ter is American unity. Intercommunication, common business interests and common national ideals are named as factors contributing to this unity.

The final chapter treats of 'Governmental Study of our Domain.' It contains a description of the work of the Geological Survey, Coast Survey, Fish Commission, Department of Agriculture and other departments of governmental activity.

'Geographic Influences' is almost a pioneer in its line. Among the geographic influences the author places the greatest emphasis upon physiography, but the treatment is not overbalanced. A quality which can hardly be shown in a review is the vigorous, attractive style. The author presents a wealth of facts without a trace of 'statistical' manner. The illustrations are well selected and several maps are included in the work. The book should have a good circulation among those readers who are interested in American history. It will also appeal strongly to an increasing number of students who are considering the relations of the earth sciences to the politico-historical sciences.

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DISCUSSION AND CORRESPONDENCE.

THE METRIC SYSTEM.

TO THE EDITOR OF SCIENCE: I feel that I must congratulate your readers on the review of 'The Metric Fallacy,' published in your issue for August 5, from the pen of Professor W. Le Conte Stevens. Passing by the charges of partisanship and intolerance for the moment, as of no real importance, the review exhibits a comprehension of the subject which is rare—I might almost say unique—among metric advocates. My purpose in writing this letter is to point out that Professor Stevens's admissions are of far greater importance than he seems to suspect, and I trust you will find a place for it—not as a reply to the review, nor as a defence of the book, but as a continuation of an important discussion.

As I have pointed out in a special chapter of 'The Metric Fallacy' (The Pro Metric Argument), the metric advocates have based their case upon the belief that the change to their system is an easy one. This belief is the chief burden of the pro-metric statements made before the house committee on coinage, weights and measures, of the fifty-seventh congress, and it was largely through its reiteration that the favorable report of that committee was obtained. In the above-named chapter will be found quotations from the statements made by a dozen metric advocates before that committee in which the longest period named for the change is five years. I can, however, ask you for space to repeat but one of these—the gem of the whole collection—which came from Lord Kelvin (italics mine):

> I believe that *in a fortnight* people would become so accustomed to the perfect simplicity and easy working of the metrical system, that they will feel that instead of its being a labor to pass from one system to the other, *it will be less than no labor.*

This opinion, I should add, was repeated with approval at the great discussion of the American Society of Mechanical Engineers in 1902.

Through a clipping bureau, I have received from Great Britain hundreds of newspaper clippings pertaining to this agitation in that country, and the case there, as here, is based upon this assumption.

It would, indeed, be superfluous to mention this contention of the metric advocates, except to point out that Professor Stevens is so far in advance of his associates as to frankly tell us that 'reasonably complete assimilation will take several generations' and that 'none of us of to-day will live to see anything better than good progress on the part of the general public in getting accustomed to the new standards and in losing devotion to the old ones.'

Among those whose opinions as to the shortness of the transition period are given in the chapter on 'The Pro Metric Argument,' are: Elihu Thompson, Harvey W. Wiley, S. W. Stratton, Simon Newcomb and Lord Kelvin. Professor Stevens seems to think I have not treated these opinions with due respect, but in view of the above quotations from his review it is hard to see wherein he respects them more than I do. He plainly regards

them as worthless and I can go no farther than that.

In view of the facts regarding the use of old units in all metric countries, how is it possible to treat with respect the repeated assertion of the metric advocates before the house committee on coinage, weights and measures that the change with us will require but from two to five years, and what matters it that these statements are made by men of distinction, chief of whom is Lord Kelvin?

Following the assumption of the ease of the change, and a necessary outgrowth of it, is the assumption that it has been made in countries in which the system has been adopted. Thus in 'The Coming of the Kilogram,' published by the English Decimal Association, and thus made official, we may find:

'There are now no longer a great number of sets of weights and measures in use among the civilized peoples of Europe; there are really for all useful purposes two only,' these being, of course, the English and the metric.

It would again be superfluous to mention this contention of the metric party, but for Professor Stevens's remarkable admission:

> A century has not been sufficient to cause the abolition of old names and units among the common people of France, resort to them being usual when no penalty is involved. The same is true in Germany and Switzerland and in every other country where the metric system is, in business transactions, either obligatory or permissive.

If it is the common experience that the people of metric countries resort to the old units when no penalty is involved, then it is clearly impossible to bring the system into common use in this country where general compulsion is admittedly impossible. Furthermore, if this system is so superior, how can this admission be true? Why should it be necessary to compel people to use such a wonderfully superior thing as the metric system is represented to be? It is certainly the only case of the kind on earth.

