of Rosse, the Earl of Crawford and Balcarres, Drs. Wagner, Schjellerup, Ball, and Backlund, and Professors Klinkerfues and Bredicton. American astronomers have also done their full share; papers having been contributed by Dr. Peters, and Professors Pickering, Holden, Todd, Wright, and Stone. We express the hope that *Copernicus*, as a high-class journal for the publication of astronomical papers, may at some future time be re-issued under the same management as before.

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.*

'Illusive memory.'

THE subject presented in *Science* for March 7 (p. 274) under the above heading, by Mr. Osborn, if an obscure, is certainly an interesting problem in psychology. Its scientific treatment, however, will probably require a much wider range of investigation than that proposed by the writer. He has indicated 'two widely different theories' in explanation of the mental phenomenon: a third hypothesis appears to have escaped him.

Plato, as is well known, recognized this peculiar condition of the mind, and made use of it as an evidence of pre-existence, — a fancy embodied in the familiar lines of the poet: —

> "Our birth is but a sleep and a forgetting:
> The soul that rises with us, our life's Star,
> Hath had elsewhere its setting,
> And cometh from afar:
> Not in entire forgetfulness,
> And not in utter nakedness,
> But trailing clouds of glory, do we come."

If, now, we substitute for Plato's conception of an individual personal experience the more prosaic one of ancestral experience, we shall have, in brief, the third hypothesis, — the partial continuity of consciousness through genetic descent, instead of through metempsychosis or transmigration. From this aspect, the problem of the irreferable impressions of vague reminiscence would not fall under the class of *erinnerungs-täuschung*, or '*illusive memory*,' at all.

The modern reference of all the varied 'instincts' of animal life to the simple physiological datum of the heredity of a limited experience and memory, would naturally lead us to anticipate some such exhibition in the human race; nay, rather to wonder why we do not find such experiences much more pronounced and abundant. Notwithstanding the enormously greater expansiveness of cerebral action in man than in his lower fellow-creatures, the long-continued or reiterated impressions of a far-reaching ancestry would seem to justify the induction that 'intuitions' (so precious to the metaphysician) should be manifested in particular channels in a much stronger and more decisive form than we actually observe. Here, then, is a negative psychologic problem calling for explanation, and well deserving a careful comparative investigation.

To satisfactorily test this 'third hypothesis' is undoubtedly an extremely difficult undertaking, both by reason of the usual 'haziness' of these Platonic reminiscences, and of the rare opportunities of authentic verification of special parental or aval recollections. The question, however, is one of such biologic importance, that it merits an even laborious research; and, if in only one or two instances a clear evidence of such transmitted memory in man could be established, it would justify the inference that many similar cases are referable to the same principle.

The inquiry should include the antecedent experiences of grand-parents as well as of parents: since there is reason to believe that aval heredity is *relatively* more frequent than direct parental heredity; or, in other words, that there is a tendency to 'alternate generation' running through the animal kingdom.

Washington, March 13. W. B. T.

'The oldest living type of Vertebrata,' Chlamydoselachus.

In *Science*, No. 57, p. 275, my friend, Professor Cope, falls into the error of placing among the species of the genus Diplodus Ag. (re-named Didymodus by Cope) the 'peculiar selachian' recently discovered, and described by me in these columns. With the specimen before him, he would be the last man to make such a mistake. And no doubt he will thank you for giving the space necessary to a correction.

The most important of the characters on which the genus Diplodus was founded by Agassiz (1843, Poissons fossiles, iii., pp. 204, 209), that by which it is separated from Hybodus, Sphenonchus, and Cladodus, is a greater development of the secondary cones of the teeth, while the median cone remains rudimentary or comparatively undeveloped. This is not the case with Chlamydoselachus: it is not the secondary, but the median, cone in which is found the greatest development; agreeing in this respect with Agassiz' genera Hybodus, Sphenonchus, and Cladodus, in which "le cône médian l'emporte sensiblement sur les cônes latéraux, et se développe en quelque sorte à leur détriment." In the teeth of Chlamydoselachus, the cone at either side of the median is a mere rudiment. If the new selachian was to have been placed in either of the fossil genera mentioned, it should have been Cladodus. Mr. Cope says of Didymodus, 'The species possess two, three, or four denticles.' Of course, a second thought will increase the number so as to include Chlamydoselachus, which has more than four.

The propriety of placing living species in fossil genera of so long ago on account of resemblances in a single organ, such as a tooth only of a selachian, is to be questioned. The teeth do not give satisfactory clews to structure and shape of other organs, or of the body itself, in the majority of the sharks and skates. This is evident enough on comparison of the teeth of Carcharias, Alopias, Zygaena, Squatina, Torpedo, Scyllium, Raja, Triakis, Disceus, Mustelus, Trygon, Pristis, Potamotrygon, Rhinobatus, Dicerobatus, and others. It would be hardly worth the while to separate recent genera by the number and position of fins, or shape of body, and then make them equal to the same fossil genus on account of some similarity in teeth. Material in my possession will enable me, as soon as the necessary drawings can be made, to prove conclusively that Chlamydoselachus does not belong to the genus Didymodus of Cope (= Diplodus Ag.), and that it was hardly safe to announce Didymodus as the 'oldest living type of Vertebrata' until more was known about Chlamydoselachus. S. GARMAN.

Cambridge, March 17.

The 'shark recently discovered in Japanese waters,' described by Mr. Garman as Chlamydoselachus anguineus (in *Science* for Feb. 1, vol. iii. pp. 116, 117; *Bull. Essex inst.*, vol. xvi.), as its describer has remarked, "is a form of more than ordinary interest on account of the respects in which it differs from the majority of its kindred." It not only appears as a new element in selachology, and becomes the representative of a hitherto unknown type, but it throws light on the ancestry and some of the extinct forms of the class; and, still further, it may serve as a guide for the interpretation of certain of the tales of the sea-serpent.

