

government assistance, documents must be presented showing the existence of suitable lands and other facilities to maintain such establishments.

UNIVERSITY AND EDUCATIONAL NEWS

It is planned to build a hospital on the campus of the University of Washington, Seattle, to cost a million dollars and which is to form the nucleus for a medical department of the university.

WILLIAM P. BROOKS, Ph.D., director of the Massachusetts Agricultural Experiment Station, has resigned his position. Dr. Brooks has been connected with the Massachusetts Agricultural College since 1889, previous to which he was professor of agriculture for twelve years in the Imperial College of Japan. He will continue in the service of the experiment station as consulting agriculturist.

PROFESSOR W. C. SABINE, acting director of the Jefferson Physical Laboratory of Harvard University, has retired and is succeeded by Professor Edwin H. Hall.

DR. PAUL F. GAHR, of the department of physics at Wells College, has been appointed acting professor at Cornell University, where he will assist in the Students' Army Training Corps two days a week.

E. C. AUCHTER, associate professor of horticulture at the University of West Virginia, has been employed by the Maryland State College to head the department of horticulture.

ROBERT O. CALDWELL, Ph.D. (Princeton, '18) formerly professor of physics at Geneva College, has accepted a position as assistant professor of physics at West Virginia University.

THE following appointments have been made at Marquette School of Medicine: Mrs. Paul M. Smith, M.A. (Wisconsin), formerly assistant in botany at University of Wisconsin, as instructor in bacteriology. Mr. C. A. Hills, M.A., formerly instructor in physiology at the University of Kansas, now in charge of laboratory work in physiology and pharmacology, as

instructor. Mr. A. H. Hersch, M.A., formerly instructor in biology at the Kansas State Agricultural College, as instructor in the department of anatomy and biology.

DISCUSSION AND CORRESPONDENCE

MR. ABBOT'S THEORY OF THE PYRHELIO- METER

TO THE EDITOR OF SCIENCE: Referring to Mr. Abbot's open letter to me, published in SCIENCE, June 21, 1918, I should like to make a few remarks. The important points can be taken as two, which require attention.

1. The first is that my research ranks as an "interesting speculation" without "quantitative value." After adapting the Boyle-Gay-Lussac Law, $P = \rho RT$, to atmospheric physics, the computations proceed by using only the standard formulas of thermodynamics, kinetic theory of gases, and electron physics; the checks are always complete and numerous; the results are in full agreement with observational data, so that Mr. Abbot's statement implies that these laws have no application in free atmospheres, which few will admit. The results have succeeded in clearing up a long series of heretofore unsolved problems, circulation, thermal data of various types from the adiabatic strata to the top of the various atmospheres, the origin of atmospheric electricity and magnetism, the thermodynamic environment of several spectra in the sun, and the end is not in sight. The Planck theory of radiation, the Bohr origin of spectrum lines, and the electron-atomic data are already seen from a new point of view. There are few computations whose data interpenetrate and are supported by so many distinct series of physical laws as are these, and the evidence is that they form the basis for future developments in atmospheric physics.

2. The second point is that Mr. Abbot reiterates this argument: that his well-known method of discussing the pyrheliometric observations must be correct, because it produces the same solar constant, 1.94×10^8 cal./cm.² min., when repeated many times at many stations. If the method is erroneous it can not be made valid by repetition. It will be recalled that

Professor Langley deduced from his bolometer studies about 3.00 calories; that Angström and others obtained 4.00 calories, and those were common results for some years. Mr. Abbot reduced the value to 1.94 calories, relying solely upon the pyrhelimeter, and at the same time recognized that the ordinates of the bolometric spectrum indicate a solar temperature of about 7000° A., the pyrhelimeter requiring only 5800° A. He passed over this wide discrepancy by assuming that the sun does not radiate as a black body. This is the critical point. The Poynting equation of equilibrium asserts that the surface flux of radiation over a given volume sustains a certain volume density whose temperature is T . This equation has been applied by me in detail to the earth's atmosphere, so that in ten distinct integrations the volume density from the sea level to the vanishing plane amounts to 3.98 calories; it has been applied in the sun's atmosphere with the result that the solar radiation originates in a deep isothermal layer at the temperature 7655° . It is, therefore, black radiation, of an equivalent value of 5.85 calories; using Abbot's coefficients of transmission for several spectrum lines, from the center to the limb, this is depleted by 1.87 calories, thus agreeing with the terrestrial data and the bolometer. This result destroys Abbot's theory, and renders his pyrhelimetric method useless.

It is not difficult to understand the source of Mr. Abbot's error. He relies upon the Bouquer Formula of depletion, and, indeed, substitutes this for the Poynting Theorem, which is erroneous. When there is lack of equilibrium between the surface flux and the volume density, there is a product of free heat, $dQ = cdT$, while the temperature is changing. The pyrhelimeter works on this change of temperature alone, omits to register the stored potentials and inner energy within the metals, glass, mercury, these last being very difficult to follow. In short, Abbot's theory identifies the surface flux of radiation with this free heat, and it follows that it does not manifest the entire radiation received. For these reasons I have abandoned Abbot's

methods and substituted those found in my "Treatise on the Sun's Radiation." It may be noted that the pyrhelimeter is a very inefficient apparatus for atmospheric studies, because it is unable to eliminate the depletions due to the effects of vapor, dust and even molecular scattering in the higher levels. Applying certain correcting ordinates, the stations at Cordoba-Pilar, 438 meters, and at La Quiaca, 3465 meters, are working together within 0.02 calories, and they follow the solar variations as indicated by the sun-spots, prominences, magnetic field and the meteorological data in Argentina. It is imperative that Mr. Abbot should abandon his unfortunate pyrhelimeter method, which is flatly contradicted by a very extensive series of data, in favor of the results which are clearly indicated by his admirable observations with the bolometer.

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FIREFLIES FLASHING IN UNISON

TO THE EDITOR OF SCIENCE: In SCIENCE for July 26, 1918, there appears an article on "Fireflies Flashing in Unison," by Edward S. Morse. Confirming his statement and that of other observers that fireflies do at times synchronize their flashes I beg to relate an instance that occurred on the evening of May 4, 1918, on the Benguet road. At that time I was a passenger on the auto-stage run by the Philippine government between the railroad station at Mangaldan and Baguio. As the stage rounded one of the numerous curves on the grade there appeared on our left, apparently in motion, a ghostly incandescence which came and went in regularly repeated flashes and intervals of darkness. The appearance was uncanny and was plainly visible to all the passengers in the stage. We did not at first realize its cause but soon attributed it to fireflies. As I have said the light was apparently in motion, but I am inclined to believe that the insects which caused it were not in continuous flight but were congregated (as is frequently the case in the Philippines) about some tree standing