulty in heating a furnace to an exactly uniform temperature. A new method has now been developed which permits a satisfactory standardization of a radiation pyrometer within one hour. Many suggestions are given for minimizing the errors to which the pyrometer is subject, and it is shown that this type of instrument suitably designed, adequately calibrated, and correctly used, is a trustworthy pyrometer having many advantages over other types of temperature measuring devices, both for scientific and technical use.

THE government's herd of buffalo on the Wichita National Forest, in Oklahoma, which is also a federal game preserve, has been increased by the arrival of ten calves, according to a report received by the Forest Service from the supervisor in charge. The herd, which now comprises sixty-two specimens of the almost extinct bison, is in good condition, says the supervisor, and promises to continue increasing at a rapid rate. Eight of the calves are females, bringing the number of heifers and cows up to thirty. The bulls number thirty-two and have been placed by themselves in a pasture which has just been fenced in for them. Three years ago the buffalo herd on the Wichita Forest was little more than half as large as it is now. It is said that the other game animals in the preserve, including the elk and antelope, also are increasing, due to the protection afforded, not only against hunters, but against wolves, wild cats and other predatory animals, which committed serious depredations from the establishment of the preserve in 1905 until measures were taken to stop them. In protecting the game from predatory animals, the wardens and forest officers are also promoting the interests of local stockmen, who graze several thousand head of cattle on certain allotted areas within the preserve.

Nature says of the Harvard College Observatory: "Anything concerning this famous institution can not fail to be of interest, and thus we welcome a reprint from the *Harvard Alumni Bulletin,* March 10, 1915, of two articles, one by the director, Professor Pickering, and the other over the initials 'J. D. M.' dealing with the observatory and its work respectively. Founded in 1840 by W. C. Bond, with the help of thirty subscriptions of £20 each, the endowments now amount to £200,000, and the annual income exceeds £10,000, yet, we are told, 'there has never been a time . . . when funds . . . were needed more than they are today.' In addition to the well-known Arequipa Station in Peru, where the 24-in. photographic doublet has been mounted, a station in Jamaica has recently been founded for visual work. No fewer than seventy complete quarto volumes of *Annals* have been published and eight others are in preparation, whilst about 200 circulars have been issued. Concerning the progress of the Draper Catalogue, we are informed that down to March 1, 1915, Miss Cannon had classified no fewer than 188,350 stellar spectra."

UNIVERSITY AND EDUCATIONAL NEWS

CAPTAIN C. F. BALLEINE, fellow of Exeter College, Oxford, who was killed in action on July 2, bequeathed £1,000 to the college.

ACCORDING to the London *Times* Sir A. H. Church has bequeathed to fellows of Lincoln College, Oxford, £500; to the Waynflete professor of mineralogy in the university £100 for the purchase of apparatus and mineral specimens, together with the testator's optical instruments, mineral specimens and chemical apparatus; and £100 to the curators of the Ashmolean Museum.

DR. T. C. HEBB, professor of physics at the Northern State Normal School, Marquette, Michigan, has been granted his sabbatical year and will devote it to study at Columbia University.

NEW appointments at Bedford College, London, as we learn from *Nature,* include: assistant lecturer in physics, Miss M. O. Saltmarsh; demonstrator in physics, Miss M. Baxter; demonstrators in physiology, Miss Hartwell and Miss Tweedy; demonstrator in geology, Miss I. Lowe.

DR. H. G. EARLE has been appointed to the chair of physiology in the University of Hongkong.

DISCUSSION AND CORRESPONDENCE

MASS AS QUANTITY OF MATTER

THAT the words "quantity of matter" are of service in explaining the significance of "mass" in dynamics has been assumed either explicity or tacitly by many authorities, including Newton, Maxwell, Kelvin, Tait and Clifford, and this view is obviously held by several of those who have contributed to the recent discussion in SCIENCE. There are, however, those who dissent from this view,[1] maintaining that the word mass as used in dynamics has no meaning except that given to it by the "law of acceleration" (Newton's second law), and that the statement that "the mass of a body is a measure of its quantity of matter" contributes nothing to our understanding of the definition. My present object is to call attention to a consideration which appears to be lost sight of by those who take this latter position. This consideration, stated briefly, is that *the mass of a body is distributed in a perfectly definite way among the individual portions of matter of which the body is composed.*

Dynamics deals with the motions of bodies. By a body we mean any connected aggregate of matter. Without attempting to define matter, we recognize the applicability to it of the notions that *the whole is greater than any part* and *the whole is equal to the sum of its parts.* These are quantitative notions; and it will be seen that they are an essential part of the notion of *mass* which we habitually use in interpreting the second law of motion.

Consider the following proposition:

I. *If two bodies be acted upon by equal forces, the body having the greater mass will have the lesser acceleration.*

According to one view this is merely an arbitrary definition of the meaning of greater and less as applied to mass; *i. e.,* the statement that "the mass of a body A is greater than that of a body B" is held to mean nothing more than that "if A and B be acted upon by equal forces the acceleration of A will be less than that of B." If, however, we are to regard proposition I. as having any application to actual physical bodies, it is easy to show that it is not a mere definition, but a partial expression of a physical law, enabling us in certain cases to make predictions. Thus, suppose material to be removed from a body A, leaving a body B; we know that, if a certain force be applied to A and an equal force afterward to B, the acceleration of B will be greater than that of A; and the truth of this is recognized because we know that B contains less material than A. That is, in applying I. to this case we associate with *mass* the notion of *quantity of matter.*

Consider now the following more definitely quantitative proposition:

II. *If different bodies are acted upon by equal forces, the resulting accelerations are in the inverse ratios of the masses of the bodies.*

The interpretation we put upon this proposition becomes evident from a consideration of particular cases.

As a first illustration let A be a body which, when acted upon by a force F, has the acceleration a; and suppose A to be divided into two

[1] The dissenting view is vigorously advocated by Professor Huntington in his latest letter (SCIENCE, July 30, 1915). It should be noted that this question is aside from the question whether mass should appear in the fundamental equations. Whatever definition of mass may be adopted, the fact remains that the quantity ordinarily called mass is a part of the fundamental data of dynamics. That Professor Huntington's formulation of principles obscures this fact is my chief reason for dissenting from it. Further discussion of this point by me would, however, be a reiteration of what has been said in a former communication (SCIENCE, April 23, 1915). Any reader who is interested in Professor Huntington's reference to my text-book on theoretical mechanics may find by consulting the book that the explanation of the laws of motion contained in it is substantially that which I have recently favored in the pages of SCIENCE; but it is my present belief that the notion of quantity of matter might have been used more effectively in this book, as well as in most other text-books that are known to me.