



## Annals and Magazine of Natural History: Series 6

Publication details, including instructions for authors and subscription information:  
<http://www.tandfonline.com/loi/tnah12>

### XVII.—On movement in a circle as the fundamental form of movement in animals: its cause, manifestation, and significance

F.O. Guldborg

Published online: 06 Oct 2009.

To cite this article: F.O. Guldborg (1897) XVII.—On movement in a circle as the fundamental form of movement in animals: its cause, manifestation, and significance , Annals and Magazine of Natural History: Series 6, 19:110, 155-160, DOI: [10.1080/00222939708680522](https://doi.org/10.1080/00222939708680522)

To link to this article: <http://dx.doi.org/10.1080/00222939708680522>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views

of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

XVI.—*Description of a new Fish from Lake Nyassa.*

By G. A. BOULENGER, F.R.S.

*Chromis auratus.*

23 teeth on each side of the outer series of the upper jaw. Depth of body  $3\frac{2}{3}$  in total length, length of head  $3\frac{1}{3}$  times. Profile of snout curved; eye equally distant from the end of the snout and the gill-opening, its diameter 4 times in length of head and but slightly greater than interorbital width; maxillary not extending to below anterior border of eye; three series of scales on the cheek below the eye; opercle and interorbital region scaled; præopercular limbs forming a right angle. Gill-rakers very short, 8 on lower part of anterior arch. Dorsal XIX 6; spines subequal in length from the fourth, which is  $\frac{1}{3}$  length of head. Pectoral pointed,  $\frac{3}{4}$  length of head; ventral as long as pectoral, reaching vent. Anal III 6; third spine longest, stronger and a little longer than dorsals. Caudal truncate. Caudal peduncle a little longer than deep. Scales  $34\frac{5}{12}$ , finely denticulate below the lateral line; lat. l.  $1\frac{24}{12}$ . Bright golden yellow, with three black stripes, one along the side of the body from the eye to the base of the caudal, a second above the upper lateral line from the occiput to the caudal peduncle, and a third along the dorsal fin; two curved black bands across the snout from eye to eye; a few black spots on the upper part of the caudal fin.

Total length 75 millim.

A single specimen from Monkey Bay, W. Nyassa; presented to the British Museum by G. H. Pigott, Esq.

XVII.—*On Movement in a Circle as the Fundamental Form of Movement in Animals: its Cause, Manifestation, and Significance.* By F. O. GULDBERG\*.

[A Lecture † delivered before the Biological Society of Christiania, March 30, 1896.]

THE majority of those who are accustomed to walk in the fields and woods with open eyes for the observation of animal

\* Translated by E. E. Austen from the 'Biologisches Centralblatt,' xvi. Bd., No. 21 (November 1, 1896), pp. 779–783.

† This lecture is a brief preliminary communication on the subject of an investigation which, so long ago as the spring of the year 1888, the

life have surely been struck by the readiness with which animals belonging to the same family or community find each other again, after having separated voluntarily or under compulsion. Indeed, even newly hatched or new-born young, which one surely cannot easily suspect of having a fully developed memory for places or any acquaintance with the locality, and as to which it is quite impossible to imagine that they are already in possession of the full use of their senses, nevertheless again discover, apparently with the greatest ease, their parents, brothers and sisters, or companions, even when they have been separated from them for so long a time or by so great a distance that their sensory powers are inadequate to bring them into direct communication one with another.

For life in a state of nature has furnished us with a series of observations, showing that the higher animals, at all events under circumstances in which their senses do not act normally or perfectly, or when they are prevented from bringing themselves into communication one with another by aid of their senses, seek and find each other again in such a manner that **they return to the spot where they were separated** or where their senses corresponded for the last time. This ordinary and necessary returning of animals to the spot where they were separated must, as I shall show, be of a double nature, namely both **instinctive** as well as **physiological**, since meeting takes place by two different methods, either in consequence of the animals by aid of their senses seeking and finding their way back to the spot where they separated, or by their making **without the aid of their senses a circular movement**, which necessarily also leads them back to the place of separation. Now, in order to come to a clear understanding as to the nature of this circular movement, as to what must be the basis or cause of the instinctive phenomenon in question, I have instituted, in conjunction with my fellow-worker Prof. G. A. Guldberg, a series of physiological experiments whereby, by depriving the subjects of the experiments of their senses, we have succeeded in compelling them to make a circular movement of this kind. This movement in a circle is certainly to be regarded as having a **physiological** origin, and as the immediate cause we assume a **func-**

