

vary in size, from small pebbles no larger than a pea, to pieces an inch or more in diameter. They are of very irregular shapes, and of colors varying from light bluish gray to dark brown. When rubbed together, they emit the peculiar 'naphthous' odor which characterizes the South-Carolina phosphates. I collected and weighed the loose specimens from a square foot of surface: the weight was about two pounds, which would correspond to some forty-three tons to the acre. I was not able to ascertain whether the nodules were distributed through the whole of stratum no. 3, or whether they were confined to a distinct layer therein, though a number of sections were examined; nor can I as yet state the probable yield per acre in these nodules, but investigations are now in progress which will probably soon give some more definite information on this point. Associated with the nodules are great numbers of fossils, consisting of fragments of Nautili, of Ammonites, of Baculites, and other well-known cretaceous forms. In most instances these fossils are phosphatized more or less completely, in extreme cases to the extent of nearly obliterating the organic structure; and then the fossils resemble the nodules very closely. In addition to these are found many vertebrae, and other bones of saurians, and teeth of sharks, among which are some very large 'pavement' teeth. I have had several analyses made of the nodules, and find the content of phosphoric acid to be from twenty-five to thirty-eight per cent.

4. Indurated ledge of light-colored sandy marl from a foot to eighteen inches in thickness. This stratum, which is quite persistent, holds about ten per cent of phosphoric acid, the average of several analyses of samples taken from different localities.

5. Loose whitish calcareous sands, passing downwards into micaceous sands, and, at the depth of twenty to thirty feet below the ledge no. 4, passing into compact bluish sands, with considerable greensand.

The whitest sands, at the top of these beds, hold in places compact beds of small oyster-shells. The sands just below the ledge no. 4 are also impregnated with phosphoric acid; and, though no quantitative analysis has yet been made, the percentage, judging from appearance, cannot be less than ten. We have thus eighteen or twenty feet of strata charged with phosphoric acid; the content of this acid varying from ten per cent in the lower beds, to twenty per cent in the greensand at the top. No analyses have yet been made of the beds which hold the nodules.

Of the economical importance of this discovery it is as yet impossible to speak definitely, but, if the greensand beds can be made available, the yield will be very large; and the nodules may yet be found in compact masses instead of loose pebbles.

It is probable that phosphate beds, in similar geological position, may be traced across the state; and already some greensands from Eutaw have been analyzed, and found to contain eight per cent of phosphoric acid. The following towns are situated near the line of contact of the rotten limestone and the underlying sandy strata: Tuskegee, Montgomery, Vernon, Autaugaville, Burnsville, Summerfield, Hamburg, Greenvboro, Eutaw, Clinton, Pleasant Ridge, Bridgeville, and Pickensville in Alabama, and Columbus, Aberdeen, Cotton-gin Port, Guntown, Baldwin, Booneville, Rienzi, and Farmington in Mississippi; and it is well worth while to search along this line for other occurrences of phosphates, especially where the saurian bones and sharks' teeth are abundant.

EUGENE A. SMITH.

University of Alabama, May 3.

A blind fish from the Missouri River.

An old fisherman on the river brought me yesterday an anomaly which none of his craft had ever seen before. It was a shovel-nosed sturgeon (*Scaphirhynchops platyrhynchus* (Raf.) Gill), which exhibited on the surface no sign whatever of eyes. These were concealed by a complete overgrowth of the prickly skin, which, on casual examination, differed in no respect from its normal appearance elsewhere. Upon very close inspection, however, a slight indentation, like a small pin-prick, was found to mark the place where one eye ought to be, but it did not penetrate the skin; and even this could not be detected over the other eye.

I skinned and mounted the fish, and, after skinning, removed the eyes from the inside through the mouth and gill openings. In one of these I could detect nothing abnormal. The other was without the crystalline lens, though the cornea and iris were apparently in place when I took it out; but, as it was removed with considerable difficulty, the lens *might* have been pressed out in the process. The first-mentioned eye was taken out with more care and less difficulty, and was entirely uninjured.

The sturgeon was normal in every other respect, twenty-five inches long to the tail, and showed no sign of injury to account for the monstrosity. It was in as good physical condition as others of its kind, so far as I could see, and seemed to have labored under no unusual disadvantage in its struggle for existence. The alimentary canal contained several insect larvae, the only contents that could be recognized. Most of these were so far digested as to be beyond identification. One, about an inch long, had rudimentary mouth-parts and no legs, and might have been a dipterous larva. Two fragments resembled the larva and pupa of some Lampyridae. Another was a lamellicorn beetle larva, probably of *Lachnosterna fusca* Fröhl.

As the habit of this sturgeon is to plough in the mud for its food, and to use its tactually sensitive barbels, with perhaps the soft skin covering the under surface of its shovel-nose, as a substitute for sight, it can have but little use for eyes: hence they might about as well be covered with skin, or become rudimentary, as those in the blind fishes, cray-fishes, etc., in Mammoth Cave and in certain subterranean streams and ditches, and for the same reason.

