

A pictorial biography of *Bathybius haeckelii*, the short-lived primordial life form of the deep sea

Une biographie illustrée de *Bathybius haeckelii*, la forme de vie primordiale des grands fonds à l'existence éphémère

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ABSTRACT. In 1859, Darwin's *Origin of the Species* provoked a revolution in biology, providing an explanation for the tremendous diversity of life forms. However, it had no explanation of how life originated on earth, nor discussion of a primordial life form that would give rise to existing life forms. Two of Darwin's most devoted followers, Thomas Huxley and Ernst Haeckel, believed a solution had been found in the form Huxley's discovery in 1868 of a microorganism he christened, *Bathybius Haeckelii*. It was a featureless gelatinous masse, covering the floor of the deep sea, according to Huxley, and plausibly formed by spontaneous generation, according to Haeckel. Although widely heralded, it was short-lived as gelatinous masses found in samples of deep-sea mud were found to be an artifact of sample preservation in 1875. Here the view put forward is that *Bathybius* was accepted, if only for a few years, not only because it filled a perceived lack in Darwin's theory, but also due in large part to Haeckel's illustrations of *Bathybius* as life-like creature, shown here through a pictorial biography of *Bathybius*.

RÉSUMÉ. En 1859, l'*Origine des Espèces* de Darwin a provoqué une révolution en biologie en offrant une explication à l'immense diversité des formes de vie. Toutefois, il n'expliquait pas l'origine de la vie sur Terre et n'évoquait aucune forme de vie primordiale susceptible d'avoir donné naissance aux espèces actuelles. Deux des plus fervents disciples de Darwin, Thomas Huxley et Ernst Haeckel, crurent avoir trouvé une réponse grâce à la découverte, faite par Huxley en 1868, d'un micro-organisme qu'il baptisa *Bathybius haeckelii*. Selon Huxley, il s'agissait des masses gélatineuses dépourvues de structure distincte tapissant les fonds marins; pour Haeckel, elles résultaient vraisemblablement d'une génération spontanée. Bien que largement saluée, cette découverte fut de courte durée: en 1875, il fut établi que ces masses gélatineuses, observées dans des échantillons de boue abyssale, n'étaient en réalité qu'un artefact lié à la conservation des prélèvements. L'hypothèse avancée ici est que le *Bathybius* fut accepté, ne serait-ce que pour quelques années, non seulement parce qu'il comblait une lacune perçue dans la théorie de Darwin, mais aussi, en grande partie, grâce aux illustrations de Haeckel le représentant comme une créature vivante; c'est ce que montre la biographie illustrée du *Bathybius* présentée ici.

KEYWORDS. Thomas Huxley, Ernst Haeckel, Origin of Life, Scientific Illustration.

MOTS-CLÉS. Thomas Huxley, Ernst Haeckel, Origine de la Vie, Illustration Scientifique.

1. Introduction

Those who are familiar with the search for the origins of life on earth may have heard of *Bathybius Haeckelii* (from hereon *Bathybius*). It was first described in October of 1868 from samples of deep sea mud. For several years, it was widely heralded as the primordial life form, living gelatinous masses, likely covering the bottom of the deep seas, the result of spontaneous generation. While quite famous in its time, it was short-lived, lasting not quite seven years. In August of 1875, it was announced that the gelatinous masses, which trembled when manipulated, were found to be the product of preserving mud samples with alcohol. Consequently, by the early 20th century, *Bathybius* was known as one of the colossal jokes of science (Nutting 1901), and by 1920 as "a celebrated myth" (Herdman 1920). Today it is largely forgotten. Stephen J. Gould stated that likely less than 1% of today's biologists have ever heard of it (Gould 1978). However, in contrast to today's biologists, today's historians of biology

have, in relatively recent years, devoted considerable attention to the phenomenon of *Bathybius* (i.e., McGraw 1974; Rehbock 1975; Rupke 1976; Gould 1978; Rice 1983; Peton 2015).

