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EDWARD HERON-ALLEN AND HIS THEORY OF
'PURPOSE AND INTELLIGENCE' IN THE
FORAMINIFERA

by MICHAEL A. KAMINSKI

INTRODUCTION

In 1915, during the dark winter days of the Great War, the membership of the venerable Royal Microscopical Society was treated to an ingenious exchange of wit between two of the great natural historians of the day. The Society was host to a debate between its newly elected President, Edward Heron-Allen, who was regarded as more of an "amateur" naturalist, and his long-time friend, the eminent biologist and systematic zoologist, Professor Sir E. Ray Lankester. The "debate", if one can call it that, centred upon the suggestion put forward by Heron-Allen that the selectivity exhibited by several species of "arenaceous" (or agglutinating) foraminifera in building the unique architecture of their tests (shells) revealed...."the possession in these organisms of faculties akin to Purpose and Intelligence" (Heron-Allen, 1915c).

In a richly illustrated lantern slide presentation given to the Society in October of that year, its President-elect concluded that...."there appears to be no organism in the Animal Kingdom, however simple be its structure, which lives a life of its own independently of any other organism, which is not capable of developing functions and behaviour, which in the Metazoa might be called the Phenomena of Purpose and Intelligence".

My talk to you today seeks to trace the development of Heron-Allen's ideas on the "Phenomena of Purpose and Intelligence" as he put it, recall the reactions of his peers and their written replies, and examine whether or not his theory was unique at the time. From the perspective of the period the

entire matter of whether or not the single-celled foraminifera are capable of making any conscious decisions now seems esoteric. Nevertheless, the phenomenon of “grain selection” among agglutinated foraminifera remains a matter of scientific investigation. The generic-level taxonomy of certain groups of these foraminifera is based upon their remarkable capability to build their shells out of certain materials selected from the sediment upon which they live. My presentation reveals that Edward Heron-Allen was not alone in suggesting that protozoa exhibit behaviour that in the higher animals might be considered “intelligent”.

**HERON-ALLEN'S EARLY OBSERVATIONS ON
“SELECTIVE POWERS” AMONG THE FORAMINIFERA**

Edward Heron-Allen became interested in the study of Foraminifera while still a schoolboy. One of the reasons why he later chose to live at “Large Acres” in Selsey, was to be near the shore, where foraminiferal-bearing sands could easily be collected during a stroll on the beach. In fact, Heron-Allen himself recalls in his War Journal (Harvey & Fitzgerald, 2002):

“I am thankful that from my earliest years, whilst I was by profession a lawyer, I have always had some strongly pursued ‘hobby’ which occupied all my leisure hours, and have carried these hobbies to the point of minute study resulting in a considerable number of published volumes. I refer to the violin, the hand, Umar Khayyám, and the Foraminifera which latter have occupied my attention off and on since I was a boy at Harrow in 1876, and of late years have kept me continuously employed.”
- Edward Heron-Allen's War Journal, 21st November 1914.

Heron-Allen's collaboration with Arthur Earland was particularly fruitful. Between 1908 and 1911, this pair of enthusiasts managed to document the foraminifera from the shore sands of Selsey, a work that was published in eight parts in the *Journal of the Royal Microscopical Society*. This is the point where Edward Heron-Allen's affiliation with that Society begins - an affiliation that culminated in his election to

the office of President in January, 1916. As the reputation of this foraminiferal partnership grew, Heron-Allen & Earland were invited to collaborate on other scientific projects, such as the description of the fauna and flora of the Kerimba Archipelago, the Clare Island Survey, the *Goldseeker* deep-sea dredgings, and later, the R.R.S. *Discovery* expeditions. Soon the pair were examining and documenting the foraminifera from various parts of the North Atlantic, Indian, and Southern Oceans.

