range between indoor and outdoor temperatures. Lord Kelvin actually proposed to heat a house by a reversed heat engine or refrigerating machine. I am not aware whether this has actually been tried in practise.

By the efficiency of a boiler we mean the ratio of the energy, contained in the hot water and steam into which it has been converted, to the amount of heat that may be realized by burning the coal. This suffices to indicate the performance of the boiler, while that of the engine is a separate thing, and suffices to compare the performance of the engine with that of a perfect engine, limited as it is by the second law of thermodynamics. Mr. Forbes casts doubt upon Carnot's cycle being the most perfect one, but that was thoroughly proved by Carnot to be the case. In fact the gas-engine and the Diesel, which approach most nearly to the Carnot cycle, have the highest efficiency that has been attained. Mr. Forbes is correct in pointing out the fact that the efficiency of electric heating is unity, a fact which interests the consumer, who in this rare case knows that the meter can not do him an injustice, and yet, for all that, this is not a cheap method of heating. Electricity *can* compete with the ice-man.

Arthur Gordon Webster

## REVERSAL OF THE SODIUM LINE

To the Editor of Science: On a recent visit to a large plate-glass factory in the vicinity of Charleston, West Va., I had the good fortune to note the reversal of the well-known sodium line "D." The instrument used was a small pocket direct-vision spectroscope, which I carry with me on technical trips.

The furnace was a 200-ton plate-glass type, gas fired; and the reversal was noted at the peep-hole near the charging end, and shortly after the introduction of a fresh charge of the "mix." The reversal was noted in the case of two furnaces, one of these giving a *steady* reversal, and one giving a *wavering* and *intermittent* reversal. The phenomenon was noted both by myself and also by three distinguished technical friends attendant on the trip. Of course the reversal of the sodium lines is frequently observed in the electric arc, but this is the first instance in my experience that I have noted such reversal in a *fuel-fired furnace.* The temperature of the furance was probably approximately 3,000° F.

The observation may be more common in the experience and observation of others; but if this brief note should prove of value, the writer will be glad to answer any detailed questions regarding this rather unique matter. I have long held the opinion that the spectroscope has not been—and is not yet—used for its full technical worth in the practical arts.

Charles S. Palmer

United Fuel Gas Co.,
Charleston, West Va.

## THE CARNEGIE FOUNDATION AND RESEARCH IN THE COLLEGES

In a paper on college government and the teacher's salary, in the 14th annual report of the Carnegie Foundation for the Advancement of Teaching, the statement is made that much of what passes for research in American universities is only imitation research, which is detracting from the quality of the teaching to which the students are entitled. The conclusion is drawn, by inference at least, that the large sums of money spent on this kind of research could be expended much more profitably in strengthening the teaching work. It is unnecessary to debate the correctness of the writer's judgment as to the quality of the research work done in the universities. A large part of the research work done everywhere is mediocre or poor and it would be surprising indeed if this did not imply also to the colleges. No doubt the work done in some institutions is inferior to that of some others just as the teaching is of different degrees of perfection. It seems, however, that the writer has entirely overlooked one aspect of research work which in the colleges should be given the most serious consideration.

For many years the appreciation of the value of research has been growing in this country. This interest has been greatly stim-

ulated by the war and is especially reflected by the demand for investigators by the industries. Obviously, if this interest is to be maintained, if indeed it is not to be seriously checked by unsatisfactory work of poorly trained men, a supply of investigators must be available, and they must come from the colleges. Of course, a student can not be taught to be an investigator. He can only be given the tools of the trade, the essential training in the fundamentals, and the opportunity to make himself into an investigator if he has the proper mental equipment. He must learn first of all that there is such a thing as research by which a livelihood and an honorable position can be gained. Through contact with research workers he must acquire that spirit which is absolutely essential to continued investigation, and without which few young men will choose the laboratory in preference to the more lucrative offerings of the business and professional world. This contact can be obtained only in colleges doing research work. Every one who has had experience in maintaining the personnel of an investigational institution knows that the chances of getting good research men is much greater in the colleges doing research work. Not only does he find there students sufficiently interested in research to consider it as a calling, but those who are temperamentally adapted to this exacting type of work have had some opportunity of demonstrating their fitness. Colleges doing no research work rarely turn out an investigator. It is improbable that the students in these institutions differ essentially from those whence most of our investigators come. The difference lies in the fact that nothing is done to develop those having qualifications for this work. Musicians are not developed in a technical school, nor artists in a college of law.

Presumably research is conducted primarily for the results it may yield, but what we usually consider as the results of university research is in reality but a by-product; the real results are the investigators it develops.

There has never been a time when the colleges were so unable to meet the demand for men to fill research positions. Under these conditions should the Carnegie Foundation attempt to discourage research in the universities, or should it use its great resources and power to strengthen the weak places it has found?

L. A. ROGERS

WASHINGTON, D. C.

## RADICALISM AND RESEARCH IN AMERICA

IN a communication by Neil E. Stevens having the title "Radicalism and Research in America" printed in the last issue of SCIENCE, both the title and the purport of the article seem to challenge comment as a form of veiled propaganda such as is all too common at the present time. When radicalism is now pretty clearly identified with bolshevism, I.W.W.ism and other similar yearnings after dictation by the proletariat styled pure democracy, and when these eruptions within the body politic are threatening to overthrow our established system of representative (not democratic) government, the claim is set up through insinuations rather than by direct assertions that the fathers of our government, Washington, Adams, Jefferson, Franklin and Madison, were all radicals identified with such tearing-down movements. It seems further to be implied that because they encouraged science, therefore scientific men need have no fear that such overturns as our radical now propose will be other than advantageous to them.

If I have misinterpreted the purport of the article I trust that Mr. Stevens will explain just what *radicalism* connotes in his communication.

WILLIAM HERBERT HOBBS

ANN ARBOR, MICHIGAN,
July 10, 1920

[Dr. Stevens writes that he does not wish to reply to Professor Hobbs, but that he has no objection to a quotation from a personal letter to the editor in which he says: "I used the word 'radicalism' in what I believed to be its correct sense as established by good usage, as Dr. True uses it in the opening paragraph of his article 'Thomas Jefferson