Historians of biology have shown it to have been completely and utterly of its era, a creation fulfilling a perceived need to explain the origin of life which was conspicuously lacking in Darwin's foundational 1859 "Origin of the Species". A problem pointed out early on in reviews of Darwin's treatise (e.g. Anon. 1860). The several studies of *Bathybius* by historians of science (McGraw 1974; Rehbock 1975; Rupke 1976; Gould 1978; Rice 1983; Peton 2015) all agree in characterizing it as not only of its time, but also attribute its rapid acceptance as due in large part to the scientific stature of both the discover of *Bathybius*, Thomas Huxley, and also the major proponent of *Bathybius*, Ernst Haeckel. The two authoritative personalities (Fig. 1) were the widely respected biologists. In this essay the view will put forward that the wide acceptance of *Bathybius* was due not only to the considerable statures of the two men, but importantly, also due to the quality of Haeckel's illustrations of *Bathybius* and the various versions, adaptations of Haeckel's illustrations, which appeared. Here, first the story of the appearance of *Bathybius* is reviewed. Then the major part of this essay is presented, the 'Pictorial Biography of *Bathybius*'. It is a chronological review of illustrations. These begin with early illustrations of 'primitive' life forms, the amorphous *Amoeba*, continuing through Haeckel's primordial Monera to Huxley's *Bathybius*, and finally to Haeckel's illustrations of *Bathybius*, the original and derived versions, which had little in common with Huxley's crude illustrations. This pictorial biography here purports to tell the story of *Bathybius* as being actually a creation more of Haeckel than of Huxley. Its description by Huxley would not have occurred without Haeckel's preceding erection of a group of primordial microorganisms, his Moneren. Furthermore, the wide acceptance of *Bathybius* would not have occurred without Haeckel's illustrations of *Bathybius*, and importantly, the adaptations of his drawings because Huxley's illustrations did not depict a plausible life form.



Figure 1. A. Thomas Huxley (1825-1895), in 1870 at age 45. His vigorous defense of Darwin's theories led him later to be known as Darwin's Bulldog in Great Britain (Wyhe 2019). Huxley described the primordial life form, *Bathybius Haeckelii* in 1868. B. Ernst Haeckel (1834-1919) in 1879 at age 45. Haeckel's was described as 'the German Darwin' due to his support of Darwinian theories in the German states (Kutschera et al. 2019). Shown here is that Haeckel accepted *Bathybius* as a primordial life form, wrote prolifically on it, and produced illustrations of *Bathybius* that were much more life-like than those of Huxley.

2. Huxley, Haeckel, and Haeckel's Monera: the story of Bathybius

Huxley, who discovered and described Bathybius in 1868 (Huxley 1868) from a deep sea mud sample taken in 1857, was the most active and powerful advocate of Darwinism in Great Britain. He was the central figures of the "X Club", a small group of scientists, all of whom supported Darwin, and met weekly to "further the cause of science", primarily by defending Darwinism from attacks by the Church of England and its allies. The X Club members exercised considerable, but discrete, power in the politics of the Royal Society of London, the premier scientific organization of Great Britain (see Barton 2018). Huxley, for example, served as both secretary (1872-1877) and president (1883-1885) of the Royal Society. The stature of the describer of Bathybius played a large part in its notoriety. However, in reality, the major promoter of Bathybius, as the primordial life form in 1870's, was its namesake, Ernst Haeckel. He was Darwin's most fervent advocate in the German states (see Richards 2008). Much like Huxley, Haeckel gave talks on Darwin's theories at meetings of scientific societies (e.g. Haeckel 1864) and in lectures for the general public (e.g. Haeckel 1868a).

Years before Huxley's discovery of Bathybius, Haeckel prepared the ground for the reception of Huxley's Bathybius through his work on primitive life forms, and their places in the development of complex life forms. In 1863, he found a new microorganism that he considered more primitive than any known form, a possible representative of primordial life. Haeckel called his new life form *Protogenes primordialis* in a publication published in August of 1865 (Haeckel 1865). In November, he wrote to Charles Darwin, announcing his discovery of this life form without a nucleus, representing the most primitive life form known, so simple that it was perhaps formed by spontaneous generation, thus solving one of the omissions of Darwin's Theory of Evolution, that of explaining the origin of life.

In 1866 Haeckel's 2-volume, monumental work "*Generelle Morphologie der Organismen: allgemeine Grundzüge der organischen Formen-Wissenschaft, mechanisch begründet durch die von Charles Darwin reformirte Descendenz-Theorie*" (General Morphology of Organisms: general principles of the science of organic forms, mechanically based on the theory of descent formulated by Charles Darwin) appeared. In it first he presented a new group of life forms, the Monera, headed by his *Protogenes*, with a new primitive amoeboid form he called *Protoamoeba* described in footnote, grouped with previously described supposedly primitive species (Haeckel 1866). Both Darwin and Huxley were familiar with "Generelle Morphologie..." and had discussed the possibility of having it translated into English for Haeckel, a plan eventually abandoned (see Darwin Correspondence (1867 letters "Generelle Morphologie"))

In August 1868, Haeckel published a formal treatment of his Monera in a monograph. He described some new forms and provided a formal description of *Protoamoeba*. Haeckel presented the Monera as the most simple microscopic organisms, masses of 'protoplasm,' lacking any apparent cell membrane or nucleus and likely formed by spontaneous generation (Haeckel 1868b). In September 1868 the first edition of Haeckel's long-titled popular account of the evolution of life appeared: *Natürliche Schöpfungsgeschichte. Gemeinverständliche wissenschaftliche Vorträge über die Entwicklungslehre im Allgemeinen und diejenige von Darwin, Goethe und Lamarck im Besonderen, über die Anwendung derselben auf den Ursprung des Menschen und andere damit zusammenhängende Grundfragen der Naturwissenschaft* (Natural Creation Story: Popular scientific lectures on the theory of evolution in general and that of Darwin, Goethe and Lamarck in particular, on its application to the origin of man and other related fundamental questions of natural science). In it, the Monera were clearly identified as the primordial life forms, the root forms of all animal life. The only one of Haeckel's Monera shown in the book was *Protoamoeba primordialis*, the simplest, smallest, and most amoeboid form of his Monera (Haeckel 1868c).