Among the many studies that Heron-Allen & Earland undertook over the years, perhaps the most thought-provoking were their investigations of agglutinated foraminifera from the North Sea and from the deeper waters of the northern Atlantic. Around 1908-1909, Heron-Allen established a working relationship with Professor D'Arcy Thompson, who was then the Director for the International Committee for Investigation of the North Sea (Scotland). The Heron-Allen & Earland team received sediment samples from some of the deeper dredgings recovered during the *Goldseeker* cruises, and in a series of papers described some of the unusual agglutinated foraminifera that live in the deeper waters surrounding the British Isles. Among the new species discovered in this material was a small tubular species of *Technitella* that was given the name *T. thompsoni*, in honour of Heron-Allen's friend who had provided the sample material. In their paper communicated at the Quekett Microscopical Club in the April

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Figs 1-2. Foraminifera from the North Sea, dredged by the Fisheries Cruiser *Goldseeker*. Reproduction of the original lithographic plates from Edward Heron-Allen & Earland (1913), illustrating the selection of varied materials from which these simple agglutinating foraminifera constructed their shell walls. Magnifications between x30 and x40.

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of 1909, Heron-Allen & Earland noted the remarkable ability of this organism to select only echinoderm plates of a certain size and neatly cement them together to build a tubular shell. In the discussion to their paper, they remarked:

“Of all the arenaceous foraminifera, *Technitella* is the neatest builder, and displays the highest development of selective power in the choice of material. There is, however, a considerable range of skill shown ... and *T. thompsoni* must unquestionably take first rank for selective power and neatness of construction.”

However, in this early study the authors did not go beyond describing observable facts, and as they noted in the introduction to their paper (Heron-Allen & Earland, 1909), “no attempt is made to explain either the processes by which the tests of the arenaceous foraminifera are constructed, or the idiosyncracies displayed by many of the genera and species in the choice of their materials”.

In another paper based on the study of the Fisheries Cruiser *Goldseeker* samples published in the *Journal of the Royal Microscopical Society* in 1913, Heron-Allen & Earland studied some of the most primitive and simple agglutinated foraminifera that can be found in the British offshore. The genus *Psammosphaera* and *Saccamina* are nothing more than simple “balls of sand” as the name *Psammosphaera* implies. Such simple, single-chambered forms have been found in the geological record extending back to the Vendian stage of the latest Precambrian (about 550 million years ago). They are regarded to be among the earliest known ancestral forms of the Foraminifera, and it is believed that more complex genera have evolved from them. They can be truly described as living fossils.

In their paper, which was richly illustrated with colour lithographs (reproduced here as Figs 1-2), Heron-Allen & Earland (1913) again noted a remarkable degree of grain

selection in some of these simple forms. Indeed, the material used in the construction of the test is the only way to distinguish the various species of these "sand balls". One form in particular attracted the attention of Heron-Allen & Earland. The species *Psammosphaera parva* reminds the observer of the Norwegian letter "ø" (Fig. 2.8). It has a habit of selecting one single long sponge-spicule around which it builds its spherical house of finely selected sand grains. The sand grains themselves are all just about the same shape and size. They were apparently enthralled by this species, and remarked:

"Two other species which we have described from 'Goldseeker' dredgings display marked selective powers. We cannot but arrive at the conclusions that the presence of the central spindle in var. *parva* is not fortuitous, but that the animal deliberately chooses the spindle as a main constituent of its 'house', and constructs its abode round the spicule in order to obtain the increased support afforded by its projections in supporting itself upon the surface layers of the bottom ooze."

- *Journal of the Royal Microscopical Society*, 1913, p. 18.

THE DEVELOPMENT OF IDEAS - THE PHENOMENON OF PURPOSE.

The mentioned earlier, descriptive work of examining samples, selecting specimens for illustration, and describing the foraminifera was always carried out jointly, with Arthur Earland as a co-author to the study. However, it is clear that even in these papers Edward Heron-Allen provided the motivation for the study, and wrote much of the final paper (sometimes even with acknowledgements obviously written by him in the first person). Of the two, only Heron-Allen elaborated upon the initial findings of the descriptive papers and carried the work further. He also publicised the results of the studies and communicated them to the learned societies.

