the possibilities the empire affords, there is no reason why our outlook should not be as hopeful as that of the United States. The resources at our disposal, the agricultural possibilities within the empire, may well be regarded as boundless; but we need to make ourselves acquainted with them and to take concerted measures to exploit them. To this end, it is all-important to constitute effective central organizations in this country similar to those which exist in the United States.

One other illustration may be given. In New York, on the occasion of our visit to the Museum of Natural History, Professor Bickmore, to whom this magnificent museum owes its origin, favored us with an account of the manner in which material was provided for illustrated free popular lectures delivered at the museum, for the purpose of making the people acquainted with their country and its resources; and he delivered a charming lecture to us in illustration of the work. The lantern slides prepared in the museum are placed on sale, so that they can be used for educational purposes all over the country. The lecture we heard was of a very popular character; it was quite clear, however, that pioneer work of a most useful character was being done. It was impossible not to feel that if the resources of the British Museum were were made known by sound popular lectures and handbooks; if the museum, the ordnance and the geological survey departments and the colonial office were to cooperate with the education department in making known the conditions which prevail throughout our Empire, it would at once be possible to put the teaching of history and geography on a basis of fact and make these subjects eminently attractive. The geological survey exists as a branch of the educational department, but its reports are of technical rather than of educational value; they might well, in part, be so written as to be delightful essays on physical geography suitable for school use, if only a little thought were given to them from this point of view.

It is quite clear that the right spirit is at work in the United States; but the lack of the critical faculty and of depth of purpose, combined with an excessive development of the utilitarian spirit, are serious drawbacks at present and militate against progress in education. Until higher ideals prevail and sober calculation takes the place of a somewhat emotional and superficial consideration of its problems, it will be difficult to introduce reforms. Here our difficulty is to break through academic, conservative traditions and to arouse an interest in education; that in reality it is the most important of all subjects to be seriously considered has never yet been made clear to us either by preacher or by politician—the message awaits delivery and we need more than anything else the man to make it heard.

Henry E. Armstrong.

SCIENTIFIC BOOKS.

The Metric Fallacy, by Frederick A. Halsey, and *The Metric Failure in the Textile Industry,* by Samuel S. Dale. New York, D. Van Nostrand Company. 1904. Pp. 231.

A bill was introduced in congress in 1902 with a view to the general adoption of the metric system of weights and measures in the United States. The committee on coinage, weights and measures secured the views of a number of prominent representatives of different professions, trades and manufacturing interests, the majority of whom favored the bill. A change of such fundamental importance required mature deliberation; and the committee were disposed to allow the fullest opportunity for discussion on the part of opponents as well as advocates. The bill will not be brought to a third reading for some months yet, and congress will not be apt to take any precipitate action.

Mr. Frederick A. Halsey, associate editor of the *American Machinist,* presented a paper to the American Society of Mechanical Engineers in December, 1902, in which his aim was to rebut the arguments of those who had advocated the metric system, and especially to show how great would be the cost of the change to the mechanical industries of the country. Mr. Samuel S. Dale, editor of the *Textile World Record,* published some articles with the same object in view, particularly in relation to textile interests. The final result is the volume now before us.

The two parts of this volume are very different in tone, and it would be unfair to use the same words of criticism for both. Mr. Halsey's mental attitude is fairly indicated by the following extracts from his introductory chapter. He says (p. 12) of the metric system: "Nowhere has the system made material progress in industry except when backed by the policeman's club. * * * With their system of weights and measures as a foundation, the English-speaking peoples have built up the greatest commercial and industrial structure the world has known. They are asked to enter the slough of despond in which metric Europe wallows in order to help metric Europe out. They are asked to destroy the very warp and woof of their own vast industrial fabric in order that they may assist in weaving another of alien origin and with no resulting gain except to aliens. * * * Representative of their historic methods of development, foundation of their industrial life and bond of union between all sections—shall all these be destroyed for this French fad?" (p. 14). "The pro-metric argument is, substantially, an *a priori* argument. The metric advocates adopt the methods of the old philosophers who laboriously sought to prove what ought to be. My method is that of modern science, which interrogates nature in order to learn what is."

