greatest effect observable in the differences of the earth's magnetism?

Third: Are the sun-spots caused by clouds or curtains outside, and hiding the apparent surface of the sun, or are they deep cavities through the same? STEPHEN W. ALLEN

Boston, U.S.A., March 27

Metachromism

I REFRAIN from replying to Mr. Petrie's second letter (p. 426) until after the appearance of the article to which Mr. Costerus refers (p. 427) on "Organic Colour Change."

In defence of Miller, however, I would just add that on p. 298, vol. ii. (fifth edition), occur the following words:—"The sodic dioxide, Na_2O_2, obtained by igniting sodium in oxygen is of a *pure white colour*." WM. ACKROYD

Royal Coll. of Chemistry, South Ken'ington, April 3

Dr. Klein on the Small-pox of Sheep

I WRITE this note in order to inform you that, my attention having been directed to some alleged fallacies in some of my observations regarding the small-pox of sheep, I am at present engaged in reinvestigating the subject. E. KLEIN

The Brown Institution, April 11

OUR ASTRONOMICAL COLUMN

OLBERS' SUPPOSED VARIABLE STAR NEAR 53 VIRGINIS.—The only comet detected in the year 1796 was found by Olbers in Virgo on the night of March 31. On the following evening, at 8h. 55m., apparent time at Bremen, it was over a star of the seventh magnitude south—following 53 Virginis, and the light of the star was remarked to be little affected by the intervention of the comet. On March 1, 1797, desiring to fix more exactly the place of this star, Olbers found in its position one of only the tenth or eleventh magnitude, whereas in April previous, according to Schroeter, who appears to have compared the comet with it early on the morning of April 2, it was the brightest star in the immediate neighbourhood of 53 Virginis, and hence in Olbers' judgment "a seventh magnitude at least." Writing to Bode in March 1797 he directs attention to this star, as perhaps a more remarkable variable star than even χ Cygni. The circumstances preclude suspicion of a similar phenomenon to that described by Piazzi when the great comet of 1811 passed over his star XX. 197.

From the positions of the supposed variable, and its neighbours given by Olbers (who also appends a diagram), it is evident that his star, which followed 53 Virginis 30′ 55″ in R.A., 20′ 45″ to the south, is No. 12,728 of Oeltzen's Argelander, a star observed 1851, April 24, and noted of the eighth magnitude. For 1876·0 its place is in R.A. 13h. 7m. 32s., and N.P.D. 105° 53′·7.

Approximate mean places for 1797, March 1, of several stars with which Olbers compared the one in question were:—

	Olbers' Magnitude.	R.A.	N.P.D.
		° ′	° ′
(*c*)	9	194 40	106 6
(*a*)	7	194 44	105 24
(*d*)	11	196 15	105 11

The star (*c*) is Lalande 24,421, called by him $8\frac{1}{2}$; (*d*) is L. 24,597, noted 9; but the star (*a*) is not found either in Lalande or Argelander. Its position in Olbers' diagram corresponds to the place above assigned. What is its present magnitude, or is there some mistake about its position?

On April 1, 1796, the supposed variable was considerably brighter than the star (*a*), according to Olbers; in March 1797, much fainter than (*c*) and only slightly brighter than (*d*); he remarked no change in March, April, and May. Bode says, on April 24 and May 12 and 20 of the same year he saw it as a 9·10. In March 1855 it was fully eighth magnitude or 7·7.

THE APRIL METEORS.—As the moon will be absent during the nights of the 19th and 20th of the present month, a watch may be advantageously kept for meteors which are supposed to move in the path of the first comet of 1861 discovered by Mr. Thatcher, of New York, on April 4. At the descending node this comet makes a remarkably close approach to the earth's annual track, the definitive orbit calculated by Prof. Oppölzer, showing that at this point the distance between the two orbits is only 0·00232 of the earth's mean distance from the sun, or 214,000 miles; less, therefore, than the moon's mean distance from the earth. The elements are elliptical with a revolution of 415 years, and this form of orbit we may assume with much probability to have been occasioned by a near approach of the comet to the earth at some distant epoch. The descending node is passed $22\frac{1}{2}$ days before perihelion passage, and to bring the comet into closest possible proximity to our globe, it is necessary that the perihelion point should be passed on May 12. Had this been the case in 1861, the comet would have occupied the following positions on its descent towards the plane of the ecliptic:—

	R.A.	N.P.D.	Distance from earth.
	°	°	
March 24·0	269·2	57·4	0·700
April 1·0	270·3	57·0	0·494
„ 9·0	271·3	57·1	0·281
„ 17·0	285·2	59·4	0·065

The true dimensions of the orbit of this comet will be defined by the following numbers, which are in units of the earth's mean distance from the sun.