Thus, by late 1868, Haeckel's polymorphic forms of Monera were the ready-made home for Huxley's Bathybius. It was the small, amorphous, gelatinous objects he belatedly found in a sample or samples of deep sea mud. The samples were collected from the North Atlantic between Ireland and Newfoundland during a depth-sounding cruise in 1857. The sounding device collected small volumes

of sediment for subsequent determination of the nature of the bottom (e.g., sand, rock, mud). Huxley, charged with the microscopic analysis of the mud samples, examined them in 1858. In his report, he mentioned finding an abundance of small (5- 10 μm in length) calcareous platelets that he named 'coccoliths', but made no mention of any gelatinous objects, nor were any shown in the illustration accompanying his report (Huxley 1858). Huxley re-examined the samples a full 11 years after their collection. He announced his discovery of gelatinous microorganisms in an article published in October of 1868.

Huxley gave no reason for re-examining 11 year old samples in his 1868 article, nor later. It should be noted that in the existing accounts of Bathybius by historians of biology, Huxley's examination of the samples in 1868 has been treated in various fashions. In some, the fact that Huxley had previously examined the samples is simply not mentioned (Rupke 1976; Gould 1978; Peton 2015). In others, the reason for Huxley's return to the samples has been either not considered (McGraw 1974), or described as "unclear" (e.g. Rehbock) or "somewhat mysterious" (Rice 1983). Here the position taken is that Huxley's return to his 1857 samples is directly linked to the appearance of Haeckel's erection of his primordial amoeboid life forms, the Monera in his 1866 book, *Generelle Morphologie*, with which Huxley was quite familiar. The Monera figure very prominently in Huxley's article as he described Bathybius "*... as a new form of those simple animated beings which have recently been so well described by Haeckel in his 'Monographie der Moneren'. I proposed to confer upon this new 'Moner' the generic name of Bathybius, and to call it after the eminent Professor of Zoology in the University of Jena, B. Haeckelii*" (Huxley 1868a). The new deep-sea creature was described by Huxley as "*...lumps of a transparent, gelatinous substance. These lumps are of all sizes, from patches visible to the naked eye to excessively minute particles. When one of these is submitted to microscopical analysis it exhibits-imbedded in the transparent, colourless, and structureless matrix- granules, coccoliths, and foreign bodies*". Left unsaid is how Huxley could have failed to notice apparently conspicuous the lumps of gelatinous substance when he examined the mud samples 11 years previously.

Huxley did not hesitate to spread the news of his discovery. In a letter to Haeckel dated October 6 1868, Huxley announced his new article and his important discovery: "*It is about a new 'Moner' which lives at the bottom of the Atlantic to all appearance, and gives rise to some wonderful calcified bodies – I have christened it Bathybius Haeckelii and I hope that you will not be ashamed of your godchild. I will send you some of the mud itself with the paper.*" (Huxley 1868b). In February of 1869, Huxley claimed, in a discussion of a presentation on the Gulf Stream, that the according to reports he had read, the gelatinous masses he had described as Bathybius, appeared to cover the entire bottom of the deep sea around the globe (Huxley 1869).

Inexplicably, Haeckel never received the promised deep-sea mud sample from Huxley. Instead, through personal connections, he finally obtained a very different sample in the autumn of 1869 (Haeckel 1870a). It was a sample taken from the North Atlantic in July 1869 during the second cruise of the *H.M.S. Porcupine*. It was a dredge sample, not a mud sample from a sounding device. The dredge sample was from the deepest depth dredged, 4453 meters. Haeckel received it in a round-about fashion. A sample of the mud was somehow in the possession of a Mr. Randropp, a gentleman naturalist in Tøshavn in the Faroe Islands. It was shared with one of Haeckel's fellow faculty members in Jena, Professor Preyer. In the autumn of 1869, Haeckel had in his hands a glass jar labeled "*Dredged by Professor Thomson and Dr. Carpenter with the Steamer Porcupine at 2435 fathoms. 22 July 1869. Lat. 47° 38'. Long. 12° 4'.*". By the end of 1870, he had published three works, each with different illustrations of Bathybius. The fact that Haeckel's study of Bathybius was based on a mud sample from a different time and place, and collected in a different manner, as well being a relatively 'fresh sample' compared to those studied by Huxley in 1868, seems to have never been mentioned.