The last paragraph just cited is Mr. Halsey's comment after quoting the views of a number of pro-metric advocates, including such representatives of science as Elihu Thomson, Harvey W. Wiley, S. W. Stratton, Simon Newcomb and Lord Kelvin. Each reader can draw appropriate conclusions regarding Mr. Halsey's estimate of facts without any comparison of personal standing. That his attitude is marked by judicial fairness and dignity can scarcely be claimed any more than that such method is 'that of modern science.' The objects of his criticism are men who have already manifested ability at least equal to that of Mr. Halsey in interrogating nature. What he writes about wallowing in a slough of despond and sacrificing our advantages for the benefit of aliens, all for a French fad, might, perhaps, be called political claptrap of the same value as the cries about 'infant industries,' 'pauper labor' and 'sixteen-to-one.' It certainly is not argument. It emphasizes, what is evident on every page of his book, that he is a carping critic, much given to extreme forms of expression. For example, after quoting Dr. Wiley, Professor Newcomb and Dr. Geddes, he criticizes in these words (p. 96): "Was there ever such a case of distorted perspective? Was there ever such a case of rainbow chasing? As an epitome of the reasons for making this great change this pamphlet is pitiful. Are we a nation of dreaming idealists and transcendentalists that we should be swayed by such considerations?" The man who advocates the displacement of the old standards, he says (p. 97), 'deserves to be placed in the pillory and held up to the scorn of men.' Really, this is somewhat disturbing. It might be considered intolerant if its author were not so evidently a victim of what Mark Twain has aptly called 'French calm.' Such expressions make it hard to take seriously what he writes. A wide but very uncertain margin of discount is naturally suggested. The writer who resorts to sarcasm whenever the chance is presented, who confounds railing with argument, who suppresses or belittles everything that tends to controvert what he wishes to advocate, has only himself to blame if he forfeits the confidence of those who consider fairness an essential element in the effort to get at the truth.

The metric controversy may be summed up in a very few words. Certain people wish to give to our weights and measures the same

simplicity that characterizes our system of coinage, and in the remote future to attain international unity of coinage, weights and measures. Certain other people would lose money and otherwise suffer much inconvenience by the change. No good can result from calling the former doctrinaires or denouncing the latter as selfish. We have to consider the practical question, is the game worth the candle? If so, how can the transition be made least burdensome? If not, how can the existing system be improved with least inconvenience? Each of these questions may receive a different answer, and none of them will be fully answered during the twentieth century. The present writer has elsewhere taken part in the discussion and expressed the belief that if the metric system is to be popularly adopted at all by English-speaking nations it must be through some sort of compromise. Of his critics one scientific friend, a physicist (SCIENCE, Vol. XIX., p. 860), prefers to avoid compromise and believes that the American people will soon do what the French and Germans have done. Another, an engineer (p. 767), opposes all change of standards and thinks the proposed compromise 'might be a good one if the English-speaking race were to disappear from the earth.' The newspaper press has manifested similar diversity in views expressed.

The scientific men are probably as devoted to the metric system as the mechanical engineers are to its opposite. In the scientific laboratories no compromise whatever is now, or will be, necessary. The metric system will continue in use as the most convenient for laboratory purposes. But outside of the laboratory there are a good many considerations that can not be ignored. Even if intemperately urged and exaggerated, as they are by Mr. Halsey, they must be candidly recognized by those who advocate metric reform among the people, and allowance has to be made for two very obstinate and omnipresent opponents, conservatism and vested interests.

Mr. Halsey devotes a large part of his book to a presentation of statistical evidence intended to show that in all of the countries where the metric system has been made legal the people have held on to the old units to which they were accustomed. Adoption by statute is not a guarantee of adoption in practise. A century has not been sufficient to cause the abolition of old names and units among the common people in France, whether in city or country, 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. The fact is in no way remarkable. There is no reason to expect within the next century that conservatism will be so diminished that the exclusive use of the metric system will prevail even in France. The progress already made is all that could be reasonably expected. If the system be established by legal statute in America no such law can be enforced until the people generally shall have forgotten old names and values. If old names are retained and values but little changed the task of assimilation is made easier, but reasonably complete assimilation will take several generations. Thus, while our American coinage system is a model of simplicity and convenience, the rural Virginian persists in using the names 'shillings' and 'pence,' utterly superfluous as these may be. Advocates of the metric system deceive themselves if they think that new standards can be established among the masses, by statute or otherwise, within a few years. The initiative can be, and should be, taken by the central government, and in the application of the law all possible consideration should be accorded, particularly at first, to those whose large pecuniary interests are affected. The first result will be, not the abolition of confusion, but the increase of confusion by an addition to the units and standards in use. None of us 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 losing devotion to the old ones.

That fairly good progress has been made, and will continue to be made, in the use of the metric system for international commerce may be inferred from the following extract,

printed by Mr. Halsey with another object in view. The collector of the port of New York says (p. 74):

> I have caused to be taken from the files of this office a number of invoices from Spain, Italy, Holland and Belgium, and find as follows: From Spain, 233 invoices, in 37 of which the weights are expressed as pounds, the remainder being made out according to the metric system; from Italy, 15 invoices, the weights therein expressed in the metric system; from Holland, 55 invoices, in 14 of which the weights are expressed as pounds, 11 of the 14 are expressed as pounds avoirdupois, and the other 3 invoices not stating the kind of pound, the remainder of the invoices being made out according to the metric system; from Belgium, 126 invoices, in 14 of which the weights are expressed in pounds, 31 in feet and inches, 2 in yards, and 1 in gallons; the remainder being made out according to the metric system.

