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October 16, 1916.

Dr. R. T. Glazebrook,
The National Physical Laboratory,
Teddington, Middlesex,
England.

Dear Dr. Glazebrook:

Referring to your letter of August 7, 1916, in regard to a suitable standardization temperature for commercial metric standards of length, I have to say that we have carefully read Mr. Sears' memorandum, and while we agree with him that commercial standards of length, whether metric or English, should be standardized at the temperature at which they are to be used, we do not concur in his opinion that the mean work-shop temperature to be selected should be 62° F.

There is, at the present time, a decided tendency away from the Fahrenheit temperature scale, and we feel that the tendency should be encouraged. There is, in fact, a bill now pending in Congress by which it is hoped to abolish the Fahrenheit scale, at least from Government publications.

The temperature 20° C is coming more and more to be accepted as the standard temperature for industrial as well as scientific operations. The sugar industry, for example,

is practically on the 20° basis. All polariscopic tubes, flasks, etc. used in making up sugar solutions are made standard at that temperature. Very many hydrometers are standard at this temperature and the glass volumetric apparatus standardized by this bureau is on that basis and has been for the past ten years or more. Also many of the steel tapes used in this country are standard at 20° C.

I might add many other examples to show that 20° C is being largely accepted as the standard temperature in scientific and technical work. Would it not, therefore, under the circumstances, be better to standardize both the English and metric commercial standards on this basis rather than that of 62° F? 20° C would certainly have a very great advantage over 62° F if urged for international adoption; and from a practical point of view it would be no more difficult to change the English commercial standard from 62° F to 20° C (68° F), than to change the metric standards from 0° C to 16.67 C (62° F).

I would like also to make another suggestion to you that I have contemplated for some time; namely, that you use your influence to secure in England the adoption of the yard used in this country, namely, that based on the international meter in accordance with the relation, 1 yard = $\frac{3600}{3937}$ meters. Such action on the part of England would have the double advantage of putting all "English" measures of length on the same basis, and at the same time giving them a definite and direct relation

to the International Meter.

We do not agree with the statement of Mr. Sears' that the English yard in terms of the meter, "may be accepted as accurate certainly to well within one part in a million, and probably within two or three parts in ten million." It has been some time since we looked this matter up, but our recollection is that successive comparisons made between the British Imperial Yard, and its authentic copies, showed variations of over one part in four hundred thousand for the values found at different periods. If a yard of exactly the same composition and construction as the British Imperial Yard shows variations at different epochs of 0.00015 inches, is it not possible that a large part of this variation is in the British standard itself? This is the attitude that the United States has always taken in regard to the dropping of the figures beyond 39.37. At best the value of any other significant figures are doubtful and no useful purpose is gained by retaining them. On the other hand, if the yard is defined in terms of the international meter according to the relation adopted by this country, our yards would be in exact accord and, moreover, fixed in terms of the same international standard.

In regard to some of the problems and uncertainties pointed out by Mr. Sears', I should like to state that in my opinion they will still arise in practice, though perhaps to a lesser extent, even though work-shop standards are

graduated to be correct at 62° F, 20° C, or any other chosen temperature. Lengths will still have to be expressed in terms of a unit of length which is independent of temperature, and measured in terms of a standard of length whose value is continually changing with temperature. It will still be necessary, in order to completely define a length, to state both the unit and the temperature of measurement.

In regard to Mr. Sears' statement as to the desirability of representing the relation between the inch and the centimeter by the simple figure:

$$1 \text{ inch} = 2.54 \text{ cms.}$$

we will say that if the relation between the yard and the meter adopted in this country is accepted, then 1 inch is equal to 2.54 cms. to within 2 parts in a million. This is no doubt amply close for all mechanical and industrial purposes.

Changes of temperature will not, of course, change the ratio of the inch to the centimeter; but for the sake of convenience the scales on which the inch and the centimeter are represented should be correct at the same temperature.

With apologies for the delay in replying to your communications on this subject, I am

Very truly yours,

W. M. Sears

Director.

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