Semi-axis major	55·676
Semi-axis minor	10·083
Semi-parameter	1·826
Perihelion distance	0·921
Aphelion distance	110·430

PROF. HUXLEY'S LECTURES ON THE EVIDENCE AS TO THE ORIGIN OF EXISTING VERTEBRATE ANIMALS[1]

IV.

THE crocodiles form the highest group of existing reptiles; they are higher than lizards as a steam-vessel is higher than a sailing-ship; for, while built essentially on the same lines, and exhibiting altogether the same fundamental structure, they are in some respects peculiarly modified, and that always in the direction of greater complexity.

Besides the characters of the skull mentioned in the last lecture, they are distinguished from lizards by having a four-chambered heart, one in which the separation of the ventricle into two distinct cavities is completed, so that, in the heart itself, the blood from the lungs is kept separate from that returned from the body generally. A mixture, however, takes place subsequently, through an aperture between the two aortæ, one of which springs from each ventricle.

Crocodiles are found in Central America, India, Africa, and Australia. Of the many species, the greater number are short-snouted; the fish-eating Gavial of the Ganges, on the other hand, has an extremely long and narrow snout.

All the existing crocodiles are fresh-water or estuarine animals, but, fortunately, this was not the case with the ancient forms, many of which were exclusively marine, seeming, so to say, to take the place, in the sea of their own epoch, of our porpoises and dolphins.

Besides Tertiary species, crocodiles are found in the Chalk, Oolite, Lias, and Trias often in the best possible state of preservation; they therefore extend back to the very commencement of the Mesozoic epoch.

[1] A course of six lectures to working men, delivered in the theatre of the Royal School of Mines. Lecture IV., March 20. Continued from p. 430.

If we had specimens of all known forms of crocodiles, recent and extinct, and set to work to classify them according to their degrees of likeness and unlikeness, we should find that they naturally fell into three series.

In the first of these it would be found that the skull had all the characters mentioned at the end of the last lecture, the posterior nares being small apertures opening into the cavity of the mouth behind the pterygoid bones; the vertebræ would be concave in front and convex behind; the two bones composing the shoulder-girdle, the shoulder-blade or scapula and the coracoid, would be similar in shape, both being long and narrow; in the hip-girdle, the haunch-bone or ilium would be much cut away in front and excavated below, the ischium and pubis being both long blade-like bones; and there would be seven or eight longitudinal rows of bony plates on the back.

In the second set we should find the posterior nares to be much larger and placed farther forwards, immediately behind the palatine bones, the pterygoids not uniting as in the first group. The vertebræ would be slightly hollowed out at each end. In the shoulder and hip girdles there would be no important difference from the first group, with which also the more minute structure of the limbs would correspond closely. A difference would, however, be found in the fact of there being not more than two rows of plates on the back.

In the third series, we should notice certain very striking changes. The posterior nares would be actually as far forward as in a lizard; neither the palatine nor the pterygoids uniting in the floor of the mouth; the vertebræ would be completely amphicœlous or biconcave; the coracoid no longer long and narrow, but expanded and rounded like that of a lizard; the ilium more elongated and without the notch on its lower edge; and the ischium considerably broadened. As in the preceding group, the rows of bony plates on the back would not exceed two.

Thus we should find that the second group held an exactly intermediate place between the first and third, and that the third set, in every respect in which it differed from the normal crocodilian structure, approached to that of lizards.

It is a very interesting point to see how these three groups appear in time. We should find that in the first are included all the Recent and Tertiary forms, and that there are no indications of the type below the later Cretaceous.

The second group would be found to extend from the older Cretaceous down to the Lias; moreover, a careful examination would show that there were lesser modifications among the individual species of a very instructive nature; those from the Wealden, for instance, would be seen to have the posterior nares farther back (*i.e.*, nearer the typical crocodilian position) than those of the middle Mesozoic, and these again than those of the Lias.

The third group would contain exclusively Triassic forms, such as the dragon-like *Belodon* and the *Stagonolepis* of the Elgin sandstones. In this latter formation the fossils are in a very curious condition; after the sand accumulated round the bodies of the Triasssic animals had hardened, water, percolating through the porous rock, completely dissolved out the bones, leaving nothing but cavities. Thus we have only the remains of remains to deal with, but casts taken from the cavities enable us to make out, with perfect certainty, even important characters, although there may be hardly a bone left.

We see then, that our third set of forms is the oldest, our first the youngest, and the study of crocodilian remains seem to show that that has happened in the history of crocodiles, which should have happened, if the theory of evolution be true. Anatomical characters show that crocodiles are a modification of the lacertian type, and to this type the Triassic species, from which we are certainly justified in supposing that existing forms are descended, exhibit a marked approximation.