This is very encouraging to those who believe that all great changes must be gradual. One of the anti-metric advocates writes: 'The question of weights deals rather with the future, but linear measures are tied irrevocably to the past.' The metric advocates should accept this statement with the substitution of 'strongly' for 'irrevocably.' If the statement were true as it stands, we should still be measuring lengths in cubits. The inch has not been invariable in the past. It may yet vary enough to become exactly commensurate with the centimeter if the exigencies of trade should make this desirable, but not otherwise. Or, unwelcome as such a proposition may be to the physicists, the meter, which we all admit to be an arbitrary standard, may yet be lengthened enough to become equal to forty inches. In either event readjustment implies inconvenience and opponents will be plentiful.

All fear about destroying the value of a vast body of technical literature founded on the English system is gratuitous. A very considerable body of literature has grown up, founded on the centimeter. Its value will not be destroyed if the millimeter should be lengthened to one twenty-fifth of an inch. Both the technical world and the scientific world have thus far readily adapted their literature to the times, with no regard for the inviolability of past usage. The fact that Newton's 'Principia' is now but little read does not take away its importance as the foundation of modern exact science. We simply adapt it to modern nomenclature and modern improved methods.

Mr. Halsey's book closes with these words, which apparently settle the case of the metric advocates for all time: 'These people may legislate until doomsday; they may make infinite confusion, endless turmoil, limitless sacrifice; but move the English inch?—the Archimedean lever is still unknown.' Dr. Lardner is credited with having proved that the Atlantic could never be crossed by a steam vessel. The rôle of the prophet is often unsafe; as unsafe as the exhibition of rage in print.

Mr. Dale in his discussion of the failure of the metric system to meet the requirements of those engaged in textile industry is in general more dispassionate than Mr. Halsey, but both writers exhibit considerable personal venom. This is intelligible, if it is not excusable, when we consider that each is a special representative of industries in which many millions of dollars are locked up in machinery that would all need to be changed if a law were passed that should impose a penalty upon the use of standards other than metric. Each considers that such coercion is implied in the legislation that has been provisionally discussed in committee at Washington. Mr. Dale, after criticizing some testimony in favor of the metric system that had been given to the committee by the president of a New England cotton mill and the principal of a textile school, says (p. 148): "This is the kind of evidence that was followed by a report bearing all the earmarks of having been dictated from that metric hothouse, the National Bureau of Standards." He calls the metric system a product of the French Revolution, associating it with the excesses of the Reign of Terror. He makes a violent attack on the personal character of the greatest of French mathematicians, whom he calls 'the designer of the metric system,' and who 'exhibited an utter disregard of principle in both private and public life' and 'appropriated the work of others as his own.' It is not uncommon to find men of genius who are deficient in administrative

ability; but even if we should admit that the author of 'The Nebular Hypothesis' was the ingrate, the time server, the fantastic visionary that he is here represented to be, it is hard to see what logical connection this can have with the question of international uniformity of weights and measures in the twentieth century. Mr. Dale seems to think that his cause, that of protection to textile industries, can be helped by such personalities. Of the great mathematician he says: "He was familiar with theories of infinity, but ignorant of the wants, necessities and limitations of textile manufacturing. The co-workers of this man in constructing the metric system differed from him only in degree. They were a party of mathematical prodigies, ignorant of the essentials of textile weights and measures."

The textile industry is undoubtedly important, but not enough so to warrant Mr. Dale's apparent assumption that knowledge of its technicalities is needed by the student of science or the legislator. That these technicalities are abundant and confusing is sufficiently shown in his chapter on 'The Continental Chaos.' This oldest of arts has always had its variable nomenclature, which has been developed without any reference to theoretic consistency or international uniformity. Even if the metric system had never been devised, the chaos could hardly have been much worse than what is here exposed. Attempts in France to dispel this chaos by legislation in behalf of the metric system have been rewarded with little or no success. Conservatism has been too strong and vested interests too great to permit the enforcement of any interfering laws. The statutes were passed, but had no life. Scarcely any better success has been had in Germany or, indeed, anywhere else. English and American textile standards seem to have been adopted away from home more than any others, this progress being entirely an incident of commercial convenience and not through legislation. Mr. Dale thinks that these textile standards will become the standards of the civilized world. Experience thus far certainly seems to indicate that legislation which contravenes custom in technical arts and manufactures is incapable of enforcement. Any attempts to secure change must be wholly unselfish, and directed toward the advantage of future generations rather than of present interests.