Also previously unremarked, is that Huxley's 1868 illustrations of Bathybius, the supposed authoritative depictions accompanying a first description, were never reproduced in another publication. In contrast, Haeckel's illustrations of Bathybius, both his originals and the adaptations of his drawings by others, were widely reproduced and even complimented. The proposition put forward

here is that Haeckel's scientific artwork, in contrast to that of Huxley, portrayed Bathybius as plausibly life-like. It was then, Haeckel's artwork that was likely responsible for the wide acceptance of Huxley's "lumps of transparent gelatinous substance" as a living primordial life form. However, the contention relies on admittedly subjective judgment of the illustrations. It will then be up to the reader to decide if the proposition is supported or not.

3.1. Introduction to the Pictorial Biography of Bathybius

In the following section a series of illustrations concerning Bathybius is presented in chronological order. The section begins with illustrations giving the background concerning knowledge of gelatinous microorganisms in the mid-1800's. These were the species first named *Proteus*, then *Amoeba*. They were well-known to many naturalists as amorphous, or polymorphous (a temporally variable morphology) gelatinous microorganisms.

Illustrations of *Amoeba* are followed by the plate from Huxley's 1858 report on his microscopical examination of the deep sea mud samples collected in 1857. Huxley showed no gelatinous masses, but he would re-examine the samples in 1868 and announce his discovery of Bathybius, gelatinous masses. In the intervening years, Haeckel developed his ideas as to the current existence and nature of the most primitive microorganisms. Presented are the illustrations from Haeckel's works on these supposed primitive forms, works that preceded, first by just a few years, and the last by just a few months, the 1868 publication of Huxley's discovery of Bathybius. These are from publications in which Haeckel established his Monera or Moneren, first as a group of the most simple life forms existing, and then as representing the very base of the tree of life, shown in the first Darwinian 'Tree of Life'. The plate from Huxley's 1868 publication follows, showing his remarkably crude illustrations of Bathybius, proposed as life forms, a newly discovered member of Haeckel's Monera.

Haeckel's subsequent promotion of Bathybius, his illustrations, from three publications, all from 1870, follow. Haeckel's depictions did not show something plausibly alive, but the illustrations were a great improvement over Huxley's figures. Then are shown examples of the adaptations of Haeckel's drawings which appeared, some much more life-like than the figures of Huxley or Haeckel's originals are shown. Bathybius also appeared in Haeckel's novel trees of life. Finally, one of last the uses of Bathybius by Haeckel as the first life form leading to humans, is shown with his iconic tree-like tree of animal life. It was published shortly before the end of Bathybius was announced in 1875 with Huxley's admission that it was, after all, simply an artifact of preserving mud samples with alcohol.

3.2. Amoeba was a well-known gelatinous microorganism

In the mid 1800's, among known microorganisms, were forms of *Amoeba*, the nearly feature-less, shape-shifting microorganisms. In 1820, Bory de Saint-Vincent described them as "*Genre d'animaux microscopiques, gymnodés, dont le corps est gélatineux, transparent, sans forme constante, changeant continuellement de figure, et émettant des prolongements variables servant à la locomotion*" (genus of microscopic naked organisms, whose body is gelatinous and transparent, has no constant form, continually changes its shape, and emits variable extensions that serve locomotion).