Just as the pro-metric case has been based upon the belief that the change will be short and easy, so the anti-metric case has been based upon the belief that, as shown by the experience of other countries, it would be long, difficult and costly, and that the long transition period would be one of great confusion. While I have made no count of its pages, it is safe to say that eighty per cent. of 'The Metric Fallacy' is devoted to enforcing this and to nothing else. Professor Stevens now comes to our assistance, however, and admits that a century of compulsory laws in France, and thirty years of them in Germany, have been insufficient to complete the change, that 'certain people would lose money and otherwise suffer much inconvenience from the change,' that 'all possible consideration should be accorded to those whose large pecuniary interests are affected' and that 'the first result will be not the abolition of confusion, but the increase of confusion,' and how long he expects this period of added confusion to be is shown by his admission that 'none of us of to-day will live to see anything better than good progress on the part of the general public in getting accustomed to the new standards and in losing devotion to the old ones.'

It thus seems to me that Professor Stevens has admitted pretty much all that we have contended for. There remain, in fact, but two important differences between us—he regards the change as worth this cost and this period of confusion, while Mr. Dale and I do not, and he regards the change as feasible, while, in a manufacturing sense, we regard it as impossible.

In common with other scientific men, Professor Stevens fails to recognize the root of the difficulty and of the opposition, the difficulty of changing established manufacturing standards, of which textile, screw thread and pipe standards are representative. I am, in fact, in this respect, disappointed in this review, as it ignores what I regard as the two most important chapters of my portion of the book 'Scientific and Industrial Measurements' and 'Scientific and Industrial Difficulties.' I have there pointed out—I believe for the first time and without reflection upon either party—the reason why scientific men favor the system while manufacturers oppose it. In brief, this is because 'the scientific use of measurements consists in measuring existing things; the industrial use of measurements

consists in making things to required sizes.' In scientific work the change involves a change in measuring instruments only, while in industrial work it involves a complete change in standardized manufactured goods—a change which manufacturers know to be impossible. I can not ask for space to enlarge upon this, but it explains completely the different attitudes of the two parties.

Mr. Dale and I profess to speak as those who are experienced in manufacturing, and as having given protracted study to the effect of this change upon manufacturing industry. As scientific men have, rightly, no respect for the opinions of the non-scientific upon scientific questions, so we have no respect for the opinions of those who have no expert knowledge of manufacturing upon the effect of this change upon manufacturing industry. We acknowledge that our language is harsh, but it is in no way more so than the stock dismissal of all objections to this change as due to 'ignorant prejudice,' and it is not for those who have always treated our views with contempt to object when they find their own non-expert views treated in the same manner. While Professor Stevens, although opposed to us, has been so generous as to frankly give recognition to our book by saying that it contains 'a mass of information that must be taken into account,' he should, and doubtless does, know that the chief weapons of the prometric party have been ridicule and contempt, and he should not criticize us for making use of the same guns. We believe that we are justified in using them when discussing opinions that entirely fail to recognize the importance, in many cases the existence, and in all the formidable nature of the difficulties that surround the manufacturing side of the question. What scientific men need to learn more than all else in connection with this subject is that their experience, their knowledge and their horizon do not include manufacturing. They have uniformly failed to recognize the difference, or, indeed, that there is a difference between measuring things and making things. They are measurers, not makers, and their opinions have no value and no application as related to manufacturing.

The proposition is that we make this change in industry and commerce. It is, therefore, an industrial and commercial, and not a scientific question. It is the province of scientific men to determine the weights and measures which they shall use, but when they endeavor to foist this thing upon others who must pay the cost, while they pay nothing, as they have succeeded in doing wherever the system has been adopted, and as they have tried to do here through the hearings of the house committee on coinage, weights and measures, they simply meddle with other people's affairs, and exhibit an assurance which furnishes the occasion, and I believe the justifiable occasion, for the vigorous language of 'The Metric Fallacy' which, however, has obviously not prevented Professor Stevens from learning some wholesome facts from it.

Contrast the enormous development of organized manufacturing to-day with its comparatively trifling development at the introduction of the metric system in France a century ago. Even with that trifling development Professor Stevens admits that 'conservatism has been too strong and vested interests too great to permit the enforcement of any interfering laws.' Is it not obvious that the change in France under the conditions of a century ago was easy compared with what it now is here? If, starting with the conditions of 1793, and after a century of compulsory laws, resort to the old units is in France still 'usual when no penalty is involved,' how many centuries must elapse before that resort becomes unusual under existing manufacturing development here where general compulsion is not to be contemplated?

Were the metric party to unite on the admissions made by Professor Stevens when presenting their case to the committee on coinage, weights and measures—and I shall see to it that they go before any such future committee—the metric bill would be killed at the hands of its friends as it was last winter killed at the hands of its enemies, for, contrary apparently to the impressions of Professor Stevens, the metric system from a legislative standpoint is the 'deadest' thing in this country.

F. A. HALSEY.

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