By the early months of 1914, Heron-Allen's broader "synthesis" studies were well underway. He had occupied his time during the winter of 1913-1914 by compiling an

exhaustive study on the biology and reproductive processes of the foraminifera. He spent the first week of March in Edinburgh visiting his friend Sir John Murray, who placed at his disposal the original notes the latter had made during the H.M.S. *Challenger* Expedition. At the encouragement of Murray, Heron-Allen prepared the study for publication in the *Proceedings of the Royal Society*. Sadly, Sir John Murray died tragically in a motor car accident just a week after Heron-Allen's visit. The paper, which was printed the following year in the *Philosophical Transactions* of that learned society (Heron-Allen, 1915a), is an excellent review of the biology and life history of the foraminifera, and many of the observations he carried out are still valid. The final section of the paper (Section IX), though, contains some interesting speculation. Heron-Allen had apparently been contemplating the significance of grain selection amongst agglutinated foraminifera, and added a final section that carried the unassuming title "On Selection and Growth in some Arenaceous Foraminifera". In this section he concludes:

"When we arrive at the consideration of the arenaceous forms it behoves us to proceed with the greatest possible caution, for the phenomena exhibited reveal an apparent development of purpose and what in the Metazoa would be termed 'intelligence', which is apt to lead the imagination far astray unless it is kept rigidly within the bounds imposed by the observed results..."

Heron-Allen's paper was communicated to the Royal Society on March 11th 1915, and shortly thereafter he was invited to give a lantern-slide presentation to the Royal Institution of Great Britain. He gave a presentation at their weekly evening meeting on May 21st entitled "On Beauty, Design and Purpose in the Foraminifera". His published paper (Heron-Allen, 1915b) stands as a literary masterpiece in the field of foraminifera. In it, he builds up the case for intelligence even further, stating:

“An evolutionary cycle is ex hypothesi continuous, and I refuse to allow a consistent evolutionist to postulate a discontinuity in his evolutionary cycle - he cannot at some unknown point introduce into his bioplasm an outside and novel influence to which he gives the name ‘intelligence’. I claim that every living organism living an independent existence of its own is endowed with the measure of intelligence requisite to its individual needs.”

Notice that the quotation marks have now disappeared from the word “intelligence” in the last sentence. As Heron-Allen explained in the text of these two papers, the purported intelligence displayed by the foraminifera manifests itself in two ways. First, in the exclusive selection of certain materials. He provided the examples of *Ammobaculites agglutinans* and *Verneuilinoides polystrophus*, which select heavy gem minerals such as magnetite, garnet, and topaz, even though these minerals are very rare in the surrounding sediment. Secondly, in the manner in which these materials are used. Heron-Allen gives the example of *Halyphysema tumanowiczii*, which “protects its aperture with long sponge spicules that radiate in all directions ... which must offer very efficient protection from parasitic worms”. Another species mentioned is *Marsipella spiralis*, which builds its shell from sponge spicules arranged in a left-hand spiral. With reference to this last-named species he remarks that it “made the same discovery as did the prehistoric genius who invented string”. Finally, he again cites *Psammosphaera parva*, speculating that the animal selects a long spicule to “buoy it up on the mud surface”.

IS THERE INTELLIGENT BEHAVIOUR AMONG THE PROTOZOANS?

At this point, we can ask ourselves whether or not Heron-Allen’s use of the terms “Purpose and Intelligence” was unique, or even original given the state of knowledge of protozoan behaviour, as it existed before the First World War.

Was he alone in attributing such properties to the lower organisms?

On the other side of the Atlantic, a young scientist at the University of Pennsylvania by the name of Herbert Spencer Jennings (Fig. 3) had been observing single-celled animals since the turn of the 20th Century. From a humble background, Jennings had even spent a year in Europe at the University of Jena and at the Naples Zoological Station, working with some of the most prominent protozoologists of the day. By 1906, he had made enough observations on the behaviour of *Amoeba* that he was able to put his ideas on paper. His popular textbook "*Behavior of the Lower Organisms*" published by the Columbia University Press went through several printings and was used as a college text well into the 1960's. Most of the book describes the behaviour of protozoans in the laboratory - their responses to various stimuli, hunger, pain, and various chemicals. However, in the final chapter, Jennings asks the question... "Do we find in the lower organisms objective phenomena of a similar character, so that psychic names would be applied if found in higher organisms?"