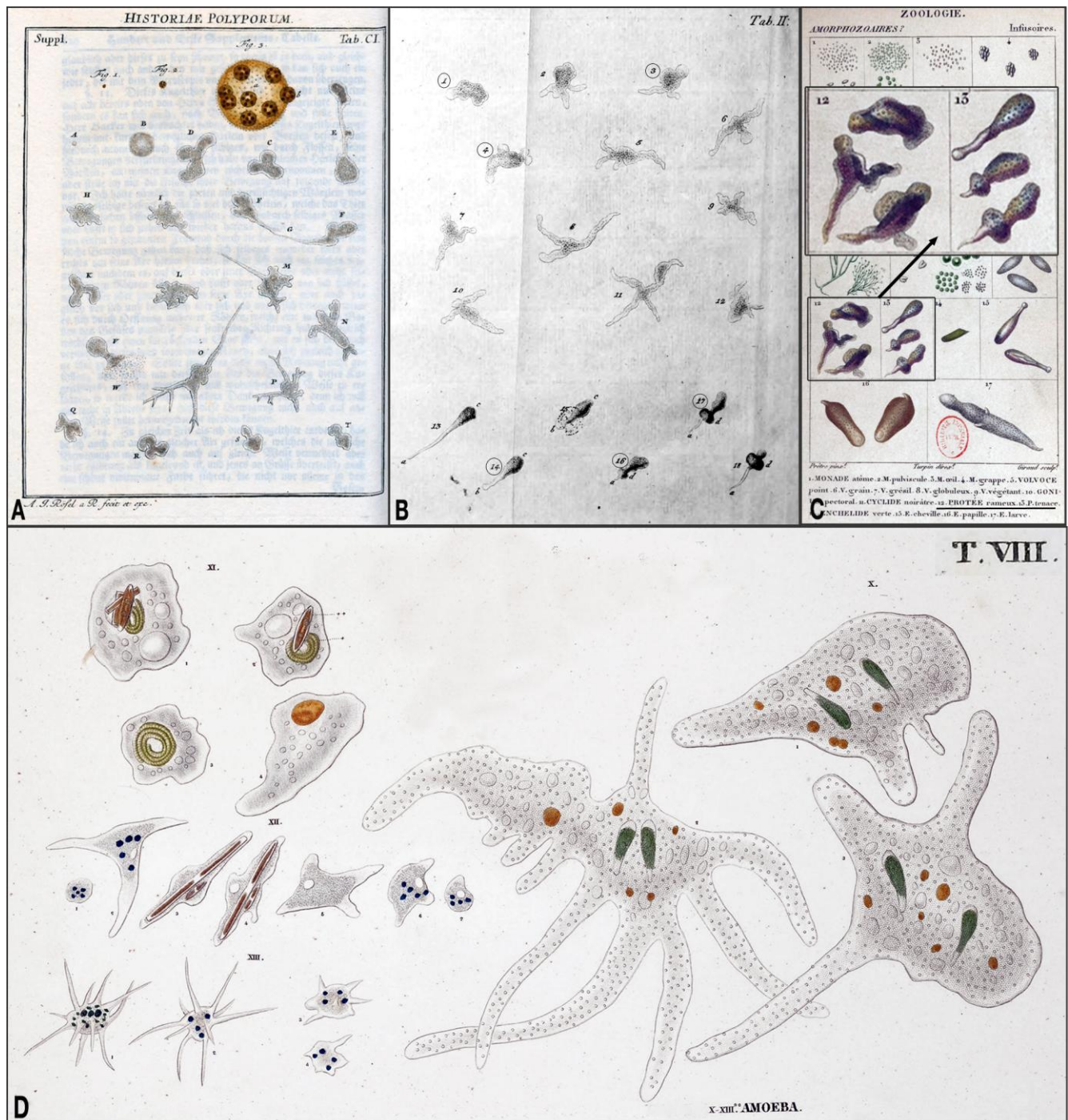


Figure 2. 1755-1836. Illustrations of Amoeba known in the mid-1800's. A. The earliest illustrations, as Kleiner Proteus (little changer, for the Greek god Proteus with the ability to transform himself at will), the figures in grey, in plate 101 of Rösel von Rosenhof (1775). B. Plate 2 is from Müller 1786 showing Proteus, defined as "Vermis inconspicuus, simplicissimus, pellucidus, mutabilis" (worm inconspicuous, simple, transparent, mutable). In 1822 Bory St. Vincent renamed the genus Amibe (from the Greek to change) as Proteus was a taxon of a plant and a reptile (Bory Saint Vincent 1822) and in 1836, Ehrenberg Latinized the name to Amoeba. C. Illustrations as 'Proteus' (square added) in the plate labeled "AMOPHOZOIRES? Infusoires" of the Dictionnaire Classique de l'Histoire Naturelle (Planches Zoologie "vers et Zoophytes"), re-drawn from Müller 1786. D. Figures of species of Amoeba shown in plate 8 of Ehrenberg (1836), with ingested prey items, various algal cells, included green alga and diatoms, the first illustrations of Amoeba with ingested prey items. The illustrations were very well known and widely reproduced (e.g. Pritchard 1841, 1861). Based on magnification factors given, and printed size, the Amoeba shown ranged in actual size from 5 to 350 μm in longest dimension, thus some were visible with unaided eye.

3.3. Huxley's 1858 examination of deep-sea mud made no mention of gelatinous masses

In 1858 Huxley published his report on the microscopical examination of mud samples gathered during the 1857 cruise of the *H.M.S. Cyclops*. He described finding minute (5-10 μm) platelets, coccoliths, later found to be cell coverings on minute algal cells. The description of the small objects suggests that the samples had been carefully examined. However, in his report no mention is made of gelatinous masses, nor were any apparent in the plate illustrating his findings.

