Protodrilus appears to inhabit only the European seas,[1] having been taken in the Black Sea, the Mediterranean, at Heligoland in the North Sea, and at Ambleteuse, on the French side of the Straits of Dover. Protodrilus was found on March 2 in a small bay just outside and to the east of Plymouth Sound. On March 11 the spot was again visited, and a large number of specimens, more than a hundred, gathered in about an hour. The animals were found almost at the high-water mark among stones and gravel at a point where a small stream of fresh water runs into the sea.

It is an interesting fact that the animals are immersed at one period in practically fresh water, and at another period in sea water; samples of the water in which the animals were living taken at low water during the neap and spring tides were found to have densities as indicated by a hydrometer of about 1·001 and 1·009 respectively; while the density of a sample of sea water taken just outside the breakwater at Plymouth, estimated by the same instrument, was found to be about 1·025.[2]

These specimens of Protodrilus are undoubtedly different from those previously taken at Ambleteuse and Heligoland, but they resemble in some characters both the Mediterranean forms, *Protodrilus flavocapitatus*, Uljanin, and *Protodrilus spongioides*, Pierantoni. The former of these species occurs in situations which are never covered by more than a few decimetres of water, while the latter is represented by only four specimens taken from fresh water. A fuller investigation of the English specimens is being undertaken in order to compare them in more detail with the known species of this genus.

The English Protodrilus were living in the situation described above along with *Gammarus marinus*, an Oligochæte and *Gunda* (*Procerodes*) *ulvae*; the latter of these species was first taken in this spot in great numbers two years ago, and does not appear to have been recorded previously on the English coast.

J. H. ORTON.

The Laboratory, Citadel Hill, Plymouth.

[1] U. Pierantoni, "Fauna und Flora des Golfes von Neapel." Vol. xxxi. Protodrilus. 1908.

[2] These values of density were made at temperatures between 15° and 17° C., and are to be regarded as approximations only to the absolute density: as the water in which the Protodrilus were living would be constantly changing, it was not considered worth while to analyse accurately two random samples.

On the Gain of Definition obtained by Moving a Telescope.

THE following is an account of a very singular fact which came recently under my notice, and for the explanation of which I am absolutely at a loss.

I am in the habit of rating my chronometer by means of the time-ball dropped at the Greenwich Royal Observatory, about $3\frac{1}{8}$ miles away, a signal which I observe in a small hand telescope.

On March 11, the weather being misty, I failed to pick the signal post, although I knew exactly where it was, and had placed the telescope exactly in the right direction. I moved the telescope a little, thinking I had displaced it in putting my eye to the eyepiece, and I immediately saw, very dimly, the dome of the observatory, and the signal, with the ball at half-mast, and noticed that *they were in the centre of the field all the time.* As soon as I steadied the telescope, however, they vanished completely. They reappeared as soon as I began to "sweep" for them, but remained discernible only while the motion lasted. I repeated the experiment several times; the signal was really invisible while the telescope was fixed, but by imparting to it a slow oscillation right and left I kept the signal in view with sufficient distinctness to see the ball drop, although I was not certain it had really dropped until a second or so afterwards, owing to the great faintness of the image observed.

I recollected then that, often, in similar conditions of seeing, having picked the signal without any difficulty *while "sweeping" for it.* I had failed to see it afterwards, and gave up the attempt, thinking I had been mistaken, or that the mist had become thicker. I have therefore no doubt as to this most curious and inexplicable fact: an indistinct object is better seen in a slowly moving telescope than in the same telescope when kept steady. There must be a very interesting physiological property of the eye involved in producing this result, which is quite in opposition with what one would naturally expect. Perhaps some of your readers have noticed something similar, and could throw a little light on this mysterious phenomenon.

M. E. J. GHEURY.

Woolwich Polytechnic, March 15.

Four-horned Sheep.

MR. RITCHIE's note on four-horned sheep in NATURE of March 6 is interesting, but I am inclined to doubt whether there ever was, in Scotland or any other country, a breed in which four horns are normal. No doubt it is possible to fix this character in the male sex by careful selection, as has been done by some breeders of the spotted or Barbary sheep (sometimes called Spanish, Syrian, or Zulu sheep); but even these have not succeeded in fixing the character in the female sex. I have evidence, in the shape of specimens or photographs, of the existence of four-horned sheep in North and South Africa, Mongolia, China, the Himalayas, Baluchistan, and Chile. The Iceland breed was supposed to be four-horned, and no doubt four-horned examples were often found amongst them, a specimen I have being precisely similar in type to an abnormally four-horned Shetland.