Still we are very far from knowing the whole story: it is certainly allowable to assume that our third group of crocodilian forms was evolved from a common stock with lizards, but this is as far as the facts of the case will take us at present.

There seems, at first sight, to be something unnatural in speaking of birds and reptiles together, for no two animals can be, to all appearance, more unlike. The wonderfully constructed feathers of the one group, compared with the scutes and scales of the other, the cold blood of the reptile contrasted with the hot fluid which circulates through the vessels of a bird and raises its body several degrees above our own in temperature; the dumbness and general sluggishness of the reptile as compared with the vocal powers and the rapid flight of birds; all these compel us to say, and justly so, that nothing can be more different than the character of the two classes.

Even when we go more into details, similar differences are apparent. The bird has a small head, set on a long flexible neck, and provided with a horny beak in lieu of teeth; its bones are hollow and full of air; its breast-bone, instead of being a small plate of cartilage, is a huge bony plate, usually provided with a large keel for the attachment of the powerful muscles of flight; the fore-limb is of no use in progression on the ground, and, the body having to be supported entirely by the hind limbs, the femora are placed parallel to the long axis of the body, instead of almost at right angles to it as in a reptile, so that the body is well raised from the ground, and a gait the very opposite of a reptile's sprawling waddle is the result.

The scapula and coracoid are not so very different from the corresponding bones in the lower class; the humerus, ulna, and radius, can also be perfectly well identified, but the modification of the distal division of the limb—the part answering to the reptile's fore-paw or to our own hand—is very great. First come two small bones answering to carpals, then three longer ones all united together, which represent the metacarpus, and are followed by the rudiments of the phalanges of the three corresponding digits. In the ostrich two of these three "fingers" are terminated by claws, the use of which it is rather hard to divine, unless the bird uses them for scratching itself, an operation in which a very large portion of the activity of the lower animals is taken up.

The haunch-bone, or ilium, is of enormous size, and extends a long way in front of, as well as behind, the acetabulum; in correspondence with this, a great number of vertebræ are fused together to form a sacrum of sufficient size for the attachment of the ilia and the support of the weight of the body. The ischium and pubis are long slender bones, and the latter, as well as the former, is bent back, so that they both come to lie nearly parallel with the vertebral column.

To allow of the femur taking up its position parallel with the axis of the body, its well-finished globular head is set on at right-angles to the shaft; moreover, its further end has a characteristic notch for the reception of the upper extremity of the fibula. The shin-bone is provided with a large and very characteristic crest for the attachment of the strong muscles of the anterior part of the thigh; its lower extremity is pulley-shaped, and, in a young bird, the pulley-like end, continued into a tongue of bone running up the back of the tibia, can be separated as a perfectly distinct ossification; its shaft also is so twisted that its two ends come to lie in different planes.

Following upon the tibia comes a bone with an easily separable piece at its upper end, and showing signs of a longitudinal division into three separate bones; this is the tarso-metatarsus, and represents the metatarsals and all the tarsals except one—the astragalus—which is represented by the pulley of the tibia. As a rule there are four toes, three of which are turned forwards and articulate with the tarso-metatarsus, while the fourth, the representative of our hallux or great toe, is turned backwards and articulates with a small distinct bone.

The heart has four perfectly distinct chambers, so that the pure blood from the lungs, and the impure blood from the rest of the body, are kept quite separate. There is a single aorta which turns to the right side after leaving the heart.

(*To be continued.*)

ON SAFETY MATCHES

THE fact has been known during some years past that the so-called safety matches, which are warranted to ignite "only on the box," can be fired by being rubbed on glass, and as Mr. Preece recently pointed out (NATURE, vol. xiii. p. 208), on ebonite. I find that they can be ignited by friction against ivory (I used an ivory paper-knife), steel (a steel spatula, somewhat worn), zinc, copper, marble with the polish worn off, and a freshly-cleaved surface of slate.

The match (or two matches together, for the sake of strength) should be held near the tipped end, and then be rubbed with strong friction, and with a long sweep upon the solid surface. From two to twelve such sweeps may be required before the match ignites, and the result seems to be due to the conversion of mechanical work into heat sufficient to fire the paste at the end of the match, which, I suppose, consists mainly of potassic chlorate and sulphide of antimony.

After a few rubs the match begins to crackle, and then suddenly bursts into flame. A similar result may be obtained by grinding the chlorate in a mortar with a little sulphur or sulphide.

