

upon the market, as might be inferred from your criticism, — I trust I may be allowed a word relating thereto.

There are various uses for topographical models, and that for which they are designed must necessarily govern their construction. While the technical geologist, in considering orographic questions, finds it undesirable to exaggerate the vertical scale of his cross-sections, such profiles would be absolutely useless in the actual construction of a railroad. It should be equally evident that the needs of school-children under sixteen years, and those of the field geologist, are not necessarily met by identical appliances. The construction of suitable topographical models for use in the common schools is educationally of the utmost importance, and, now that the matter has been referred to, I hope it may receive the consideration it demands. Almost every great physiographic and commercial problem requires the pupil to see his locality and state in its vertical relations to other states and countries; and how best to enable him to do this, is not solved by Professor Lesley's dictum.

What we need to-day for educational purposes, as I see it, is an accurate topographic model of every state in the union, constructed in such proportions as will enable the pupils, in their respective schools, to use it as a working-plan for the making of a larger model of their state. This map should not be isolated. The pupil must see it in its horizontal and vertical relationships to other states. Now, to meet these demands, a relief-map of the United States is required, in which both the horizontal and vertical elements for each state may be measured with sufficient accuracy and facility by the pupil. Such a model must be portable, very strong, and *extremely cheap*. I emphasize the last, because, unless they are cheap, the schools needing them most cannot have them. Now, a model of the United States might be constructed, as Professor Lesley suggests, but it would be useless for topographic purposes if made of any portable size. Our own map has the horizontal scale sixty-five miles to the inch, and it is certainly as large as can be conveniently handled in the average school-room. But taking the Grand Cañon district as an example of what might be done with both scales alike, using Mr. Dutton's profile, extending from the Markagunt plateau southward across the Grand Cañon, for data, we should have the following profile:—

1. Markagunt plateau	10,568	feet above sea-level, or .0295 inch.
2. North bank of Parunuweap	4,659	" below (1) " " .0138 "
3. Depth of bed of stream	1,250	" " (2) " " .0036 "
4. Height of Vermilion Cliffs	1,818	" above (2) " " .0053 "
5. Foot of Vermilion Cliffs	1,363	" below (4) " " .0040 "
6. Brink of Permian terrace	1,022	" above (5) " " .0030 "
7. Foot of cliff	568	" below (6) " " .0016 "
8. Brink of second terrace	1,022	" above (7) " " .0030 "
9. Foot of second terrace	1,931	" below (8) " " .0057 "
10. Brink of Grand Cañon	113	" above (9) " " .0004 "
11. Bed of Colorado	1,363	" below (10) " " .0040 "

These figures are a sufficient proof of the impracticability of making a model of any large section of country without exaggerating the vertical scale, to say nothing of cheaply reproducing it with any degree of accuracy. Our map, constructed with the horizontal scale 5,000 feet to the inch, that is, the same as the vertical, would be about 16 rods long and 9 rods wide. Were it constructed with the vertical scale the same as the horizontal, Mount Whitney would be but .044 of an inch high; Mount Washington, .018 of an inch; and the highest point in Wisconsin, .0053 of an inch. Our model has attached to

it one of the summits of the White Mountains, both scales alike, covering a rectangle 9 by 5 inches, and shows in itself just what the effect of exaggeration is. For my part, when I think of a mountain valley represented on the model, I think of it as 65 times wider than it is in the model; and I believe that pupils, if properly taught, will do so. F. H. KING.

River Falls, Wis.

A national university.

The issue of *Science* for Dec. 11, 1885, contains an article on 'A national university,' with such reference to my connection with the action of the National educational association on this subject, some years ago, as may be thought to demand my attention.

In so far as the article in question deals with the National educational association and its committee on a national university, it is almost wholly devoid of truth, as I proceed to show, with such fulness as a reasonable allotment of space will allow.

1. How does the author of that article know "there is no evidence that the committee ever did any active work"? The assertion is a bold one, untempered by any qualification whatever. And yet the chairman of that committee, having first sought to bring the originator of this and other misrepresentations before the bar of the national association, at Detroit, in 1874, that he might then and there be openly confuted, himself appeared with proof that a large amount of work, in conference, by correspondence, and by the repeated printing and circulation of successive draughts of a bill, had been done by it, all through a period of years.

2. There is equal falsity in the statement that "Dr. Hoyt, although chairman of the committee of the national association, had never been able to get that committee together, and it [the bill] was therefore essentially a bill presented by a private citizen." Probably there never was a meeting of any committee, composed, as this was, of members from each and every state in the union, at which every member was present; but to say, on this account, that a committee, many of whose members had repeatedly conferred with each other on the subject assigned them, never had a meeting, would be a use of terms of which no reasonable person would approve. As a matter of fact, the members of the committee who attended the sessions of the association during the years in question conferred with each other; while all of the members were repeatedly communicated with, and had a voice in the matter under consideration, as truly as though every one had been present at the meetings. Moreover, every report of the committee so agreed upon by conference and correspondence, and presented to the association, was adopted by that great body without one dissenting voice. And, as for the bill at length presented to congress, it was as truly matured by the committee as any bill was ever matured by any committee; for the three successive tentative draughts of it, each embodying some new amendment or amendments, generally concurred in, were severally sent to every member of the committee, for renewed consideration. More than this, copies of the bill, as amended from time to time, were also sent to a large number of other learned gentlemen and statesmen throughout the land, for their criticism and suggestions.

