25 presidents of the United States "23 of whom were country bred, or were brought up under what the census terms rural conditions." This fact is without significance for two reasons. First, the total 25 is so small that the probable error is necessarily too large to give a conclusion in a statistical discussion of this kind. Second, and equally important, their birth records must be taken in terms of the total proportion of the population dwelling in the country and rural districts in the early days when these men were born. The fact that "about 36 per cent. of our population actually live on the farm at the present time" has nothing to do with the question. The same criticism applies to the figures concerning United States senators. He has shown no ratio over the expected for the rural regions in terms of population distribution, at the time of their birth, some fifty or sixty years ago.

I shall look forward with expectancy to the other statistics which Mr. Spillman hopes to present, and am very glad that he takes an interest in these questions. I agree with him that "the matter must rest here until further statistics are available"; but in the meantime I shall feel much confidence in the indications which have been furnished me as drawn from a list of some sixteen thousand, more or less notable persons, out of the vast population of the United States.

FREDERICK ADAMS WOODS
BROOKLINE, MASS.,
May 17, 1909

FAIR PLAY AND TOLERATION IN CRITICISM

To that large number who accept the justice, the value and the need of the recent criticism by Blackwelder of the geological fallacies dressed out as facts in Lowell's book on Mars as the abode of life, some reply will seem called for to offset before the general scientific public the personal, befogging and dogmatic rejoinder which it evoked in a recent issue of SCIENCE from one not a geologist.[1] In this connection some preliminary statement may well be made as to the kind of articles which in the mind of the writer seem to call for certain kinds of criticism. This appears the more necessary since to some all criticism seems out of place and to indicate a carping disposition, while others would hold that specialists are too lax in permitting to pass unchallenged many works which are highly erroneous but whose character is evident to the specialist only.

Destructive criticism is to all constructive workers in science a disagreeable task, yet one which should often be regarded as a duty, especially to university teachers, since such are deeply interested in the general diffusion of knowledge and should be equally concerned in the prevention of that diffusion of error which, unless vigorously combated, takes the place of truth.

All research work, even by properly qualified men, must necessarily contain some percentage of error which is eliminated by further advances in knowledge, but which frequently serves a most valuable purpose in stimulating to further and more exact observation and analysis. Such work, addressed to specialists, is always worthy of more praise than criticism, and a proper review will always seek out the parts of value and give them more prominence than those features which in the mind of the reviewer may seem open to question or even to miss the truth. It is not such research work which is here under discussion.

Advancement of knowledge, however, implies not only abstruse technical researches, but popular expositions of the same which shall carry a vivid conception of the principles and results to the intelligent but unprofessional public, consisting of laymen as well as workers in other branches of knowledge. Such work when well done is regarded by scientists in general as of the very highest educational value, and many eminent men have contributed a part of their time to the development of popular science. In fact, no small part of the eminence of some of the best known and highly regarded men of science is due to their work in what may be called the popular field, since it reaches those whose professional interests are in other branches. It is obvious

[1] "Fair Play and Toleration in Science," by T. J. J. See, professor of mathematics, U. S. Navy, SCIENCE, Vol. XXIX., pp. 858–60, May 28, 1909.

that it is not against work of such character that Blackwelder's review is directed.

Again, there is a large class of fugitive popular scientific literature written by men of no personal reputation, bearing within it the marks of its unauthoritative nature, some of it good, some bad. Such articles hardly call for serious comment from specialists.

But there are popular works ably written and put forth in a garb of authority which, however, confuse facts, theories and hypotheses, and contain views regarded by the great body of those qualified by special knowledge to hold an opinion as outworn, or wholly erroneous and misleading. It is against such false science, not popular science, that public and severe censure becomes a duty. As Blackwelder admirably puts it, unless such criticism is directed against such a book and its author "the average reader naturally believes him, since he can not without special knowledge discern the fallacies. He has a right to think that things asserted as established facts are true, and that things other than facts will be stated with appropriate reservation. This is precisely the same as his right to believe that the maple syrup he buys under that label is not glucose, but is genuine. The misbranding of intellectual products is just as immoral as the misbranding of the products of manufacture."

This code of morality makes it the duty of the teacher and scientist to expose in print such scientific shams, a duty, however, which is always disagreeable and which the majority of men leave to their fellows to do. He whose time is fully occupied with teaching and research, but who turns aside to do the task which others have left undone, is therefore deserving of honor and not of abuse.