Jennings took the idea even further, and defined a set of criteria that he considered to constitute "psychic" or "intelligent" behaviour. These qualities included attention, perception, discrimination, choice, desire, pain, fear, and memory. Jennings defined "intelligence" as the modification of behaviour in accordance with experience. After years of observation of *Paramecium*, and other protozoans, Jennings states.... "It is clear that we find the beginnings of such adaptive changes of behavior even in the Protozoa". He describes how *Amoeba* will avoid negative stimuli and react to positive stimuli, and concludes:

"The writer is thoroughly convinced that if an *Amoeba* were a large animal, so as to come within the every day experience of human beings, its behavior would at once call forth the attribution to it of states of

pleasure and pain, of hunger, desire, and the like, on precisely the same basis as we attribute these things to a dog”.

On the question of intelligence, Jennings writes:

“I believe it beyond question that we should find similar attribution to it of certain states of consciousness a practical assistance in foreseeing and controlling its behaviour. An *Amoeba* is a beast of prey and gives the impression of being controlled by the same elemental impulses as higher beasts of prey”.

- Jennings, (1906, p. 336).

Jennings leaves the reader to conclude that the behaviour of *Amoeba* fits well within his own definition of “intelligence”.

We have no direct evidence that Heron-Allen was even aware of Jennings’ textbook. There are no citations of Jennings’ work in any of Heron-Allen’s papers. Of course, it is quite possible that both authors had arrived at similar conclusions independently of one another. Such coincidences are commonplace in the natural sciences.

THE GREAT DEBATE

We return now to the autumn of 1915. After giving yet another lantern-slide presentation to the British Association (Section D, Zoology) on the 9th of September in Manchester in which Heron-Allen again maintained that the foraminifera possess “faculties akin to Purpose and Intelligence”, a discussion ensued during which a number of Zoologists apparently “combated” while others supported his views. This discussion and the resultant correspondence he received inspired him to immediately put pen to paper in order to explain his position on the subject of foraminiferal intelligence. The result was entitled “A short Statement upon the Theory and the Phenomena of Purpose and Intelligence exhibited by the Protozoa, as illustrated by selection and behaviour in the



Figs 3-4. (3) Professor Herbert Spencer Jennings in his later years; (4) Professor Sir E. Ray Lankester at the British Museum (Natural History), c.1907. Sir Ray was Director of the museum from 1898 to 1907 and was a frequent guest at “Large Acres”.

Foraminifera”. It was presented at a meeting of the Royal Microscopical Society, attended by many prominent scientists, on October 20th, and was published in the same year (Heron-Allen, 1915c). In an effort to summarise his observations and clarify his position, Heron-Allen again reports various examples of grain selection, and concludes:

“To sum up the matter in a few words, a study of the Rhizopoda extending over some thirty years has brought me to the conclusion that there appears to be no organism in the Animal Kingdom, however simple be its structure, *which lives a life of its own independently of any other organism*, which is not capable of developing functions and behaviour, which in the Metazoa might be called, and would properly be so called, Phenomena of Purpose and Intelligence”.

On this occasion, Heron-Allen even quotes one of the basic principles of Marxism (*italicised*). We can only guess where this idea came from, but perhaps it is not a coincidence that Heron-Allen's life-long friend Professor Sir E. Ray Lankester (Fig. 4) knew Karl Marx personally, and was even one of the few people who attended the latter's funeral (Gould, 1999). This connection is quite likely, since Sir Ray was present at the meeting and took an interest in Heron-Allen's theories.