---

author proposed in a less complete form to his brother, Prof. G. A. Guldberg, who subsequently became a fellow-worker, especially as regards the morphological and physiological portion of the study. With reference to the actual evidence which has been collected, this will be laid before the scientific world in detail at an early period, so soon as time and opportunity permit.

**tional asymmetry** in the animal. It must here, however, be stated distinctly that this circular movement is not to be confused with the manège-movement known in physiology in the case of brain-lesion; for a series of morphological investigations undertaken by Prof. G. A. Guldberg renders it in the highest degree probable that the actual cause of this "senseless" circular movement is to be sought in the asymmetrical structure of the organs of locomotion, as to which a short communication will be found in the next number of this periodical (Biol. Centralbl.).

This circular movement also appears in the life of animals in the natural state so soon as the impressions derived from the senses are unable to exercise a guiding influence.

For a series of movements in circles which, so far as they were known, stood out as inexplicable riddles, must be regarded as results of the physiological action of circular motion upon natural motion guided by imperfect cerebral activity and failing senses. The forms of movement thereby produced, which become more or less regular circles, and are in part well-known phenomena in the case of higher animals and human beings, I have termed provisionally **biological circles or circular wanderings**.

In spite of the fact that in this connexion there is reason to suppose that similar phenomena in the life of insects can or must be explained in the same way as in Vertebrates, owing to the want of physiological experiments I can do nothing more here than merely to allude to this circumstance. In the case of higher animals, especially birds and mammals, on the contrary, the phenomena that have been observed are so numerous and the physiological experiments so far advanced that I now consider myself justified in propounding the theory as to the reality and signification of circular motion.

By questioning divers, who nowadays use electric lamps at the bottom of the sea, and lighthouse-keepers on the coast of Norway, I have obtained statements to the effect that in the places where these men work a variety of phenomena are always observed that are traceable in the same way—namely, circles described by fishes swimming in the light of the electric lamps and similar circular flights on the part of birds in front of the lighthouse (not round it). The easiest and most natural explanation that can be given of these movements is that they are "**biological circles**," which arise from the fact that the animal is blinded by the light, from which it seeks to get away by swimming or using its wings; since, however, it cannot find anything else to show it the way,

while the guiding sense is blinded, movement passes into the physiological circular direction, and it returns to the light. The constant repetition of these circles, until the birds often drop exhausted near the lighthouse, as well as the apparently disturbed state of mind of the animals when they are flying and swimming round and round, in our opinion also support such an explanation of this phenomenon. Mention may also be made of the circling flight of the willow-grouse and capercailzie, well known to the Scandinavian peasant-gunners who lie in wait for these birds, in which the instinct of locality alluded to above seems to appear, just as a similar instinct seems to prevail in beasts of prey during the pursuit of game. But the best illustrative evidence in favour of these biological circles is furnished by mammals, which more frequently come into contact with man either as domestic animals or as objects of the chase.—The lecturer here produced in explanation of his statement a series of graphic charts, which were sent to him by the foremost sportsmen in the country (Norway); these charts show that the course taken by hunted animals (hares and foxes) when pursued by the hounds exhibits over and over again the curve of a biological circle. This applies especially to hares, for the circles, or “Turen,” as Norwegian sportsmen call them, described by these animals can often be distinctly followed from one end to the other, since it is only paths, high roads, the animal’s own track, defiles, and insurmountable natural obstacles, or sudden interruptions due to a *rencontre* with hunter or hound, that produce changes in, or a cessation of, the biological circular course.

From these charts of circular runs it is also to be seen how the same individual always describes the biological circle towards the same side, whence it appears that the individual in travelling along is bound to go to the right or the left.

