

forced and diminished by the progression of the storm. But on lands in the temperate zone these terms have had little application; for there cyclones proper are seldom destructive, and, as a general thing, do less harm by their winds than they do good by their rains. There will, however, soon be need, at least in our western and southern states, of a corresponding expression, such as the 'dangerous octant,' to denote the sector between south and east of the broad storm where local tornadoes may be developed; for the surmise that tornadoes were thus definitely related to cyclones, suggested by the signal-service studies of a year or two ago, is rapidly becoming a well-proved fact by the investigations of this season. It is the most interesting discovery in meteorology that has been made of late years, in its theoretical as well as in its practical bearings.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Radiant heat.

In his letter to *Science* of the 15th of February, Professor Eddy states, that, in his opinion, the direction of the rays entering the region *B* is immaterial. As I am sure no other American or other scientific man agrees with him, I do not think it worth while, now that the issue has been reduced to this question, for me to continue a correspondence of the kind across the Atlantic, especially as Professor Eddy's mistakes have already been pointed out by Professor De Volson Wood.

As I am writing, I may, however, as well point out Professor Eddy's mistake in the arrangement he proposes as a substitute for mine. I agree that fig. 1 and fig. 2 represent what would happen; but fig. 3 does not represent all that would happen, as evidently, if heat can go into *B* in the direction $y'z$, as in fig. 2, there would be an escape of heat from *B* in the direction zy' , as well as that in the direction zy represented in fig. 3; and so, to the two quantities of heat coming into *B* in fig. 2, there would escape two equal quantities, which should have both been represented on fig. 3; and then, evidently, *B* is no better off than before.

Professor Eddy, I hope, will recollect that a pencil of rays of infinitesimal angle can only contain an infinitesimal quantity of heat. I make the remark because an omission to notice this fact is the only excuse I can see for the curious remark in the penultimate paragraph of his letter.

GEO. FRAS. FITZGERALD.

Trinity college, Dublin.

Another 'yellow day'

On the afternoon of May 2 a strong wind from the south-west brought to our position (seven miles

due west of West Point) thick clouds of smoke from the forest-fires in Pennsylvania and northern New Jersey. At 4.15 P.M. the sun had become completely obscured, and occasionally cinders and bits of charred leaves were borne past by the wind. The increasing density of the smoke was accompanied by a strange brassy, yellow light, which grew more vivid as the sun disappeared, and was most brilliant from five to six o'clock. It pervaded the whole sky with a diffused brassy glow, which was reflected into interiors so that an object placed before a window cast a perceptible shadow, yet the actual amount of light was less than in ordinary foggy or cloudy weather. The flame of a student-lamp had a white, dazzling appearance, not unlike the electric light. The green color of grass and foliage became of a most vivid quality, and the various shades of red seemed unusually prominent. This was attended by a high wind of from thirty to forty miles per hour, the highest temperature of the season, falling barometer, and a remarkably low percentage of relative humidity, as the following records show in part:—

Hour.	Temperature.	Relative humidity.
1 P.M.	81.0°	44%
2 "	82.0	38
3 "	81.5	33
4 "	81.0	22
5 "	80.0	15
6 "	67.0	42
7 "	61.0	45

The noteworthy feature of the phenomenon was its similarity to that of the well-remembered 'yellow day,' Sept. 6, 1881, the explanation of which was the subject of so much discussion. But, since the cause of the later occurrence was so unmistakably the presence of smoke in the air, persons who witnessed both can have little doubt that the same cause operated in the former case.

WINTHROP E. STONE.

Houghton Farm, Orange co., N.Y.

Cretaceous phosphates in Alabama.

I send you by mail some specimens of phosphatic nodules recently discovered in Perry county, in this state. Their true character was first suspected by Mr. William Spencer, on whose land they are found in abundance. Specimens were sent by him to Dr. C. U. Shepard, jun., of Charleston, S.C., and to myself, for examination, with the result of showing that they were nearly pure phosphate of lime. The geological position of this occurrence is different from that of the South-Carolina phosphates, as they are found at the base of the cretaceous rotten limestone; but the mode of occurrence is quite similar, as may be seen below.

A section (descending) of the strata at Hamburg, in Perry county, is about as follows:—

1. Rotten limestone, only the lowermost beds of which are here present.

2. Greensand beds from one to four or five feet in thickness. These beds appear to be impregnated with phosphoric acid; analyses of several specimens, selected from different spots, showing an average of about twenty per cent.

3. Sandy, calcareous beds about six feet in thickness. Where these beds outcrop in the fields, the surface of the ground is covered with nodules similar to the specimens sent herewith. These nodules

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.