My own experience of four-horned rams is that in most cases the lower horns, and in some cases the upper also, require to be cut at some time in their life to prevent them from growing into the cheek, or below the jaw, so that the animal cannot graze; and this no doubt would have a tendency to eliminate the four-horned rams where not specially selected. No instance is on record, so far as I know, of any wild sheep having more than two horns, neither have I seen any skull of domestic sheep in which there were more than four horn-cores, though five-, six-, and even eight-horned sheep have been recorded.

H. J. ELWES.

Colesborne Park, near Cheltenham, March 14.

THE EXPERIMENTAL STUDY OF FLUID MOTION.[1]

MANY attempts have been made to study the motion of fluids past an obstacle by experimental methods, and experiments made for this purpose may be divided roughly into two classes:

(*a*) Those in which the fluid is made to flow

[1] The figures which accompany this article are from the Technical Report of the Advisory Committee for Aëronautics for the year 1911–12, and are reproduced with the permission of the Controller of H.M. Stationery Office.

©1913 Nature Publishing Group

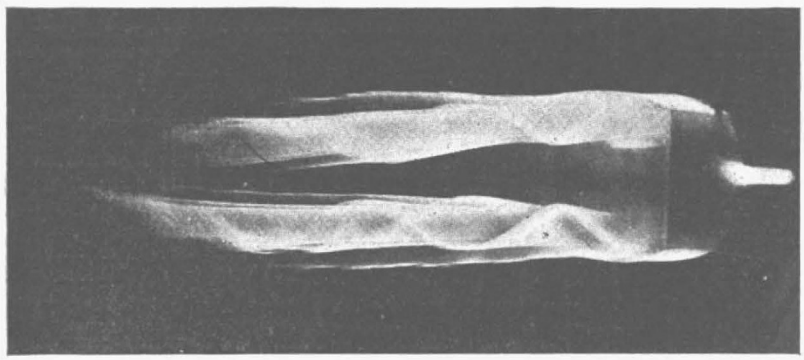

FIG. 1.—Low velocity type of flow. Air.

through a channel past a model which is fixed in the channel.

(*b*) Those in which the fluid is at rest in the channel, the model being moved relatively to the fluid and channel.

In both methods great difficulties are met with if the velocity of flow be high, owing to the rapid movements of the fluid, but in the first method the fact that in a channel the flow becomes turbulent when the critical velocity is reached

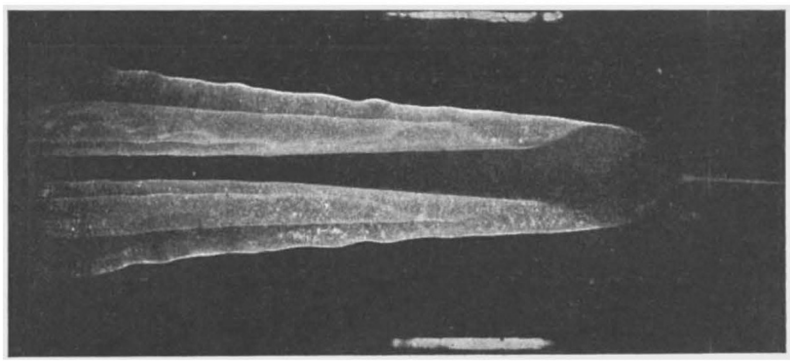

FIG. 3.—Low velocity type of flow. Water.

FIG. 2.—High velocity type of flow. Air.

makes observation at high velocities almost impossible.

During the past two years a research on fluid motion has been in progress at the National Physical Laboratory, and a brief description of some of the experiments which have been described in the report of the Advisory Committee for Aëronautics may be of interest.

The Teddington experiments have all been made in the "flowing fluid" type of channel, the flow in both air and water being studied at velocities below the critical velocities of the channels used.

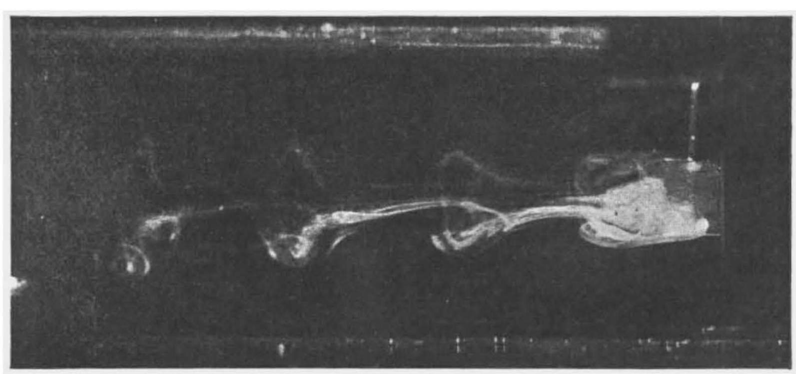

FIG. 4.—High velocity type f flow. Water.

A number of methods for indicating the direction of motion of the fluids have been tried, and, up to the present time, the best results have been obtained:

1. *In air*, by allowing tobacco smoke to issue from a jet at the velocity of the surrounding air stream, on the upstream side of the model under investigation.

