find, when the sphere is as far from the sun as the earth is, that the cap which faces the sun will have a temperature of about 62° C. The other cap will be at the absolute zero of temperature, so that the average temperature of the sphere will be about —105° C. We may, therefore, conclude that if a meteorite were spherical and black its temperature when near the earth would lie between —105° C. and +9° C.

If the meteorite is not a perfect conductor of heat the temperature of the inside will not usually be the same as that of the outside. The amount by which the temperature of the inside differs from that of the outside will depend in part on the thermal conductivity of the meteorite and in part on the rapidity of motion toward the sun or away from it, as well as on the distance from the sun. Suppose that the meteorite is a sphere and has a diffusivity of 0.01 cm.²/sec. This is about the diffusivity of limestone and is less than that of granite. Suppose further that this sphere is at the absolute zero of temperature and is suddenly placed where its surface is maintained at 9° C. Then for a sphere 10 cm. in diameter I find[2] that at the end of fifteen minutes the difference between the temperature at the center and that at the surface will be less than 15°, at the end of twenty minutes the difference will be less than 5°, and at the end of thirty minutes it will be less than 0.2°. If the meteorite travels 100 kilometers a second it would require nearly five days to go a distance equal to that from the orbit of Venus to the orbit of the earth. So, unless the meteorite travels much faster than 100 kilometers a second, or is much more than 10 cm. in diameter, it seems likely that the temperature of the inside can not be very different from that of the outside. This, of course, is before the meteorite enters the atmosphere of the earth.

As another way of attempting to get some idea as to the temperature of a meteorite suppose we consider the temperature of a cylinder. Let the cylinder be at the same distance from the sun that the earth is. Let the ends of the cylinder be black, and let one of them point directly at the sun. To simplify matters suppose that there is no radiation from the sides of the cylinder. Then the heat which reaches the end that is turned toward the sun is partly radiated from that end and partly conducted to the other end and there radiated. From this condition we obtain the equations

$$\sigma(\theta_1^4 + \theta_2^4) = b \tag{3}$$

and

$$\theta_1 = \theta_2 + \frac{l\sigma\theta_2^4}{k}, \tag{4}$$

where θ_1 and θ_2 stand for the absolute temperatures of the two ends of the cylinder, and l and k stand for the length and thermal conductivity of the cylinder. Taking k as 0.008 cal./cm.sec.deg., which is about the value for granite, equations (3) and (4) lead to the following results.

Length of cylinder	Temperatures of ends		Average temperature of cylinder
1 cm.	61° C.	63° C.	62° C.
10 cm.	52° C.	70° C.	61° C.
100 cm.	4° C.	98° C.	51° C.

In the actual case there would, of course, be considerable radiation from the sides of the cylinder, so that the temperatures would be lower than those given in the above table.

Although these calculations do not tell us precisely what the temperature of a meteorite may be expected to be just before it enters the atmosphere of the earth, they do seem to be sufficient to indicate that that temperature is nearer to 0° C. than to the absolute zero of temperature.

ARTHUR TABER JONES
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[2] From eq. (44) on p. 133 of Ingersoll and Zobel, *The Mathematical Theory of Heat Conduction.*

THE BUREAU OF STANDARDS

TO THE EDITOR OF SCIENCE: Considering the enormous interest taken even by the non-discriminating newspaper public in the achievements of the Bureau of Standards, which scientific men are justly proud of as one of the greatest physical laboratories of the world, using physics in its proper sense of including chemistry and engineering, or applied physics, your readers may be interested in the following letter, which I have just unearthed, in one of those single-handed combats in the perennial struggle against dirt, in which an armistice has just been declared. (Pardon the lack of unity in the preceding sentence. It at least does not contain the word "due," nor the adverbial phrase "back of," meaning behind).

I had written an article, the first in English, describing the Physikalisch-technische Reichsanstalt in Charlottenburg, which I had seen in its initial stages, and urging to the best of my ability the establishment of such an institution in this country. This article I had sent to the *Popular Science Monthly,* from whence it was returned with a note from the editor, Dr. Youmans, saying he did not believe that such things were the function of the government. What to do with it I did not know, but finally Dr. G. Stanley Hall took pity on the little wanderer, and published it in his *Pedagogical Seminary,* and the U. S. post-office did the rest. I sent copies to Sir Oliver Lodge, who read an article on the same matter at the meeting of the British Association, but I never heard whether he got them. It was probably as a result of his paper that the National Physical Laboratory was founded. The United States, as usual, brought up the rear. It was not until eight years after my article that the first step was taken leading to the establishment of the Bureau of Standards, which now, in size and expenditure at least, leads all the rest. This is due to the extraordinary tact and skill in management of its able director, Dr. Stratton, whose name is now a household word. May the bureau long continue to have success under his wise direction. The letter follows:

Cambridge, 1892, Jan. 13.

My dear Sir:

Your article on a National Physical Laboratory came duly, and I thank you for sending it to me. By this mail it goes back to you.

I have read it with care and much pleasure, and trust that you may soon publish it, for it can not fail to be useful. What may be the best way to bring it before the public I do not know; but, from my limited means of judgment, it seems to me that some one of the great New York magazines might afford a good opportunity—say the *Century,* or *Scribner's.* I should select a periodical of large circulation—and not a "popular scientific" one, where the public reached is one which would in general require no education on the subject, or else not to be of the influential class of people.

And when it is printed, I hope you will take steps to insure that members of Congress and professors of physics in our leading universities shall have opportunity to read it. Possibly some of the engineering journals might have the sort of circulation which is desirable.

Wishing you all success, and with cordial sympathy with such a movement, I am,

Very sincerely yours,

B. A. GOULD

Dr. Arthur G. Webster,
Worcester.

A. G. WEBSTER

WORCESTER,
JULY 8, 1922

SPECIAL ARTICLES

BASAL GLAUCONITE AND PHOSPHATE BEDS

As a result of lithologic studies of carboniferous formations in Texas I showed last year[2] that glauconite beds characterized by certain peculiarities occur at breaks in a sedimentary series. Although I pointed out that this observation was merely an extension of Cayeux's observation[3] that phosphate beds occur in similar positions, I thought at the time that the relation of typical glauconite beds to these breaks had not been noted. I was therefore much interested to learn in conversation re-

[1] Published with the permission of the director of the U. S. Geological Survey.

[2] Goldman, Marcus I.: "Lithologic Subsurface Correlation in the 'Bend Series' of North-central Texas," *U. S. Geol. Survey Prof. Paper* 129-A, pp. 1-22 (especially pp. 3-4), 1921. "Association of Glauconite with Unconformities," *Bull. Geol. Soc. America,* 32, p. 25, 1921 (abstract).

[3] Cayeux, L.: *Contribution à l'étude micrographique des terrains sédimentaires, Mém. de la Soc. géol. du Nord.* 4 pt. 2, pp. 427-432, 1897. *Genèse des gisements de phosphates de chaux sédimentaires, Bull. Soc. géol. de France,* 4e ser., *5,* pp. 750-753, 1905.