With reference to mankind the phenomenon may be regarded as being so well known that one need only mention the familiar accounts in literature and the stories with which people are acquainted in order to make the comprehension of the subject thoroughly real. There are also a multitude of statements as to rowing in a circle in a fog at sea, and in both cases, in wandering as well as in rowing in a circle, the phenomenon has had such a disturbing effect upon the condition of the senses, that the individual in some instances did not even trust the compass, and in others, as has been the case with superstitious folk, actually thought himself in the hands of a higher power. Of this, indeed, there is proof enough in tales and stories from popular life.

The effects of circular movement also make themselves

felt in military marches with an extended front, since it is only by accurate aiming and never losing the object while marching that the guide is enabled to keep the direction.

The lecturer then proceeded to show what is the importance of this peculiar form of animal motion for the creatures that possess it. He found in the fact that all animals are firmly fettered to definite natural conditions and are pretty helpless when they overstep definite limits or when they become separated from their parents or their home—especially in the earliest period of their existence, before they have learnt to use their senses and faculties—a decided proof that this circular movement, which, with irresistible force, brings each being that is under its control back to the place that possesses the conditions necessary for the preservation of life and for its prosperity, must also be of **fundamental importance** for the **maintenance of life** and the development of the individuals affected. It is thus seen that this form of movement is universally distributed—it is one of the general laws.

Imagination and superstition have eagerly seized upon this mysterious force in natural life, and have created therefrom a supernatural power. To expound this in greater detail lies beyond the scope of the present study; nevertheless it may be pointed out that Norwegian country-folk in general are wont to term this travelling in a circle “at tråde paa Vildstraa,” approaching on a false scent, that is, going astray, though in reality the intention of nature, if one may so express oneself, is exactly the opposite. In the realm of nature this phenomenon is a precaution in order that the living animal shall never go astray, but always be able again to find the spot that possesses the conditions necessary for the maintenance of life and for further development, the localities and surroundings that afford protection and food, before ever the offspring have learnt to use their senses and faculties—the native place to which all animals in the struggle for existence must so often return, be it the udder of the cow, the warmth-giving wings and the guiding experience of the hen, or the sheltering tree or bush chosen by maternal instinct. In accounts showing how very liable young animals are to perish when they are separated by the hand of man from this connexion with home and parents, we may also see the operation of the law, since under such circumstances its effects are just as destructive as under natural conditions they are the means of salvation. It is simply the opposite result carried to the same length.

The effect of this circular movement in the **psychical life** of animals may also be regarded as full of significance, since,

in spite of the innumerable false steps into which the animal may be betrayed by unpractised senses and inexperienced brain, it always brings it back to the right spot and to the proper conditions. To formulate my interpretation of this fact, I would say that **nature's educational skill would be unintelligible without the law of circular movement.**

Moreover, it is also necessary to point out that the same law appears to be the foundation of the instinct of locality in the higher animal world—that is, the already mentioned impulse to return to the spot where the animal lost its followers, and, in connexion therewith, the capacity for easily finding its companions again.

How far the importance and breadth of this instinct extends, it is certainly as yet impossible to say; whether it will ever be possible I know not; it may, however, be assumed that the fundamental forms of movement mentioned and the instinct founded thereon are closely connected with the "law of love of home" or the instinct of locality, to which the great annual migrations of animals are to be referred. And if I may be allowed to cast a glance beyond the limits of this paper, while presupposing that the law of physiological circular movement is recognized by the scientific world, I must first refer to the circumstance that circular movement will be a very serviceable instrument in investigations as to the functional breadth and signification of the senses in the different animals and animal groups.

Furthermore, in alluding to observations upon lower animals attention must also be directed to the probability that in the lowest classes the physiological circular movement is perhaps the sole form of movement that the organism possesses besides the mechanical action and the physiological reaction. In the case of such a manifestation, physiological circular movement, when its reality and extent shall be sufficiently investigated and understood, may perhaps prove to be of greater biological importance and open up a wider field for study than we at present anticipate. In any case, it will probably be found that even now we may with some show of justice regard the circular movement alluded to as a fundamental form of movement in animals, which we must never omit to take into joint consideration in studying the phases in the development of animal life, no matter whether we are dealing with the biology of individual species or with the psychical genealogy of a larger animal group.