Heron-Allen again stimulated a lively discussion that was carefully recorded in the Society's *Proceedings*. Several prominent members expressed their opinions on the subject of his talk, and some of the comments were serious and others more provocative. The chairman of the society, Mr. D.J. Scourfield opened the discussion by expressing his thanks to Heron-Allen, and added "the subject had been laid before them in a very lucid and striking manner, and that the illustrative photographs were very beautiful and of exceptional value". On the question of intelligence, Scourfield remarked that he agreed with Heron-Allen regarding the importance of the definition of terms. In comparison with what other members said, Scourfield exercised remarkable restraint when he noted "it would be admitted that the problem was not completely solved by saying that we were confronted by purpose and intelligence".

Dr. Francis Shillington Scales remarked it seemed to him that Heron-Allen's interest in the subject led him to claim for the lower animals a portion at least of the intelligence which we were apt to give to a dog. Scales noted that Heron-Allen "did not claim intelligence for many of the physiological and developmental processes that exist in life. The selective processes of the Foraminifera were elementary compared with the developmental processes of the cells of plants and animals - many processes could be explained by chemotaxis. It was difficult to understand why Mr. H.A. should claim intelligence

to one and deny it to the other, or where he drew the line.”

Heron-Allen replied that he was very glad to hear what Dr. Shillington Scales had to say, because he really voiced the views of the “old Guard” which he knew would “never surrender”. Heron-Allen restated that “the measure of purpose and intelligence exhibited by the Protozoa, and reached in its highest development in Man, was shown by the use of extraneous materials which the creature selects from its surroundings, and which it adapts to a particular purpose.” He wished to go no further than that. He further claimed what was wrong was “the introduction of anthropomorphic suggestions arising out of the words purpose and intelligence to define faculties which lead to these phenomena in the lower animals.” It is already apparent that Heron-Allen is now beginning to retreat from the use of the words “purpose and intelligence”.

The scientific critique of Heron-Allen’s paper was prepared by his friend Sir E. Ray Lankester (Fig. 4), and also published in the *Journal of the Royal Microscopical Society*, the following year (Lankester, 1916). Sir Ray had a reputation for being a contrarian who relished professional debate and never shunned controversy. In his essay “The Supposed Exhibition of Purpose and Intelligence by the Foraminifera” Sir Ray raises a polite objection to Heron-Allen’s choice of semantics. He writes:

“Mr. H.A. has been tempted, as a result of the facts observed, to ascribe what he had at first called ‘Purpose and Intelligence’, or by further modification ‘Purposive Intelligence’ and now calls ‘faculties akin to Purpose and Intelligence’ to the Foraminifera. I agree with Mr. H.A. that ‘our human vocabulary is at present most inadequate for discussing problems of this kind’”.

Sir Ray then adds a cautionary note, stating:

“To say that they are due to Purpose which is not Purpose as the word is ordinarily understood, and to Intelligence which is not Intelligence in

the usual acceptance of the term, seems to me to tend to misconception and a mistaken notion that we know more about the activities of the Protozoa than we do”.

Finally, Sir Ray expresses his own light-hearted opinion on the question of intelligence in the Foraminifera:

“If we recognise the fact that mental faculties are, like human structure, immensely complex, and are dependent for their manifestation on the healthy activity of an almost inconceivably complex structure - the brain - we shall, it seems to me, be able to conceive of the reduced and less complex mental faculties of less elaborate brains. ... Descending step by step we shall arrive at the conception of the microscopic mentality of a Foraminifer, and cannot fail to dismiss the notion of attributing to it purpose and intelligence, or anything that can seriously be called by those names.”

- *Journal of the Royal Microscopical Society* (1916, p. 137).