2. *In water:*

(*a*) By coating the model with condensed milk, which is washed off into the eddying regions, making visible the movements of the fluid in those regions.

(*b*) By introducing minute particles of oil (aniline and toluene) of the same density as the surrounding water, the direction of motion of these particles being recorded photo-

©1913 Nature Publishing Group

graphically. It should be noted that these photographs, which are short-time exposures, indicate not only the direction of motion in any region, but also the velocity of motion, which is obtained from measurement of the length of the lines, comparison being made with the length of the lines in the open channel where the velocity is known.

Some examples of the results obtained are shown in the accompanying photographs, which are taken from the report of the Advisory Committee for Aeronautics, 1911–12.

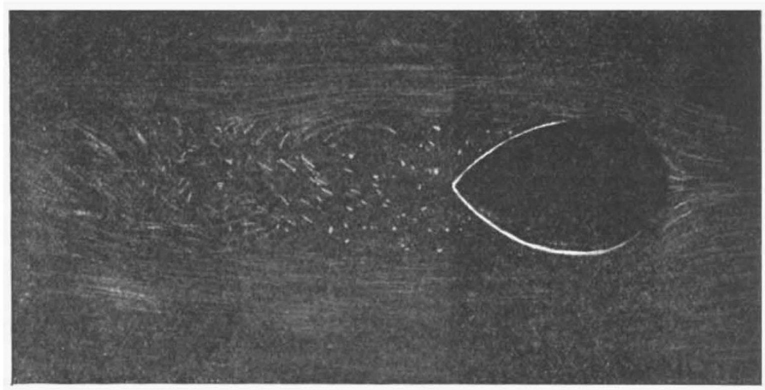

Fig. 7.—De Havilland str

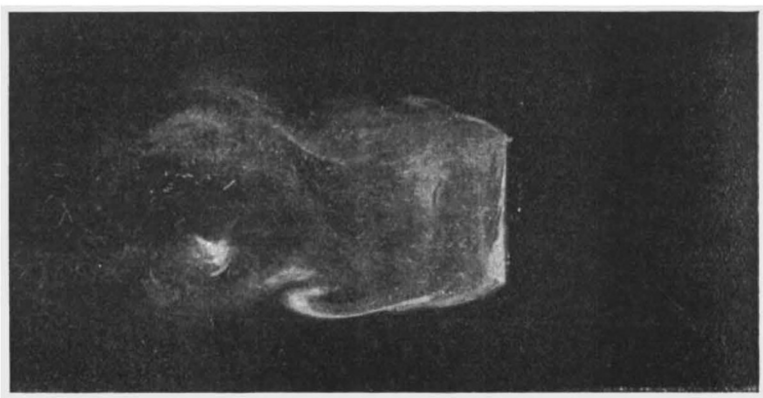

Fig. 5.—Flat p ate.

Figs. 1 and 2 show the flow past an inclined square plate in air at two different velocities (by method 1). Figs. 3 and 4 show the same types of flow in water (by method 2 [*a*]). Figs. 5 and 6 show the flow past a plate in water (by methods 2 [*a*] and [*b*]). Fig 7 shows the flow past a strut in water (by method 2 [*b*]). Fig. 8 shows the dead region which exists, even at low velocities, at the tail of an airship model.

The last figure is of some interest, as it has been found that where a dead region exists at the tail of a fish-form model, the resistance of the model is not appreciably affected by the shape of the tail within this region, and so long as the tail is sufficiently blunt to cause the formation of "dead air" (as is usually the case in airships, aëroplane hulls, struts, etc.) it is convenient for constructional reasons to end the tail rather abruptly once the boundary of the dead region has been passed.

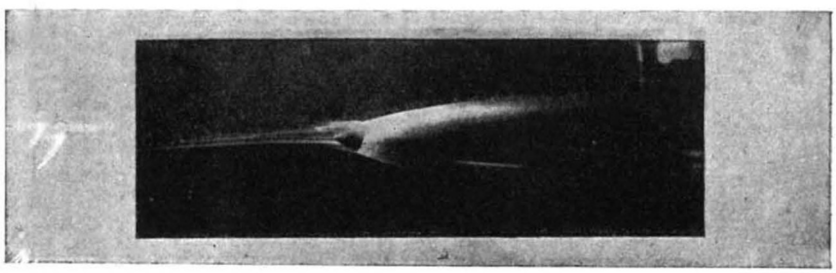

Fig. 8.—Dead region at the tail of an airship model.

A dead region is always an indication of high resistance, and is therefore undesirable.

It is hoped that observation of the flow past models, together with resistance measurements,

Fig. 6.—Flat plate.

