expense of manufacture and material is much less, it would seem as though it should be adopted, and attention turned to the weight, friction, shape of surface, etc.

Complaint is made of short, light vanes, that they often make a complete revolution in high winds. This could be obviated by increasing the weight, but this would not be as satisfactory as increasing the length. It is very evident that the same vane will not answer for both light and heavy winds. It would seem as though a long flat vane would do for the higher winds; and the lighter winds may be determined by the motion of smoke or a light banner, always being careful to keep the line of sight at right angles to the wind. This question is an eminently practical one. Experiments are much needed to determine the most satisfactory size of surface, length and weight of vane, for winds of different velocities, to satisfy the conditions first laid down.

Since writing the above, it has been suggested to me that the double vane can be so readily braced, it can be made out of very light material, and hence may be much lighter than the flat vane. The fallacy here consists in the implication that a single vane needs any bracing at all. Since there is no strain upon a flat vane, as it always turns immediately into the air-current, it need not be very stiff; but it is far otherwise with the double vane. Here the spreading of the tails at once brings a tendency to collapse, to each tail, which increases with the wind-velocity, and is never absent, being greatest when the vane is in the air-current. Each tail, then, must be far stiffer than the single tail, which has no strain at any time. But this is not all: the material used in the bracing will add much to the weight, especially with the greater angles of the tails. For example: take the most sensitive vane, where $2i = 90°$ and $e = 45°$. If the tails are 4 feet long, the spread at the tips will be 5.6 feet. A width of half a foot would give a strain of 30 pounds, with a wind-velocity of 40 miles per hour, and the tails must be very stiff. In addition, if the web bracing is as stiff as the tails, the total weight would be more than four times that of a single vane with double the surface and better fitted for service. H. ALLEN.

Philadelphia, March 15.

On certain electrical phenomena.

There are a few mystics in science (I am not one of them), but I fail, even upon a second reading, to discover that shroud of mystery enveloping my letter 'On certain electrical phenomena' (*Science*, No. 211), which seems to have impressed my critic, 'T. C. M.,' in a subsequent issue (No. 213).

My letter was copied into a number of the daily papers in the eastern and western cities, and I have letters from people who are strangers to me, in regard to it; but thus far, excepting 'T. C. M.,' no one seems to think it 'mysterious.' I am sure I did not when I wrote the account.

Your correspondent furcher advises me that I should 'possibly eliminate a few of the facts' in making such investigations, to which I can only reply that I am not in the habit of eliminating any of the facts in the premises of any scientific investigation I may be engaged in, whatsoever may be its character. Usually I gather and use all such *facts* as I can lay my hands on.

As the point is an important one, I would also like to say to Professor Mendenhall that he evidently misquotes me in the next paragraph of his letter, wherein he says that "Dr. Shufeldt states that he had never observed such exhibitions in Washington." I made no such statement, but did remark that "I had never observed (there) such exhibitions so far as my own person was concerned, and they only gradually developed at this place" (Fort Wingate, N. Mex.). The cases cited for that city by him are very interesting.

I repeat, that in my case the "electrical discharge was considerably greater from the tip of the index-finger than from any of the others of the hand, and gradually diminished in regular order as we proceeded to the little finger;" and this after careful experimentation. I nowhere even imply that this will be found to be universally the case.

Further, your correspondent seems to hold the opinion that every one exhibits such electrical phenomena in the same degree, when submitted to similar conditions to excite it. In this I thoroughly disagree with him; for further experimentation here, goes to show that phenomena similar to those I described in my letter to *Science* are exhibited in varying degree by my three children, whereas on the other hand, in the case of the mulatto child I referred to, it has thus far, after numerous trials, been impossible to excite them in her.

And I must believe, that, when Professor Mendenhall comes to make more extended inquiry among a greater number of people, he will discover that there are many of them who have absolutely never heard of such things, to say nothing of having observed them in the case of their own persons. Common it is, no doubt; and, ah, me! how wise we would all be if we were but only thoroughly informed upon all common phenomena! R. W. SHUFELDT.

Fort Wingate, N. Mex., March 10.

Comparative taxation.

It is true, as Mr. Atkinson says, that it is easier to criticise than to construct, and Mr. Atkinson deserves credit for his undertaking. Yet criticism of what has already been done may be of value in clearing the way for more perfect work in the future, and I therefore venture to offer a further criticism of some of the views expressed in Mr. Atkinson's letter of March 4.

Mr. Atkinson gives, as a reason for considering national taxation separately, the fact that in Europe so large a portion of the national revenue is expended for '*destructive* purposes,' by which I suppose is meant war purposes. The difference between Europe and this country is not so great as most people probably believe. If we consider the army and navy and pensions, which are a war expenditure, we find that in 1885–86 the German empire expended for the above purposes $110,500,784, and the United States $111,636,903. A comparison of the relation of these expenditures to total expenditures in the two countries is rendered difficult by the different character of the governments; but considering only the ordinary governmental expenditures, that is, omitting the consideration of railways, mines, etc., we find that in the United States war expenditures amount to 39 per cent of the whole; in the German empire, exclusive of the individual states, to 77 per cent; and in Prussia and the empire taken together, to 28 per cent.