Even more acute criticism of Heron-Allen's theory was interjected by Professor J. Arthur Thomson, professor of Natural History at the University of Aberdeen, who was a member of the Editorial Board of the *Journal* at the time. His discussion appears in the Society's *Transactions*. Adopting a sound pedagogical approach, Prof. Thompson introduces the problem with a bit of humour. He remarked that when he left Aberdeen there was much snow, some of the roads were blocked, and he saw the wind making some beautiful snow wreaths. He asked himself whether there was any purposefulness in the wind's finely finished work, and he answered emphatically “no” because he could interpret it without introducing any concept of purpose, purely by the laws of dynamics. Prof. Thompson then asked himself whether, in coming south, he had himself any purpose, whether his behaviour in making the journey was purposeful or purposive, and he felt compelled to answer in the affirmative. He proclaimed...“the difficulty in the present discussion seems to lie between these two extremes - between the work of the wind and the work of Man”. Prof. Thompson

then cuts the Gordian knot of semantics by defining the terms himself through the clever use of common examples of animal behaviour:

“When rooks take up mussels in their claws and let them fall on the shingle, with the result that the shells were broken and the flesh made available, this is probably *intelligent purposefulness*. When the starfish does battle with the sea urchin with its tube feet, it wrenches off all the pedicellariae or snapping blades. This is prolonged behaviour directed towards an end which is not immediate - prolonged activity directed toward a future result. This is called *organized purposiveness*. It is believed that the same category applies to the activity of the President’s Foraminifera.”

- *Proceedings of the Royal Microscopical Society*, June, 1916, p. 251.

Heron-Allen prepared a carefully worded reply to the comments of the above gentlemen, and especially to the comments published by Sir Ray. In this reply, he concedes to Prof. Thompson, and retracts his use of the term “intelligence” as defined by the Oxford Dictionary. He explains what he meant by the use of this term:

“As Sir Ray points out, I first made use of the phrase ‘Purpose and Intelligence’, and later ‘Purposive Intelligence’. Today I would rather use the term ‘Definitive Purpose’ or perhaps finally ‘Purposiveness’. It appears to me that the theory which I have endeavoured to develop, without claiming to have originated it, derives support from the following lines, quoted by Sir Ray - ‘The attributes which are restricted in the higher types of animal life to the nervous apparatus may be in the Rhizopoda diffused through every particle’ - the whole protoplasmic substance being endowed in a low degree with the power of receiving, conducting, and acting upon external impressions. (...) I have always endeavoured to point out that it is, in my opinion, only to a degree appropriate to their organisation, not in its entirety, that the behaviour of the Rhizopoda is comparable with that of Man. (...) I am not arguing for the possession of ‘high’ mental activities in the Protozoa - it is obvious that these must be as rudimentary as they are in any egg - but in that rudimentary condition it seems to me that they must be there, awaiting the stimulus that calls them into action.”

Heron-Allen concludes his reply by reaffirming:

"I cannot conclude in words more satisfactory to myself than in Sir Ray's own, when he says 'Descending step by step we shall arrive at the conception of the microscopic mentality of a Foraminifer'; and I wholly dismiss the notion of 'Purpose' and 'Intelligence' as these terms are defined in the Oxford Dictionary".

In the end Heron-Allen steps back a bit, accepts some of the criticism of the great natural historians, and appears to arrive at a consensus on the use of terminology to describe the behavioural processes he described in the Foraminifera.

As a footnote to the above discussion, it should be noted that in science, mimicry is perhaps the most genuine form of flattery. In the very next issue of the *Journal of the Royal Microscopical Society*, a minor article appeared written by Arnold T. Watson, entitled "A case of apparent intelligence exhibited by a marine tube-building worm, *Terebella conchilega*" (Watson, 1916). The author quite seriously describes what he regarded to be intelligent behaviour as a worm endeavoured to build its tube out of sand grains and gravel. One could speculate that had Sir Ray seen this paper, he would have conceded that at least this creature possesses a brain that controls its "microscopic mentality" - albeit a very rudimentary one.