The eyes of this species are very small for its size, and especially small as compared with the eyes of most fishes. So the mole has its eyes reduced to a mere speck, which doubtless, as Mr. Huxley says, 'have no functional use.' It seems, therefore, not unreasonable to suppose that this unfortunate sturgeon's closed and sightless eyes may be only a prophetic instance of the fate which *awaits* all that belong to this species, and that even the normal eye is already considerably advanced in the process of abortion.

S. H. TROWBRIDGE.

Glasgow, Mo.

The use of the method of rates in mathematical teaching.

In regard to the communication of Professor Johnson, in your issue of April 18, p. 473, he admits that he is puzzled by the form of the questions which he assumes I put into the mouth of my students. I had no intention of puzzling him; and, in regard to the questions, they were real samples of those proposed by students from time to time. Not that all were asked by one student, or during one discussion, nor limited to those given.

My students have not asked me "whether the positive and negative parts of the axis of x are separated by a point, or by a space." Their difficulty does not appear to be with permanent statical conditions, but rather with the conditions involving change of motion, either of direction or change of rate; and since *rate*, in this discussion, involves motion, we fail to see the force of the question.

Professor Johnson expresses the opinion that the difficulty in the question, "Does the change in the rate of motion take place *at* an instant, or *during* an instant?" will disappear if 'during an interval' be substituted for 'during an instant.' We do not object to the substitution if it will relieve the difficulty, but to us it only enlarges it. It may be asked, How long is the interval? If ever so small, is the rate variable *during* the interval? If variable, the original question arises, and we wish to know if *change* involves a *part* of the interval; or, to adopt as nearly as possible the language of the professor, does change in the rate take place at 'a point' in the path, or during 'a space' of the path? If at 'a point,' is it not equivalent to asserting that a change takes place in no time? and if an interval is necessary, must it not be conceived as infinitesimal? Answers to these and similar questions may enable one to decide whether the fundamental conception of rates is more simple than that of the infinitesimal method. I do not question the soundness of the method of rates; and no avenue to the acquirement of knowledge should be closed to the student, even if all are not agreed that it is the 'fittest.'

DE VOLSON WOOD.

Hoboken, May 8.

THE NAUTICAL ALMANAC OFFICE.

THE conduct of the affairs of the office of the American ephemeris and Nautical almanac under the *régime* of the present superintendent, is worthy of special note in the progress of astronomy at home. Formerly this office did very little toward the collection and discussion of data for improving the tables of the celestial motions, expending nearly the whole of its annual appropriation by congress in the preparation of the Almanac and the Ephemeris from such tables as were afforded by the labors of astronomers everywhere, and, with few exceptions, not connected with the office itself. During the past seven years, however, not only has the efficiency of the office been greatly promoted by having nearly, if not quite, all the planetary ephemerides prepared by a single expert computer under the immediate direction of the office, and by a similar concentration of work and workers in other departments where formerly the computations were executed by individuals in different parts of the country not under the direct supervision of the superintendent, but the policy of the office with regard to the conduct of original investigation has been greatly modified; and, although the increase of the annual appropriation has

been very slight, an immense amount of astronomical research has been completed and published; and, as we learn from the published papers and reports of the office, the work, now well progressed and projected for the future, is of a character even more important and extensive. The valuable series of 'Astronomical papers prepared for the use of the American ephemeris and Nautical almanac,' the third volume of which has just begun with the publication of Professor Newcomb's development of the perturbative function, has for its object a systematic determination of the constants of astronomy from the best existing data; a re-investigation of the theories of the celestial motions; and the preparation of tables, formulae, and precepts for the construction of ephemerides, as well as for other applications of the results. The papers already published in the second volume, and the six parts of the first volume completed some time ago, are such as conduce only to the object in view, and range over a vast field of astronomical inquiry, from the experimental determination of the velocity of light, to Gauss's method of computing secular perturbations. Among the more important works already well in hand, but as yet unpublished, are Mr. George W. Hill's development of the perturbations of Jupiter and Saturn according to the methods of Hansen, on which he has been engaged since 1877; a determination of the mass of Jupiter from the perturbations of Polyhymnia; a re-determination of the velocity of light by the phototachometer; as well as discussions of the older observations of the Sun, Mercury, Venus, the Moon, Mars, and the satellites of Jupiter, with a direct view to a reconstruction of the theories of the motions of these bodies.

Not among the least of the improvements inaugurated by the present superintendent of the office must be noted the material alterations in the form and arrangement of the contents of the American ephemeris, together with the extensive additions made for the first time to the volume for the year 1882; all of which conspire, on the adoption of the new and more accurate systems of planetary tables, to make the Ephemeris in most respects superior to the similar publications of the foreign governments. The administration of the office also gives good evidence that the practical applications of astronomy are kept well in mind; for within a brief period it has commenced the regular publication of the American coaster's nautical almanac, the initial volume of which is adapted to the present year, and which we shall shortly notice.