©1913 Nature Publishing Group

will in the near future supply the data necessary to enable the designer of aircraft to construct fish-form bodies of low resistance and high efficiency.

C. G. E.

LIVINGSTONE AS A MAN OF SCIENCE.

NOW, as in the year 1874, which followed his death, discussions are being carried on as to whether Livingstone was more a missionary of religion than a man of science or an enthusiastic and skilful geographer. Such contentions are a waste of argument. Livingstone ardently believed in the supreme value of Christian ethics and the power of undenominational, basic Christianity to raise the backward peoples to a happier condition of life; but to his broad mind—a mind fifty years in advance of most of its contemporaries—reasonable religion and honest science were the same thing. Most of the dogmas of his day—for which people were still being persecuted—he tacitly ignored as being either unprovable or so little essential to "true religion and undefiled" as not to be worth discussion.

If Livingstone had lived seventy years later, he would probably have sought for some science scholarship or endowment and have gone out in his religious search for knowledge as a layman, a layman of that most holy profession, the healer of disease. He had about him the making of another Darwin. As it was, he chose the path of the missionary, and fortunately selected that missionary society (the London) which had already produced men like Campbell and Moffat, and which left with its agents singular freedom of movement and judgment. Consequently, he was able to enrich science with much material for the comprehension of Africa, even when working as a missionary at a modest salary of 100*l.* a year.

No one has ever charged Livingstone with neglecting to do the work of this profession. He taught, he expounded, he translated, pleaded; and exercised a most potent influence for good over the minds of thousands of savages; impressing their chiefs, moreover, so strongly with the worth of his character and the exemplar of his own hard-working, blameless life, that he really laid firm foundations for the Christian civilisation which has now laid hold on Bechuanaland. But from the moment of landing in South Africa he stored up all the observations he could put into writing on the African flora, fauna, geology and native races.

A review of his work as a practical philanthropist, a consul and a geographer has been already dealt with by various writers during the month which preceded the centenary celebrations. Perhaps the best and the most novel treatment of these aspects of Livingstone is that given in three articles by Mr. Ralph Durand in *The African Mail. The British Medical Journal* has published an essay on the medical and surgical skill of Livingstone and his great ability in this profession, besides his anticipation of the modern treatment of malarial fever and the cogency of his researches into tsetse-fly disease. To get an all-round view of the capacity of this remarkable man there only remains to be considered his quality in other branches of scientific research—philology, ethnology, zoology, botany, geology and meteorology.

In about a year after arriving in South Africa he had mastered the Sechuana language and had acquired a vehicle for conversation with the tribes between the Orange River and the Upper Zambezi, the Limpopo and Lake Ngami; for many of the Bushmen could speak some Sechuana dialect, and the conquests of the Makalolo (a Basuto tribe) had carried the Sechuana tongue northwards almost to the verge of the Congo basin. But Livingstone, appreciating the great interest which the Bantu language-family possessed for philologists, busily collected vocabularies of the still little-known languages of Ngamiland and the western Zambezi; and though these are either stored at the Grey Library at Capetown or lost, they served the purposes of Dr. W. I. Bleek in assisting him to compose his unfinished "Comparative Grammar of the South African Languages." Ethnology owes a great debt to David Livingstone. It is impossible to write on the races of South Africa without quoting from his stores of information—information which is exact, unemotional, graphic and discerning. He wrote on the Stone Age in Central Africa before anyone had thought of such a period in negro culture; on the ancientness of pottery among the Bantu; on the domestic animals of south Central Africa; on fragments of unwritten history and half-forgotten migrations; on the importance of the Pleiades as a measurer of the seasons in the eyes of the African agricultural folk; on the racial and cultural influence of ancient Egypt on negroland.

His notes on the life-history and habits of the lion, ratel, giraffe, rhinoceros, buffalo, elephant, giant chimpanzi, baboon, hippopotamus, zebra, lechwe, situtunga, and the other striking mammals of southern and Central Africa, are strewn through his three published books, and have done good service in many a natural history book. No succeeding naturalist traveller has called his information in question. Amongst his discoveries in zoology were several antelopes and the pygmy elephant of the Congo forests, "a small variety, only 5ft. 8 in. high, yet with tusks 6 ft. 8 in. in length." (This form was only rediscovered by the Germans a few years ago.) Livingstone's notes on birds, lizards, snakes and frogs are as good reading and as accurate as those on mammals. His observations on the part played in the economy of nature by the termites (which consume and cover with soil all dead timber) were subsequently confirmed and elaborated by the late Prof. Henry Drummond.

Livingstone's botanical collections and innumerable botanical notes—more especially about the Zambezian flora—are incorporated in the old and the new editions of the "Flora of Tropical Africa." His discovery of fossil Araucarias in the rocks of the Central Zambezi valley led him to guess

©1913 Nature Publishing Group