Heron-Allen's work on grain selection in the Foraminifera and the scholarly debate that ensued did not go unrewarded. Shortly after the "great debate" Heron-Allen was offered the Presidency of the Royal Microscopical Society, an honour that he refers to as "a position which I regarded in my youth as being the highest honour which I could ever dimly aspire to" (Heron-Allen's War Journal - Harvey & Fitzgerald, 2002, p 62). However, during his first year as President, Heron-Allen seems to have busied himself instead with the task of writing a detailed biography of the great French natural historian and foraminiferologist, Alcide d'Orbigny, which he read as his first Presidential Address on January 18, 1917 (Heron-Allen,

1917). It seems that after the "great debate" of the previous year, no further notes on "Apparent Intelligence" were published in any of the subsequent issues of the *Journal of the Royal Microscopical Society*. Heron-Allen became more intensely involved with his wartime activities, and writes in his War Journal that his address given when his term as President of the Royal Microscopical Society expired in January 1918 "dealt entirely with the war-conditions under which the Society had worked since 1914". Certainly, during the latter years of the war, Heron-Allen had more urgent matters to attend to and the foraminiferal studies assumed a place on the "back burner". Heron-Allen continued his work on the Foraminifera in collaboration with Arthur Earland for another 15 years, though it seems he restricted himself to producing well-illustrated monographs of the modern foraminiferal faunas from various parts of the world ocean. As far as can be ascertained, he never again wrote anything about the subject of "Purpose and Intelligence" in the Foraminifera. The subject seems, as we say, to have "died a natural death".

A STUDY OF SUCCESS: EDWARD HERON-ALLEN VERSUS HERBERT SPENCER JENNINGS

While Edward Heron-Allen accepted the rebuttals from his colleagues, and seems to have dropped his studies of "Purpose and Intelligence", his contemporary in the States, H.S. Jennings went from strength to strength after the publication of his book "*Behavior of the Lower Organisms*". Jennings accepted a professorship at John Hopkins University, and led a distinguished career giving guest lectures at various universities. He later became involved in experimental studies of genetics, and even spent a year at Oxford University as an Eastman Visiting Professor (1935-1936). The success enjoyed by Jennings after the publication of his treatise on intelligent behaviour among the protozoans could not have been in

starker contrast compared with Heron-Allen's later scientific career. Were Americans at the time more willing to concede that lower organisms display essential traits of "psychic behaviour"? However, it must also be said that Jennings took a slightly less controversial stance than did Heron-Allen, when he concluded in the final paragraph of his book:

"The problem as to the actual existence of consciousness outside the self is an indeterminate one; no increase of objective knowledge can ever solve it. Opinions on this subject must then be largely dominated by general philosophical considerations drawn from other fields".

EPILOGUE

Fifteen years passed by after the great debate between Edward Heron-Allen and Sir Ray Lankester, until Heron-Allen's long-time friend passed away on August 15th, 1929 at the age of 83. The task of writing Sir Ray's obituary for the *Journal of the Royal Microscopical Society* fell to Heron-Allen. In his obituary he recalled some of the unknown details on their debate on "Purpose and Intelligence in the Foraminifera":

"He accepted the Presidency of the RMS in the year 1909, but after attending the inaugural meeting he left the conduct of the meetings in the hands of the Vice-Presidents. I reproached him mildly for not attending meetings. He said to me on one occasion 'Wait till you are president - then I promise I will come and attack you in the Presidential Chair'. And he did: he half supported and half differed from me in the crusade I had embarked upon to prove the phenomena of Purpose and Intelligence in the Foraminifera. He objected to anything that savoured of Teleology."

"He prepared a paper attacking the position I had taken up, and submitted it to the Council. This gave me the chance to study it and prepare a reply which I hoped might be crushing. This reply I sent to him, that he might be 'pre-cognised', as the Scottish Lawyers say. He then prepared a 'rejoinder' which he submitted to me, and we subsequently had a crowded meeting which was attended by many notable Zoologists who took part in the discussion. It was great fun, and I hope - and believe - that our "rapier-like exchange of wit and argument" seemed to the audience to be brilliantly impromptu."

- Heron-Allen (1930).

Today we ascribe the apes and dolphins with a measure of intelligence, but nobody speaks of intelligence among the protozoans, only about genetically programmed behaviour. However, in the decades before the discovery of the double helix, natural scientists had no starting point, and were still groping around to define terms. Heron-Allen is remembered because he opened up such a debate in the United Kingdom. I am sure that he argued his case with the charismatic style that was typical of all his undertakings. I only wish I had been there to witness the great debate.

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