While, therefore, the bill was drawn by the chair-

man (after years of careful study of university education, and a critical inspection of every important university in the world) and received but few modifications, as the result of its successive rounds, it was prepared by authority of the national association, and also embodied the consensus of a still larger number of persons deeply interested in the effort thus made to advance the interests of university education in America. In a word, it was a bill authorized and practically approved by the national association, and no amount of pettifoggery can efface the record of the almost unprecedented unanimity with which it was so authorized and approved.

3. Again: nothing could be more astonishingly false than the statement that "neither bill [the one under consideration and another one presented during the same session of congress] was supported by anybody in any way." For the records of the house of representatives will show that the bill matured by the national university committee was not only fully considered by the committee on education and labor of that honorable body, but was at length reported in a strong and able manner with the unanimous recommendation that it pass, as will appear from the concluding passage of the report as published by the house:—

"If, then, it be true, as the committee have briefly endeavored to show, that our country is at present wanting in the facilities for the highest culture in many departments of learning; and if it be true that a central university, besides meeting this demand, would quicken, strengthen, and systematize the schools of the country from the lowest to the highest; that it would increase the amount and the love of pure learning, now too little appreciated by our people, and so improve the intellectual and social status of the nation; that it would tend to homogeneity of sentiment, and thus strengthen the unity and patriotism of the people; that by gathering at its seat distinguished *savants*, not only of our own but other lands, it would eventually make of our national capital the intellectual centre of the world, and so help the United States of America to rank first and highest among the enlightened nations of the earth,—then is it most manifestly the duty of congress to establish and amply endow such a university at the earliest possible day.

"The committee therefore affirm their approval of the bill, and recommend its passage by the house."

4. Last of all, I call attention to the sublime self-complacency with which, in the face of all his superficiality of inquiry and flippancy of statement, the writer under notice deals with the able and learned secretary of the interior and with the merits of the national university question: telling us gravely, as a final settlement of the whole matter, that, "by all the would-be benefactors of American education, many of the difficulties in the way of establishing a national university have been overlooked." And this the dictum of a writer who, in a discussion involving matters of personal justice as well as of public interest, has been content to rely on *ex-parte* testimony,—this his *ex-cathedra* condemnation of a proposition first made by Washington, afterwards supported by a number of his most distinguished successors in the presidential office, and still more recently approved by such statesmen as Sumner, Howe, Schurz, Hoar, Ingalls, and Lamar; by such men of science as Agassiz, Peirce, Shaler, Henry, and Baird; by the heads of nearly all the univer-

sities of the United States; and by the largest association of educators in the world.

After this extraordinary manifestation, it does not seem worth while to descant upon our critic's notions concerning the evils of 'free education' and of what he is pleased to call 'the paternal government.' The demonstration of their unsoundness has been so often made, in the past, by educators who are indeed leaders, that it need not be repeated, unless there should at length appear some real 'leader of education' bold enough to express like 'un-American principles.' Up to this time, so far as I know, but one man in the United States, especially entitled by his position to be heard on the subject of a national university, has declared against the measure. Nor is it easy to see why any liberal-minded friend of American education should oppose the general proposition to found and amply endow one great institution for post graduate work, planted in the midst of the many important scientific establishments, as well as libraries, provided by the government, and so planned as to sustain helpful relations to all the universities, colleges, and common schools of the country.

JOHN W. HOYT.

Cheyenne, W. T., Jan. 11.

Temperature of the moon.

My first communication on the temperature of the moon was regarded as supplementary and confirmatory, and not controversial; my second one, as a correction of an erroneous view of my position too hastily formed. Something further here seems necessary with regard to my 'hypothetical moon,' 'an absolutely airless body' with 'equal relative radiating and absorbing powers,' and the 'endless list of limitations.' Unfortunately this is a subject, in whatever way we look at it, in which hypotheses not altogether certain have to be adopted, and in which we have to be satisfied with approximate results, subject to limitations. But my hypothetical moon is very much like the real moon as it has come to me from physicists and astronomers. More than a quarter of a century ago, Stewart established the equality of the radiating and absorbing powers for each kind of heat-ray, and so, of course, for all collectively. But this was from experiments in which there was not much difference between the temperature of the absorbing body and the body from which the heat was radiated; and this law has been extended, without sufficient warrant, to all cases, however great this difference of temperature. Professor Tait, less than two years since ('Heat,' 1884), in giving the usual definition of the equality of radiating and absorbing powers, adds the conditions of a dark body and of equality of temperatures, but immediately after adds, "We assume, with probability, that these latter conditions are not necessary."

In my paper on the 'Temperature of the atmosphere and the earth's surface' (Professional paper of the signal-service, No. 13), I thought it best to make a distinction between the heat received from the sun and that from terrestrial bodies of ordinary temperature. This was suggested by experiments made by De la Provostage and Desains, from which it appeared that polished metals reflected more, and consequently absorbed less, of the heat received from the sun, than from a Locatelli lamp. Accordingly, throughout that paper, a is used to represent the absorbing power of a body for heat from terrestrial