The readiness with which the match ignites by friction depends greatly on the nature of the surface. Lead is too soft, and tin too smooth. The metals produced by rolling have a sort of skin on the surface, over which the match glides without sufficient friction, but if the surface of zinc be rubbed with sand-paper or with a fine file, it becomes active in firing the match. I noticed that the polish of my ivory paper-knife became worn before it acted well. Nor is it very easy to fire the match on glass. A long sweep repeated about a dozen times with considerable pressure seems to be necessary. The two specimens of sheet copper used by me have a sort of grain which is favourable to the success of the experiment. The copper acted equally well whether the surface was dirty or cleaned with dilute sulphuric acid. After rubbing a match ten or twelve times on zinc, without effect, the same match rubbed on copper immediately took fire.

In the case of slate, lead, tin, and some other surfaces, the composition on the match acts as a polish, and thus renders it unfit for ignition. On the other hand, a finely-cut file removes the composition from the end of the match without igniting it.

I have no doubt that many other surfaces might be found on which the safety matches would ignite with greater or less difficulty. Notwithstanding this, the match is still a safety match, although it does not comply with the conditions asserted twice over on the box. It does not ignite readily on any of the surfaces pointed out except copper and marble, but it does ignite with wonderful facility when rubbed against the side of the box, an invention so ingenious that a few words of its history may not be out of place here.

About the year 1850 a gentleman entered the laboratory of King's College, London, and drew from his waistcoat pocket a fragment of a rough-looking red solid, and, placing it in the hands of Prof. Miller, asked him if he knew what it was. It was handed round among those present, but no one had the slightest idea as to its nature, when, to the astonishment of every one, the gentleman said, "It is phosphorus—amorphous phosphorus, discovered by me, Herr Schrötter, of Vienna."

Up to this time, and indeed for some years later, persons engaged in the manufacture of lucifers were subject to a terrible disease, known in the London hospitals as "the jaw disease;" necrosis of the lower jaw induced by constantly inhaling the fumes of phosphorus acid escaping from the phosphorus of the paste with which the matches were tipped.

Ordinary matches made with phosphorus were, during many years, dangerous contrivances. They were luminous in the dark, liable to ignition on a warm mantelpiece, poisonous; children have been killed by using them as playthings; and, moreover, they absorbed moisture, and became useless by age.

But the chief inducement in getting rid of ordinary phosphorus and substituting the new variety was to put an end, as far as possible, to the jaw disease. The red, or amorphous phosphorus, gave off no fumes, had no smell, was not poisonous, and the matches made with it were not luminous in the dark; they did not fire on a warm mantelpiece, did not contract damp, and would keep for any length of time. A manufacturer, in 1851, sent me several samples of matches made with red phosphorus. I found some of these matches the other day, and they were as active, after twenty-five years, as at first.

But here was a difficulty. When the red phosphorus is brought into contact with potassic chlorate a slight touch is sufficient to produce an explosion, in which the red phosphorus reassumes its ordinary condition. Many attempts were made to form a paste, and many accidents and some deaths occurred in consequence. Prizes and rewards were offered by manufacturers and others for a safe paste, or for some means of using the red instead of the ordinary phosphorus, but without success, so that the patent for the manufacture of red phosphorus, which was secured by Mr. Albright, of Birmingham, in 1851, threatened to be of but little value.

At length the happy idea occurred to a Swedish manufacturer not to attempt to make a paste at all with the red phosphorus, but to make the consumer bring the essential ingredients together in the act of igniting the match.

Mr. Preece's suggestion that the ignition of the matches is due to electricity, may be dismissed in the face of the following experiment:—Place a few grains of red phosphorus on a hard surface together with some powder or a crystal of potassic chlorate, when a gentle tap will cause them to burst into a flame. C. TOMLINSON

NOTES FROM SIBERIA

THE following Siberian notes are furnished me by a Polish gentleman resident at Irkutsk. The dates mentioned follow the Old System, as in Russia, and are twelve days behind our own dates. The letter is dated the 10th of February. My informant says:—

"Some time ago Mr. Czckanofski returned from his second expedition to the most northern parts of Siberia by the Olensk River. He went as far as its mouth, and the extraordinarily warm autumn gave him the opportunity to make very interesting explorations. Till the month of September there was no frost nor snow, and the sea not frozen. The same is reported by Mr. Neumann, who returned lately from the Behring Strait. It may be that these exceptional climatical conditions allowed also Mr. Nordenskjöld's entering the mouth of the Jenessei. The exploration in the Achinsk country of a cavern situated now some thirty fathoms above the bed of the river gave to Mr. Tskersky[1] a fine collection of well-conserved fossils of extinct species. Mr. Tskersky occupies himself now with the description of the Tunka Alps, which he believes to be the former boundary of Lake Baikal, as he found there the fossils of the crab and

[1] The Curator of the Museum at Irkutsk.—G. F.