On the whole, this book is much to be commended to the attention of metric advocates, despite the unbalanced intolerance of Mr. Halsey and the ungenerous personality manifested by Mr. Dale. After discounting liberally for its bitter partisanship there remains a mass of information that must be taken into account by those who wish improvement in our system of weights and measures. If the metric system, so thoroughly installed in our laboratories, which are all new, is to be adopted in our industries, many of which are old, no proofs of its excellence will be of any practical value in securing the displacement of what gives satisfaction to those who control trade. If it is finally to win universality it will not be by legislation, but by its superiority, demonstrated by a multitude of trials in various fields, each initially on a small scale, and each suggested by the prospect of gain. Hope of general adoption within a few years after the passage of appropriate legislation has to be very limited. This statement does not imply that hope of its final adoption is to be abandoned. Nor must we claim that such adoption will simplify our weights and measures at first; it will merely add to the diversity; an addition to be deliberately made, with the prospect of the final disappearance of all except what experience may prove to be the best standards. Metric advocates believe these to be the metric standards. Before final adoption standards must be subjected to competition like all else, and only considerations of utility will determine the survival of the fittest.

There is no reason for metric advocates to relax their efforts to secure the adoption of the metric system by the government and its use in all government departments. An international system of weights and measures may gradually become established for the benefit of international commerce. Whether it will be adopted in interstate commerce can not now be predicted. Initial legislation should

be very elastic, and every concession should be accorded that may tend to secure to us the essential features of the metric system, even if we discard a good deal that its founders thought desirable for the sake of consistency. There is plenty of time yet to give this subject mature consideration without undertaking the rôle of either the optimist, the pessimist or the prophet.

W. LE CONTE STEVENS.

WASHINGTON AND LEE UNIVERSITY,
July 8, 1904.

The Development and Structure of Vegetation. Studies in the Vegetation of the State [of Nebraska], III. By FREDERIC E. CLEMENTS. Lincoln, Neb., published by the Botanical Seminar of the University of Nebraska. 1904. Pp. 175.

In the present work Professor Clements has had a double purpose, first, to give an account of our present knowledge of the cardinal concepts in the study of vegetation, viewed in the light of their historical development, and second, to give more exact organization and classification to those ideas as well as greater definition to their terminology. He treats the idea of the association in its various phases, and with its diverse bases; of invasion, with its elements, migration, ecesis (or adjustment to the habitat), influence of barriers, endemism, polygenesis, kinds and manner of invasion; of succession in its various phases; of zonation; and of alternation, involving competition. Each section has its bibliography. Many interesting views are presented in the course of the paper, among others the opinion that competition in plants has a purely physical basis, or, in other words, that competing plants influence one another only as physical, and not as physiological, agents. This view, which it must be admitted is the only one justified by facts at present at our command, would make associations and other groups of this nature merely physical mixtures of plants with no organic connection between the members (excluding parasites, etc.); but it is not improbable that further research will show this view to be incorrect. Another feature of the paper is the attempt of the author to give greater definition to the terminology of the subject, to which end he proposes many new terms, all of which have the positive merit that they are etymologically appropriate and consistent. Whether or not these merits will result in their adoption remains to be seen, but Professor Clements's proposals in this as in his earlier works have the great advantage of being first in the field. The author also emphasizes the need for accurate experimental and statistical field study as a basis for further ecological advance, a matter in which ecologists seem now to be in full agreement. Altogether, Professor Clements has given us a valuable and timely contribution to the study of this increasingly attractive subject, and his work is likely to exert no small influence in its development.

W. F. GANONG.

Mineral Tables. For Determination of Minerals by their Physical Properties. By ARTHUR S. EAKLE, Ph.D., Assistant Professor of Mineralogy, University of California. New York, John Wiley and Sons. 8vo. Pp. 72.

The new features in these tables are the prominence given to color as a classifying character and the restriction to the consideration of two hundred (approximately) common species. Lustre is made very subordinate, the divisions are by the 'streak,' color of the fine powder, and the subdivisions by 'color,' color of the mass.

For minerals which crush to a colored powder this affords an easy and generally accurate separation. But the silicates of all colors and many light-colored minerals yield white powders and their distinction by physical characters alone is not easy in average massive specimens, and this division extends over two thirds of the entire book. No resource is made to blowpipe tests, the inference to be drawn from a paragraph in the introduction being that 'blowpipe analysis' should follow as a separate feature of the course. The time allotted to mineralogy in many colleges would hardly permit this, however.

The omission of the rarer species and the limitation of the necessary apparatus to knife, magnet, lens, streak-plate and hardness scale