

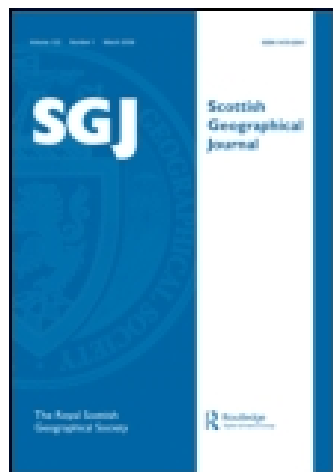
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Loch ness

T. N. Johnston M.B., CM., F.R.S.E. & James Murray

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One quotation more :—

“La limite inférieure du névé remontait, au commencement d'août, à 5700—5800 mètres sur la branche orientale du glacier de Godwin-Austin : il est probable que, dans les années normales, cette limite est refoulée encore plus haut.

“La *végétation des moraines vivantes* (gandèques de Forel) est singulièrement développée et bien plus intense que dans les Alpes. Cela tient au fait que l'épaisseur de la terre que recouvre la glace et qui est humectée par l'eau de fusion, est assez forte pour permettre aux graines de germer et de prendre racine, puis de prospérer malgré la base froide sur laquelle elles reposent ; certains exemplaires attestent un voyage considérable sur le glacier et accusent un âge avancé ; tels éphédras ou hippophaës sont plus de 15 ans, et tous touffes de carex ou d'absinthe peut-être davantage encore” (p. 339).

LOCH NESS.¹

1. THE BATHYMETRICAL SURVEY OF LOCH NESS.

By T. N. JOHNSTON, M.B., C.M., F.R.S.E.

LOCH NESS, which is one of the most beautiful lochs in Scotland, is the largest of the series lying in the great glen of Scotland, and forming the greater part of the waterway known as the Caledonian Canal. It trends in a south-west to north-east direction, extending to a length of $22\frac{1}{2}$ miles, with a maximum breadth, at Urquhart bay, of over $1\frac{1}{4}$ miles, and covering an area of over $22\frac{1}{2}$ square miles. The mean breadth is almost one mile. From a bathymetrical point of view, Loch Ness is an important loch. For a long time it has borne the reputation of being very deep, and this the soundings of the Lake Survey substantiate. The members of the Lake Survey visited Loch Ness in April 1903, and took soundings, temperature, observations, and tow-nettings. During the summer Sir John Murray and members of the staff stayed at Fort Augustus, at the south end of the loch, and carried on continuous observations on the temperatures, seiches, biology, etc. These observations have been continued during the winter by Mr. E. R. Watson, B.A., and Mr. James Murray. In June 1903 a “limnograph” (an instrument for recording “seiches,” which are oscillations of the whole mass of water in a lake) was erected at the monastery pier at Fort Augustus, under the care of Mr. E. M. Wedderburn, M.A., and some good records have been obtained. More recently a series of electrical resistance thermometers have been installed under the care of Mr. E. R. Watson.

Previous to 1903 no systematic soundings had been made in Loch Ness, with the exception of those taken early in last century, at the time of the making of the Caledonian Canal, when a series of soundings were taken along the centre of the loch, and a maximum depth of 774 feet (129 fathoms) obtained. The Lake Survey did not find so great a depth, the maximum obtained being 751 feet (125 fathoms), at a spot almost

¹ Part of a series of papers on Loch Ness, read before the Research Department of the Royal Geographical Society on January 18, 1904, and published in full in the *Geographical Journal* for October.

in the centre of the loch, $1\frac{1}{4}$ miles to the south of Urquhart bay. On the old chart supplied by the canal authorities, the soundings taken in the shallower portions of the loch practically agree with those taken by the Lake Survey, but in the deeper water the depths differ by five or six fathoms, and in some cases the differences are greater. Similar differences have occurred in other lochs which have been sounded by means of rope lines. Loch Morar, which lies in the south-west of Inverness-shire, and which in all probability is the deepest loch in the United Kingdom, was stated to have a depth of 1080 feet, but the greatest depth obtained by the Lake Survey during many hours' search over the limited 1000-feet area was 1017 feet.

The loch is fed by numerous burns and several large streams. The rivers Oich and Tarff fall in at the head of the loch at Fort Augustus; on the west side the Moriston, the Coilte, and the Enerick enter, and on the east side the Foyers and the Farigaig. The River Ness, issuing from the north end, drains the loch. The drainage-area of Loch Ness is very extensive; it extends to 696 square miles, being more than thirty-two times the area of the loch.