Prussia and the empire together would form a fairer basis for comparison with the United States than would the empire alone, because the latter leaves the civil administration almost entirely to the individual states. The comparison with Prussia and the empire together, however, would not be exact, as in Prussia the nation assumes some functions which are here left to the states; but it is safe to say, that, if we could compare with accuracy the expenditures for like purposes in Prussia and the empire together and in the United States, it would be found that the proportions in each of war expenditures were nearly the same; and of course, if we consider the *productive* expenditures of the German states, the percentage of war expenditures will be much smaller than in this country.

I do not mean to deny Mr. Atkinson's general statement that a larger proportion of expenditures goes for war purposes in Europe than in the United States, nor to underestimate the other burdens which a great standing army imposes, but merely to point out, that, so far as state expenditure for war purposes is concerned, the difference between this and other countries is not so great as we are apt to think, and that in the case of Germany it is doubtful if whatever difference there may be is in our favor.

Mr. Atkinson also holds "that the revenue of state forests, mines, and other instrumentalities of subsistence . . . constitute as true a tax upon the people as if they had been assessed directly on their property."

That is a question that ought to be determined before we begin to make comparisons. If we intend to count profits from lands, mines, and railroads as taxes in Europe, we must do so in this country.

If the consumer is served equally well and cheaply by a private and public producer, profits are no more a tax in one case than in the other. It would be difficult to convince any one that it makes no difference to the German tax-payer whether governments derive from the profits of railroads a revenue sufficient to pay the interest on the public debts, as is the case in the German states, or whether that revenue comes from taxation, provided the railroads are as well managed as they would be if government did not control them.

HENRY B. GARDNER.

Johns Hopkins univ., Baltimore, March 21.

The characteristic curves of composition.

With regard to Professor Mendenhall's novel paper on 'The characteristic curves of composition,' in your issue of March 11 (No. 214), which proposes to represent and compare the orthographical productions of writers by a statistical and graphical method, it seems to me, that, interesting and instructive as are the results he has reached, they are confined to a range of inquiry too narrow to bring into sufficient relief the personal idiosyncrasies of individual writers, and to a kind of enumeration in which personal peculiarities are too much marked by the particular language in which they write.

That the characteristic curve is principally controlled by the language in which the composition is written, is evident from the comparatively small difference to be found between the various English writers between whom comparison is made, as well as from the marked departure from this general shape of the English curve to be seen in that of Caesar's 'Commentaries.' The curve found for any other Latin author would presumably not differ from this one more than the curves of various English writers differ from each other.

What the general shape of the characteristic curve may be for any writer is determined, then, principally by the language in which he writes.

It would be interesting to compare several languages with each other, so as to obtain approximately the normal curve for each. An inflected language, like Greek, Latin, or German, will, of necessity, have its normal curve largely affected by the numerous letters forming the terminations. Moreover, any tendency toward the formation of compound words, such as *Pferdebahnwagon*, or toward agglutination, would also have its effect upon the shape of the curve. Such a comparison would doubtless furnish tests on which to build new arguments and comparisons respecting the vexed question of Teutonicity, and the like.

But to return to the point with which I began; viz., that there are other characteristics of writers equally susceptible of treatment by the statistical and graphical method, in which their personal peculiarities differ more widely, and which are therefore more characteristic than the habitual selection and use of long or short words. For example: it seems to me that the length of the sentences employed by a writer is such a peculiarity, and one which, although influenced somewhat by the particular language in which he writes, is nevertheless an expression of his habits, feeling, taste, and individuality to such an extent as to exhibit necessarily some characteristics which would distinguish him in a marked manner from other writers.

The length of the adjective modifiers of substantives seems also to be a particular well suited to bring out individual characteristics by a similar enumeration. In this category may be mentioned also the length of the adverbial expressions; the complexity of the verbs; as well as the character of the vocabulary as regards derivation from Anglo-Saxon, French, Latin, Greek, etc. The list of fit subjects of enumeration can be extended at will.

It would seem probable that a discussion of the results obtained by the simultaneous application of several of these enumerations would, in any case of disputed authorship, afford decisive tests such as could not be obtained from any one of them singly; and by its help the person making the investigation could exhibit to the public how weighty the evidence may be on which his judgment is based.

H. T. EDDY.

Cincinnati, March 14.

Earthquake weather at sea.

Your European exchanges have no doubt given you so full reports of the recent earthquake in this region, that it would be impossible for me to add any thing that would interest you or your readers. You may be interested, however, to have somewhat in as detail a report of earthquake weather at sea, such was encountered by the steamship Gottardo on its last trip from New York.

We sailed from New York on the 19th of February, and had disagreeable weather almost from the hour we left Sandy Hook. On Tuesday, the 23d, began a series of storms which kept by us almost constantly until we sighted the African coast outside the Straits of Gibraltar. The disturbance began about 4 P.M.