mass of plants would be so great that the new leaves budded out would find no room in which to expand; but, by virtue of one very simple provision, viz. the existence of inequalities of level along the edges of the leaves, clear spaces and lanes are left between the floating leaves, so long as any unoccupied space remains.

Long exposure to the air, especially in still weather, affects the life of duckweed in a material way. Dust and decaying organic substances give rise to a pellicle, which is most mischievous to floating plants; and I think I could show, if time allowed, how much the habits of duckweed have been altered thereby. But, apart from visible impurities, mere exposure to air gives, as Lord Rayleigh has taught us, a considerable degree of superficial viscosity to water. Hence, the leaves of duckweed, when the surface is contaminated, will tend to lie in whatever positions they may be thrown by accidental causes, such as wind, and the attractions due to capillarity will be more or less impeded. But the effect of the superficial viscosity will in time be overcome by the attractive forces, so that it probably does not in the long run greatly affect the distribution of the leaves over the surface of water.

Many other floating plants, but not all, behave more or less like duckweed, and for the same reason. As yet I know of none which space themselves quite so effectually, and the extreme abundance of the common duckweed, as well as its world-wide distribution, may be partly due to the completeness of its adaptation to capillary forces. Some dead objects may accidentally take a shape which causes them to spread out over water, but I have met with none which have particularly struck me. Floating natural objects, such as sticks or seeds, behave, in many cases at least, very differently, and become densely massed. My attention was first called to this subject by seeing how different was the grouping of duckweed from that of some seeds of *Potamogeton natans*, which were floating in the same pond.

The capillary forces which spread the leaves of duckweed or Azolla upon the surface of water are indirectly concerned in the transport of these and like plants to fresh sites. If we put a stick into water overspread with duckweed, we cannot fail to notice how the leaves cling to the stick. They cling in a particular way, which enables them to bear transport more safely. The wetted surface, for obvious physical reasons, is attracted to the wetted stick; and the water-repellent surface, which is that which best resists drying, is outwards. The tenacity with which duckweed clings to the legs of water-birds, and the position which it almost inevitably takes under such circumstances, may have a good deal to do with the safe transport of the plant to distant pools. It is not, I think, too much to say that the prosperity of duckweed depends very largely upon the capillary forces which come into play at the surface of water.

We have now exhausted our time, though I have been obliged to leave unnoticed many special adaptations of living things to the peculiar conditions which obtain on the surface of water. Had time allowed, I should have been glad to say something about the aquatic animals which creep on the surface-film as on a ceiling, and about the insects which run and even leap upon the surface-film without wetting their minute and hairy bodies.[1] All small animals and plants which float on water necessarily come into contact with the surface-film, and have to deal with the difficulties which result from it. We have seen that they generally manage in the long run to convert these natural difficulties into positive advantages.

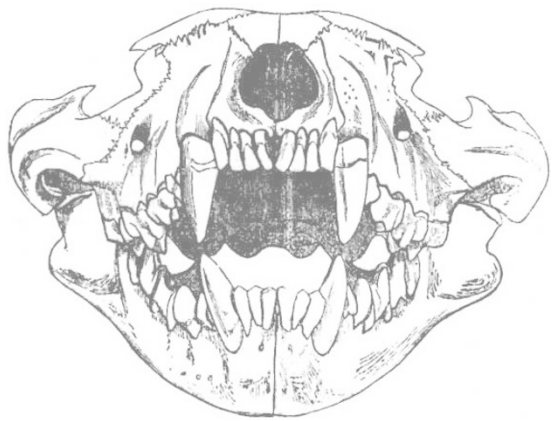
I have to thank my colleague, Dr. Stroud, for his frequent explanations of the physical principles upon which these adaptations depend, and also for much practical and valuable help in the preparation of suitable experiments.

[1] See NATURE, vol. xliv. p. 457.

THE DISCOVERY OF AUSTRALIAN-LIKE MAMMALS IN SOUTH AMERICA.