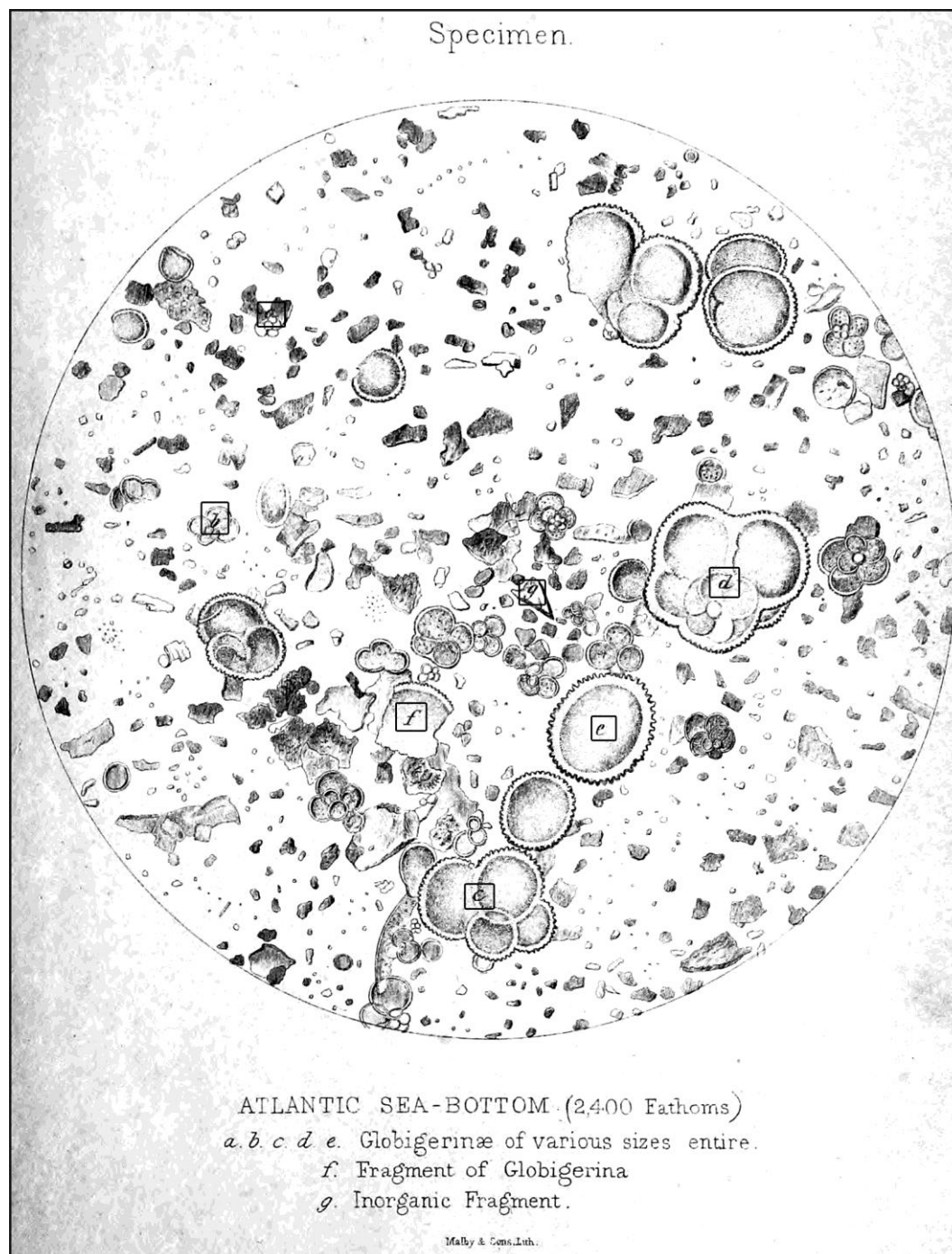


Figure 3. 1858. The plate from Huxley's 1858 report on microscopical analysis of deep-sea mud samples collected in 1857. The only objects identified are shells, whole or fragments, of the foraminifera *Globigerina*, and inorganic (mineral) fragments. Squares are added around the letter labels to facilitate location. No information on magnification was given. The largest object, 'd', is the shell of a mature *Globigerina*, which is likely about 500 μm across. The smallest object labeled is 'a' (upper left), a small *Globigerina* shell, is likely about 50 μm across, based on the estimated size of the largest shell ('d'). No amorphous gelatinous masses are apparent. In 1868, Huxley would state that re-examination of the samples revealed gelatinous masses, he described as *Bathybius*, were abundant in the mud samples, some large enough to be seen with the unaided eye.

3.4. *Protogenes primordialis* Haeckel's first primordial amoeboid organism.