The basin of Loch Ness is of a simple character, and probably at one time the 600 and 700 feet areas were continuous from end to end, but the detrital material brought down by the River Foyers has filled up the bed of the loch to a considerable extent, dividing the areas over 600 and 700 feet deep into two divisions. The bottom of Loch Ness is remarkably level, showing no irregularities, with the above exception, and it is covered with black, peaty mud, and in places with a stiff clay of a dull yellow colour. The absence of islands is striking, there being only one small islet, called "Cherry Island," near the west shore, not far from Fort Augustus. It is said that the level of Loch Ness was raised a few feet when the canal was made, but at one time the water must have stood at a considerable height above its present level, as is shown by the terraces at the mouth of the River Foyers, and by the beaches which can be seen at Dores, at the north end of the loch.

The slopes of the side of the basin are very steep, especially on the west side, to the south of Abriachan, and on the east side, where off the "Horseshoe" a depth of 316 feet was obtained at a distance of 150 feet from shore; on the same side, opposite Invermoriston, soundings of 652 feet were obtained at a distance of 360 feet from shore. The mean depth of Loch Ness is very great, being 436 feet. Loch Morar, which has a maximum depth of 1017 feet—266 feet more than Loch Ness—has a mean depth of 284 feet. The volume of Loch Ness is estimated at 216,000 million cubic feet, which is about three times that of Loch Morar, so that Loch Ness may fairly be regarded as the largest body of fresh water in Great Britain.

2. BIOLOGY OF LOCH NESS.

By JAMES MURRAY.

The observations made by the members of the Lake Survey during the summer and autumn of 1903 showed that, while every part of the loch, down to the

deepest part of the bottom, has its inhabitants, there is one area in which life, if not altogether absent, is very rare. This area is the open water of the loch from a depth of 300 feet to the bottom. Fish may live in this region, but none of the animals obtainable by our nets have been collected in it.

In studying the distribution of organisms in the loch, it is convenient to follow Forel in dividing it into three regions—the Pelagic, the Littoral, and the Abyssal. Each of these regions possesses a distinct association of species.

In the open water of the loch there is a small number of animals and plants, distributed with considerable uniformity throughout. Owing probably to the small annual range of temperature occurring in such a large lake, this pelagic association changes very little throughout the year, the only change observed being the disappearance of a few species in winter. The vertical distribution of the species is very unequal, some having a greater vertical range than others. Life is usually densest at some little distance from the surface (say 20 to 50 feet), but at night there is a distinct migration of many species towards the surface.

The shores of the loch support an abundant flora and fauna. The flowering plants, mosses and algae, which grow attached to the rocks or stones of the shore, shelter an immense number of microscopic animals. A great many of the species characteristic of this region extend to a considerable depth beyond the limits at which plants cease. The majority of the Entomostraca, and many species of Rotifera and other microscopic animals, have been dredged at a depth of nearly 300 feet. It is supposed that the abundant deposit of vegetable débris on the bottom of the loch takes the place of growing plants in maintaining this rich fauna.

The abyssal fauna includes a few species which are generally distributed all over the bottom from a depth of 300 feet to the deepest parts of the loch. Below 300 feet the majority of the littoral species cease. A few, such as *Hydra rubra*, some water-mites, and a *Limnæa*, found at depths of from 400 to 600 feet, were so rare that they may be regarded as casually present.

The abyssal fauna includes species representing most of the great groups of aquatic animals. There are Insects, Mollusca, Entomostraca, Worms (Oligochaetes, Turbellarians, Nematodes, and one Rotifer), and Infusoria. These species are not confined to the deeper parts of the loch. The majority of the species range right up to the shore. So far as we have gone, we have found no peculiar species in the abyssal fauna. It seems to be merely an extension of the littoral fauna, including those species which are best able to adapt themselves to the peculiar conditions of the abyssal region. When brought to the surface, the abyssal animals appear to suffer no inconvenience, and thrive well in bottles. A more critical examination of the species by experts may modify our conclusion as to the origin of the abyssal fauna. In one group only, the Rotifera, have we found what may be incipient species, the eyes being often reduced in size, or altogether absent.

A VISIT TO THE SINAI PENINSULA.

By G. TATTON BROWN.

ALL servants of the Egyptian Government get a few days' holiday during the Mohammedan feast of Bairan, and last year I decided to take advantage of this opportunity to pay a brief visit to the Sinai Peninsula. My friend and I, accompanied by a servant in charge of our tent, and food