In respect to its place in the system, I perfectly agree with Mr. Garman, that it is the representative of a very distinct family (Chlamydoselachidae): I am also of the opinion that it may be regarded as the type of a distinct sub-order at least. Mr. Garman, in *Science*, was "inclined to consider this the type of a new *order*, to which the name Selachophichthyoidi might be given;" but in his article in the Essex bulletin he is entirely silent on the subject of the major relations of the new type. The name, having been thus never defined, and being objectionable on account of its length and cacophony, might be replaced by a shorter one, like Pternodonta; but on this I shall not insist. A more important question is, What is the status of the selachian in classification? Mr. Garman thinks that 'it stands nearer the true fishes than do the sharks proper.' I do not know how he would express this idea in a linear arrangement, but most would do so by placing it immediately between the selachians and fishes. I am also disposed to consider Chlamydoselachus to stand 'nearer the true fishes than do the sharks proper,' not because it appears to be in the line of descent *between* the two, but because it is nearer the primitive line from which both types have diverged. Judging from Mr. Garman's remarks in the two articles referred to, I presume there would be essential concordance between us as to this point.

As to the relations of Chlamydoselachus to extinct types, however, I must dissent from Mr. Garman. Fortunately, an article throwing light on the affinity of Cladodus has been published recently, — probably too recently to be available to Mr. Garman. I refer to Dr. R. H. Traquair's communication 'on a new fossil shark,' in the *Geological magazine* for January, 1884 (decade 3, vol. i. pp. 3–8, pl. 2). Dr. Traquair has therein made known the form of the cladodont selachians, and proved beyond doubt that the cladodont dentition and ctenacanthoid spines co-existed in the same fish. The 'new shark' in which these parts were coincident has been named Ctenacanthus costellatus. In the words of Dr. Traquair, "accepting the fish just described as a new species of Ctenacanthus, it yields us the following important facts regarding the genus: —

"1. The shape of the animal was moderately elongated, with blunt snout and heterocercal tail. 2. The skin was covered with shagreen granules, mostly of an ornate, ridged, pectinate character. 3. There were two dorsal fins, each with a spine, that of the first being the longer. There were no paired spines, and the ventral fin was opposite the second dorsal. The presence of an anal fin is doubtful. 4. The dentition was cladodont. 5. The vertebral axis was unsegmented, but there were extensive calcifications in connection with other parts of the skeleton."

It is obvious from this summary, that Cladodus was not at all related to Chlamydoselachus; and I may add, that it did not have the essential dentition of Chlamydoselachus, so well indicated by Mr. Garman in the statement that "each tooth has three slender, curved, inward-directed cusps, and *a broad base . . . preventing reversion.*"

But, as Professor Cope has claimed (*Science*, vol. iii. p. 275), Chlamydoselachus did have a representative in the carboniferous genus Diplodus, or Didymodus; although I do not think that the two can be congeneric. In fine, the recent discoveries by Messrs. Garman and Traquair enable us to co-ordinate a number of extinct types, and compel us, I think, to add two sub-orders or orders to the list of those necessary for the long-known living forms. The living sharks I have proposed (in Jordan and Gilbert's Synopsis of the fishes of North America, p. 967) to distribute among four sub-orders; of which the Opistharthri or Notidanidae are the most generalized, and the Rhinae or Squatinidae the most specialized. The two additional sub-orders appear to be still more generalized than the Notidanidae, and the sequence would therefore be as follows: —

1. Lipospondyli, including selachians without developed vertebrae, but with a persistent notochord, and comprising the family Hybodontidae (Hybodus, Cladodus, Ctenacanthus, etc.).
2. Pternodonta or Selachophichthyoidi, including Squali with vertebral condition unknown, and with teeth having fixed bases, comprising the family Chlamydoselachidae (Chlamydoselachus and Didymodus).
3. Opistharthri or Cyclospondyli.
4. Proarthri (Heterodontidae).
5. Anarthri (most living sharks).
6. Rhinae.

It is by no means certain that the hybodontids are Squali at all, and they may prove to be more nearly related to the Holocephali. The plate of Dr. Traquair's memoir delineates very plainly one external branchial aperture, and one only; and the condition of the vertebral column and dorsal spines are features in which there is greater resemblance to the Holocephali than to the Plagiostomes. The primitive form from which the two diverged must theoretically have been not unlike the new Ctenacanthus, and it is quite possible that in the hybodonts we may have one of the 'missing links' between the two groups.

I had intended to refer to certain of the 'sea-serpents' which might be correlated with Chlamydoselachus; such as the Maine animal noted recently in the *Proc. U. S. nat. mus.*, the animal seen by Capt. Hope about 1848, and the selachian found in 1808, and partially described by Dr. Barclay, but must defer a notice to a future time. THEO. GILL.

Evidence of unrecorded tornadoes.

There is evidence in the forests of Pennsylvania that many localities have been visited by tornadoes of which no accounts have ever been recorded. The places referred to are called 'windfalls;' the timber having been prostrated apparently by violent storms of wind, while the trees immediately adjoining remain erect and undisturbed. Sometimes, instead of forming a path through the forest, the tornado has descended, and quickly ascended into the air, leaving its marks on a small area. Judging by the remains of the timber-trees thrown down, these events were of all ages, and of various degrees of violence. Sometimes the fallen timber was found sufficiently sound, after the first settlement of the country, to be worth manufacturing into lumber; in other cases, being older or more shattered, it was worthless; while in others it has entirely decayed and disappeared, the ground being covered with a later growth of a smaller and different kind, and the sur-