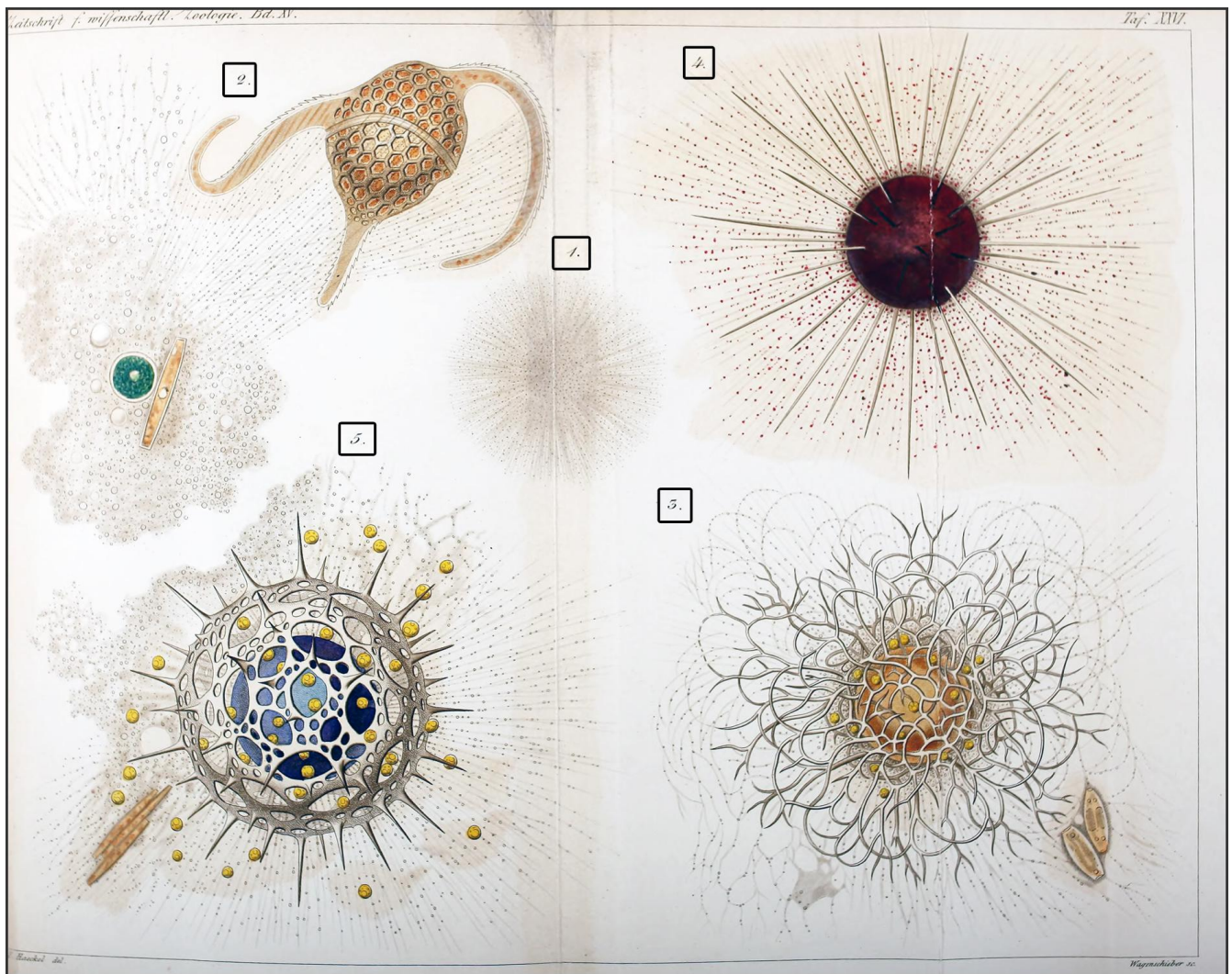


Figure 4. 1865. The plate of Haeckel's 1865 publication on the 'sarcodae' (gelatinous-like cellular material) of 'rhizopodes' (amoeba-like organisms). Figures 1 (center) and 2 (upper left) show Haeckel's primitive life form, *Protogenes primordialis*, discovered in Villefranche-sur-Mer during his 1864 stay (see Dolan 2019). His central fig. 1 is a low magnification illustration of the large contracted spherical state and his fig. 2 is a feeding amoeba-like stage. Haeckel gave the etymology of *Protogenes* as 'firstborn', *protótokos* in Greek. Based on the printed size and magnification factor given in the plate legend, the maximum dimension (height) of the body (without the strands of pseudopods) is about 200 μm . The specimen is shown ensnaring in its pseudopodial web a large dinoflagellate of the marine plankton, *Ceratium gibberum*. Shown as already captured by the specimen are a globular green algae and an oblong diatom, reminiscent of Ehrenberg's illustrations of *Amoeba* shown here in Figure 2. The plate figures 3, 4, and 5 show new species of radiolaria, (a group of rhizopodal organisms) found in Villefranche-sur-Mer. As mentioned above, Haeckel wrote to Charles Darwin, announcing his discovery of a new life form, without a nucleus, representing the most primitive life form known, so simple that it was perhaps formed by spontaneous generation, solving one of the omissions of Darwin's Theory of Evolution, that of explaining the origin of life.