THE year 1891 proved a notable one in regard to marsupials. The existing mole-like marsupial (*Notoryctes*) from the deserts of Central Australia having been made known to us, news came of the discovery in the Tertiaries of Patagonia of remains of carnivorous marsupials closely allied to the existing pouched wolf, or Thylacine, of Tasmania. This discovery was immediately recognized as one likely to considerably modify some of our views regarding the distribution of mammals. A preliminary account of these new marsupials was given by Dr. Florentino Ameghino in a paper written for the new serial, *Revist. Argent. Hist. Nat.* This description seems to leave no doubt as to the correctness of the diagnosis of the fossil remains.

Before going further, it may be well to remind our readers that, with the single exception of the opossums (*Didelphyidæ*) of America, all marsupials are now exclusively Australasian. The carnivorous types, such as the Thylacine (*Thylacinus*) and the Tasmanian Devil (*Sarcophilus*), are distinguished from all living mammals in that their upper cutting-teeth (incisors) are either four or five in number on either side, while in the lower jaw there are invariably three. This relation is shown in the figure of the skull of the Tasmanian Devil—a near ally of the Thylacine—where, between the large tusks of the upper jaw, we see the four pairs of incisors opposed to only three pairs in the lower jaw. In ordinary mammals, on the other hand, the number of pairs of incisors in each jaw does not exceed three, the number of those in the two jaws being usually equal. A further peculiarity of marsupials is that the cheek or grinding teeth comprise four true molars and not more than three premolars; whereas in ordinary mammals the typical number is three molars and four premolars, there being no known instance of the presence of four true molars except in some individuals of the fox-like *Otocyon*. Another peculiarity of most marsupials is the distinct inflection of the lower posterior extremity, or "angle," of the lower jaw, while very frequently the bony palate of the skull has unossified spaces.



Front view of the skull of the Tasmanian Devil. (After Flower.)

The new forms described by Dr. Ameghino were obtained from the lower part of that great series of freshwater formations with which so large an area of South America is covered. It has been inferred that the Patagonian deposits in question are as old as the Lower Eocene of Europe; but, although they are undoubtedly of considerable age, this inference can scarcely be regarded as an established

fact, since the occurrence of mammals allied to those of the European Lower Eocene is quite capable of explanation by their survival to a later period in South America.

One of the new Patagonian forms, to which Dr. Ameghino applies the name *Prothylacinus*, is stated to be an animal of the general conformation of the Thylacine, having apparently the same number of teeth, although the upper incisors are unknown. The main distinction of the fossil genus is, indeed, said to consist merely in the circumstance that the lower premolars are more widely separated from one another; the molars of the two forms being described as absolutely identical in character. The fossil likewise exhibits the marsupial inflection of the angle of the lower jaw. The absence of the upper incisors in the specimens of *Prothylacinus* is fortunately compensated in another genus described under the uncouth name of *Protoproviverra*. Here we find that the number of teeth is exactly the same as in the Thylacine, there being four upper and three lower incisors, a canine, three premolars, and four molars on each side of the skull. This dentition agrees numerically with that of the Tasmanian Devil; with the exception that there is an additional premolar in each jaw. These fossils also exhibit the inflection of the angle of the mandible, and the presence of unossified vacuities in the palate, which we have seen to be marsupial features.

As might have been expected to be the case, Dr. Ameghino also states that there appears to be a complete passage from these marsupial forms to others belonging to that group of primitive carnivores known as Creodonts, of which the European Upper Eocene *Hyænodon* and *Pterodon* are well-known examples. Now, if we are to trust these descriptions (and there appears every reason why we should), we must admit that *Prothylacinus* and *Protoproviverra* are veritable marsupials of an Australian type. Then comes the question, How are we to explain the occurrence of such closely allied forms in areas so remote from one another as Patagonia and Australia?

