plasmic investments of the young spores have not been previously described. The cytoplasm of this form is very delicate, and very susceptible to adverse fixation; this must account for the disappearance of the cytoplasmic envelope in the fixed material from which most of the previous work has been done, as it would have been impossible, otherwise, to overlook such conspicuous structures. S. D. King.

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### Dispersal of Butterflies and other Insects.

The letter of Mr. Robert Adkin in the issue of Nature of September 26, on the vertical upward flight of moths from the Downs near Walmer, supplies one of the desiderata required to confirm the view indicated in Mr. Felt's article in Nature of September 5 that the upper air-currents may play an important part in the distribution of flying insects. I have myself long expected that the dispersal of insects would ultimately attract the attention of the meteorologist, and Dr. Simpson's British Association address, which immediately precedes Mr. Felt's article, reads appositely beside Mr. Felt's appeal for the aid of convectional currents arising from heated surfaces in assisting insects to gain the upper air-strata. But in this connexion we must not forget that mountaineers have long exercised their brains over the problem of insects on high mountain tops. Whymper in particular, in his work on the equatorial Andes, dealt with this subject, and he quotes Humboldt and Bonpland as showing that insects are transported into the upper regions of the atmosphere (16,000 to 19,000 feet), and adds that the transportation of insects by ascending air-currents has occasionally been observed in operation. One such set of observations is noted by Mr. Felt when he writes, " Collectors on some of the high mountains, such as Mount Washington, have taken insects which are distinctly southern or south-western in habitat, probably carried there by the upper air-currents and dropped upon these cooler mountain tops."

After reading about the recent developments of our knowledge of the upper air-strata, I am inclined more and more to regard the trans-oceanic distribution of insects as carried out mainly in the upper air. My difficulty would be in assuming that insects are hardy enough to withstand the strain of upper-air conditions. When I was camped out on the top of Mauna Loa (13,600 feet) in Hawaii in 1897, this aspect of the question was brought home to me in a striking fashion. The lava rock and beds of cinders outside my tent were strewn with butterfly wings cast off by butterflies which had been brought by the trade-wind current up the mountain slopes from the forests below. The air was intensely dry and extremely electrical, producing distressing physiological effects, which, together with the freezing up of everything liquid in my tent, made life for a man scarcely bearable. To these conditions all the butterflies succumbed that reached the top of Mauna Loa.[1] There their wings lay around me in their hundreds. Mr. Felt should in this experience of mine find the greatest difficulty in accepting the 2000-mile air-trip postulated for Californian insects in reaching the Hawaiian Islands, and perhaps the meteorologist would decline taking on his shoulders the responsibility of Insect Distribution in the upper air.

Mr. Felt suggests the possibility of there being sometimes a condensation of insect life at particular levels, due to atmospheric disturbances, and that their instinctive efforts to save themselves may result in the great invasions of insects noticed in different localities. This seems likely enough. Perhaps some air-man on the wing at high altitudes has flown through a bank of insects in the clouds, held there by unfavourable conditions in the air-strata above and below.

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[1] My observations on Mauna Loa were given in my book on "Plant Dispersal in the Pacific" (1906), and were alluded to in Nature towards the close of 1897 (vol. 57, p. 20).

### Locomotion of the Sunfish.

The mode of swimming of the sunfish (Mola), which I have had many opportunities of observing at close quarters, is unusual, perhaps unique, but easy to comprehend as compared with that of other fishes. The long dorsal and ventral fins are stiffened on their anterior and flexible on their posterior edges, like the wings of insects. The action of great masses of muscle at their bases causes them to strike the water laterally, first to the right and then to the left, the two fins striking simultaneously towards the same side like wings, but in a horizontal instead of a vertical direction (Fig. 1, B). Owing to the differences

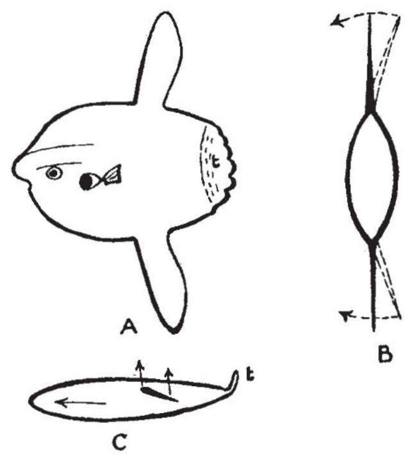


Fig. 1.—A, side view of Mola; B, transverse section in region of fins; C, diagram of Mola seen from above with fins striking to the right.

of flexibility over the surfaces of the fins, their planes are twisted in the act of striking so as to give a forward thrust (Fig. 1, C). Of course, since they strike sideways, there is also a lateral thrust, but this is correlated with the flattened shape of the body, which, acting like the keel of a sailing boat, resists lateral displacement.

The body of the fish is rigid except for the " tail " (*t* in figures), which acts exactly like the rudder of a ship. Fig. 1, C, shows it hard a'port; I have seen it held over like this as the fish turned in a large circle to the right. Since the backwash from the fins does not strike the rudder, one would expect the sunfish to resemble a paddle steamer (as opposed to a screw steamer) in not being able to turn before getting a fair amount of headway on. It is perhaps to provide an auxiliary steering apparatus that the respiratory arrangements are modified so that a very powerful jet of water can be squirted backwards from under either gill cover at will.

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