It is noteworthy that Lowell's book on "Mars as the Abode of Life," in spite of its mass of fundamental errors whenever geological matters are touched upon, errors palpable to every working geologist, has been before the public for more than a year without any criticism of these features appearing in Science, the official organ of the American Association for the Advancement of Science, an association which since the development of special societies has become devoted to the general broadening of scientific knowledge. Such a criticism seems especially called for, since the book has been given the very widest publicity, it deals with a subject of great popular interest, and its author has been grandiloquently advertised by his publishers as the "founder of the new science of planetology." As an illustration of the result it may be noted that in the scientific columns of a carefully edited popular weekly its author has been hailed as one who would henceforth relieve America from the European taunt that it had as yet produced no really great and creative man of science.

As an offset, however, to the necessarily severe criticism of "Mars as the Abode of Life," cordial recognition may well be given at the same time to that great enthusiasm manifest in all of Lowell's work, which has led to the founding of a magnificent observatory and has contributed to astronomy much of real value. A coming generation of scientists will find much to regard highly in Lowell and will see in his work a stimulus to further knowledge, but will hold it as unfortunate that the same temperament which led to these results should have given rise to writings which called forth such severe criticisms as have appeared from his contemporaries in order to separate errors of premise and conclusion from that which is of real value.

Having made these preliminary statements, the true character of See's arraignment of Blackwelder may be shown by calling attention to the several topics which are discussed.

Blackwelder's review is aimed at false science, not against popular science, regarding which he says not a word; yet See uses a column and a half to flay him on that score, and because Blackwelder criticizes Lowell assumes that the criticism is aimed also against the popular work of such men as George Darwin and Proctor.

Blackwelder specifically avoids discussing any astronomic phase of the book, and does not mention the subject of life on Mars. Yet See takes up a column in arguing this matter,

and states: "Of course there is life on Mars; there is no doubt about it."

Lowell has been fortunate in being able to personally build and maintain an observatory, which has been the means of advancing the science of astronomy in a number of lines. See asks what Blackwelder has done in comparison. This question implies that only those whose personal fortunes have enabled them to do what Lowell has done should criticize his work, since those familiar with the scientific results of both will hardly see cause on such lines for invidious comparison.

Blackwelder casually mentions, to the extent of one sentence, "Lowell's implicit belief in the Laplacian hypothesis which now, to say the least, is on the defensive," a remark which calls forth a column from See embracing such statements as, "If Professor Blackwelder will study my own (See's) paper carefully, and the work now in press (by See) when it appears, he will find that most of the recent speculations on cosmogony are not worth the paper they are written on."

See further states that he has proved in four memoirs "that the oceans are gradually drying up and the land increasing, as Lowell maintains. Therefore Lowell is right and Blackwelder wrong; and that too in a subject which he represents as his own." This statement is highly amusing, to say the least, to those cognizant of recent work on paleogeography, especially if they have also read See's voluminous publications on mountain building and related subjects, and noted that they center about the old hypothesis of a free downward permeation of ocean water. A hypothesis which is not open to direct proof, and though still advocated by certain physicists and geologists is distinctly relegated to a subordinate rôle by many economic geologists and such leaders in the more philosophic side of the earth-science as Suess, Chamberlin and Van Hise; partly because of the theoretical difficulties attending an effective downward diffusion of ocean water through the zone of rock flowage, but much more because of the failure of the hypothesis to account for many of the facts now known to geologists. These point rather to a directly opposite view, which is well expressed by the words of Suess, "volcanoes are not fed by infiltration from the sea, but the waters of the sea are increased by every eruption."

The voluminous nature of See's writings on the subject is due to a dressing out of this old and, to say the least, doubtful hypothesis with many speculative additions, with much repetition of well-known facts and theories, and with specific applications in such frequent obvious discord with modern teaching of the principles of physiography and known details of geologic structure and history, that no geologist has felt called upon to comment. In the words of See, "geologists have discreetly kept silent."

On every topic See cites his own work as the authoritative utterances on the subject, and in the last paragraph denounces, as the worst evil of American science, "this clique and faction business, by which a man who is not in the ring never can get justice or fair consideration." Since no group of geologists or, so far as the writer is aware, no single geologist of recognized standing has followed and promulgated the special views in the teachings of See and Lowell, this clique and faction evidently includes the several hundred working geologists of America. To those who are familiar with the situation, this gives the key to the whole of See's article on "Fair Play and Toleration in Science." It is a vicarious castigation in which Blackwelder stands to receive the blows for a host of unnamed men of science, because they have not accepted See's memoirs at the valuation which he places upon them. Is vicarious atonement "fair play and toleration in science"?

JOSEPH BARRELL

NEW HAVEN, CONN.,
June 15, 1909

DETERMINATION OF THE COEFFICIENT OF CORRELATION

TO THE EDITOR OF SCIENCE: I should like to make a few remarks on Dr. Franz Boas's letter on this subject in your issue of May 21. There is some danger, I think, unless we see