It had long ago been urged that the occurrence of carnivorous marsupials in South America and Australia and nowhere else (at the present time) indicated a former connection between those two areas. To this, however, Mr. Wallace ("Distribution of Animals," vol. i. p. 399) objected that the American opossums (*Didelphyidæ*) were not an Australian type, and that they occurred in the Tertiaries of Europe; and hence he argued that both the American and Australian marsupials probably took their origin from the presumed marsupials of the European Jurassic rocks. This explanation, on Mr. Wallace's own showing, will not, however, hold good for the close resemblance stated to exist between the American *Prothylacinus* and the Tasmanian Thylacine, since it is quite impossible to believe that two such similar forms could have maintained their likeness in such remote regions after having diverged from a common European ancestor as far back as the Jurassic period.

It has, however, been long known that there are certain very remarkable relationships between the fauna and flora of all the great southern continents. For instance, among mammals, the rodent family *Octodontidæ* is peculiar to South (including Central) America and Ethiopian Africa. Then, again, among fishes, the family of the *Chromidæ* is confined to the rivers of South America and Africa, with one outlying genus in India; while the true mud-fishes (*Lepidosiren* and *Protopterus*) are solely South American and Ethiopian, the third representative of the same family being the Baramunda (*Neoceratodus*) of Queensland. Again, the connection between the flora of Africa and that of Western Australia is so intimate as to have induced Mr. Wallace (*op. cit.*, p. 287) to express his belief that there must have been some kind of land connection, although not necessarily a continuous one, between these two widely distant areas.

The connection between the fauna of India and that of Ethiopian Africa is now too well known to stand in need of comment. The matter does not, however, end here; for if we go back to the Mesozoic epoch there are equally striking evidences of the connection between the faunas and floras of the southern continents. For instance, the extinct saurian genus *Mesosternum*, which appears to have been allied to the Plesiosaurs of the Lias, is known from early Secondary strata in Brazil and South Africa, and nowhere else. Then, again, the remarkable Anomodont reptiles (*Dicynodon*, &c.) of South Africa are closely connected with those of India; while the respective alliances between the Labyrinthodont amphibians and the Mesozoic floras of South Africa, India, and Australia are too well known to need more than mention.

It appears, then, that, altogether apart from the new discovery, the common factors connecting the faunas and floras of the four great southern prolongations of the continental land of the globe undoubtedly point, not only to a more or less intimate connection between these several areas, but also to their more or less partial isolation from the more northern lands.

Reverting to the new discovery, it may be observed that our comparatively intimate acquaintance with the Tertiary faunas of Europe and North America renders it in the highest degree improbable that marsupials of an Australian type lived during that time in either of those areas. It is, however, quite possible that they may turn up at any time in Tertiary formations in Africa, while there is nothing to show that they may not also have existed in peninsular India. Indeed, if we put aside as improbable any connection by way of the Pacific between South America and Australia, it seems impossible to give any explanation of the occurrence of allied marsupials in Patagonia and Australia without the assumption that their ancestors existed in some part of the great area lying between eastern South America and Western Australia.

R. LYDEKKER.

PHOTOGRAPHY IN COLOURS.

THE *Comptes rendus* for February 2, 1891, contained a brief note on colour photography, describing the method employed by M. G. Lippmann, who had been able to produce photographically the image of the spectrum with all its colours. A summary of this note was given in NATURE at the time (see vol. xlviii., p. 360).

M. G. Lippmann, who has been continuing his researches, has communicated further results, which appear in the *Comptes rendus* for April 25 (No. 17, vol. cxiv.). These results show that we are not far off the solution of a question which has been the aim of all the latest photographic researches. The following is a translation of the note in question:—

In the first communication which I had the honour to make to the Academy on this subject, I stated that the sensitive films that I then employed failed in sensitiveness and isochromatism, and that these defects were the chief obstacle to the general application of the method that I had suggested. Since then I have succeeded in improving the sensitive film, and, although much still remains to be done, the new results are sufficiently encouraging to permit me to place them before the Academy.

On the albumen-bromide of silver films rendered orthochromatic by azalin and cyanin, I have obtained very brilliant photographs of spectra. All the colours appear at once, even the red, without the interposition of coloured screens, and after an exposure varying from five to thirty seconds.