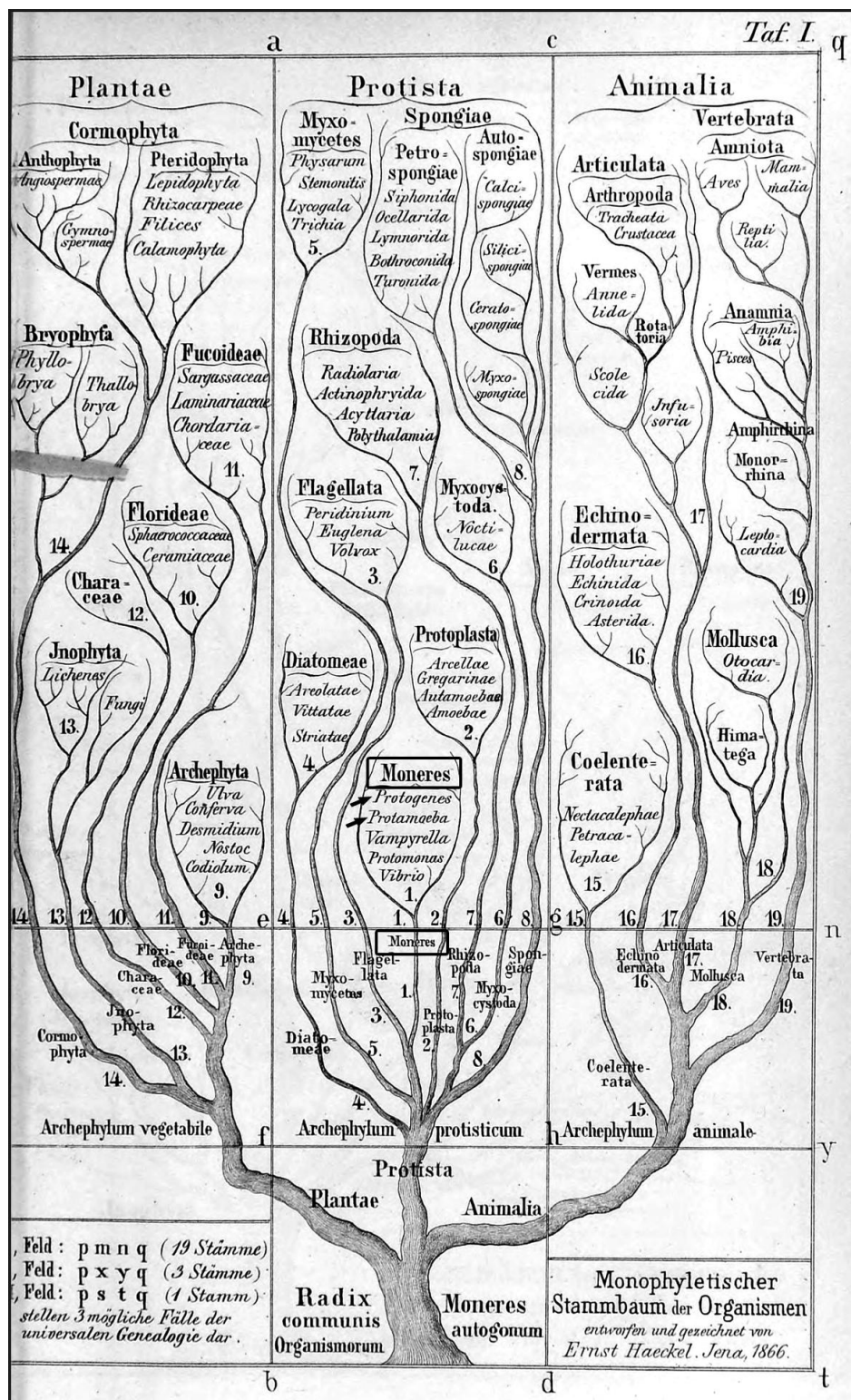


Figure 5. 1866. In September of 1866, Haeckel's 2 volume treatise *Generelle Morphologie...* appeared. Above is shown the first plate in volume 2, Haeckel's phylogenetic tree of life, credited as the first Darwinian tree of life (Hossfeld & Levit 2016). The squares and arrows were added to show the position and taxa of Moneren in which *Protogenes* and *Protamoeba*, first described by Haeckel, are the top moneren genera (added arrows) which appear in the tree, the others were previously described genera as 'Infusoiria'. Haeckel described *Protamoeba*, for the first time, only in a footnote in the first volume without any illustrations. Note that the Moneren genera are not shown as primordial 'root' organisms, they are shown, in a group, as branched after several other groups. Nonetheless, the text at the base of the tree reads "Radix communis organismorum" (the common root of organisms) and "Moneres autogonum" appears to define Moneren as formed by spontaneous generation from non-living matter (i.e., autogeny).

3.6. *Protomyxa aurantiaca*, Haeckel's first addition to his Monera

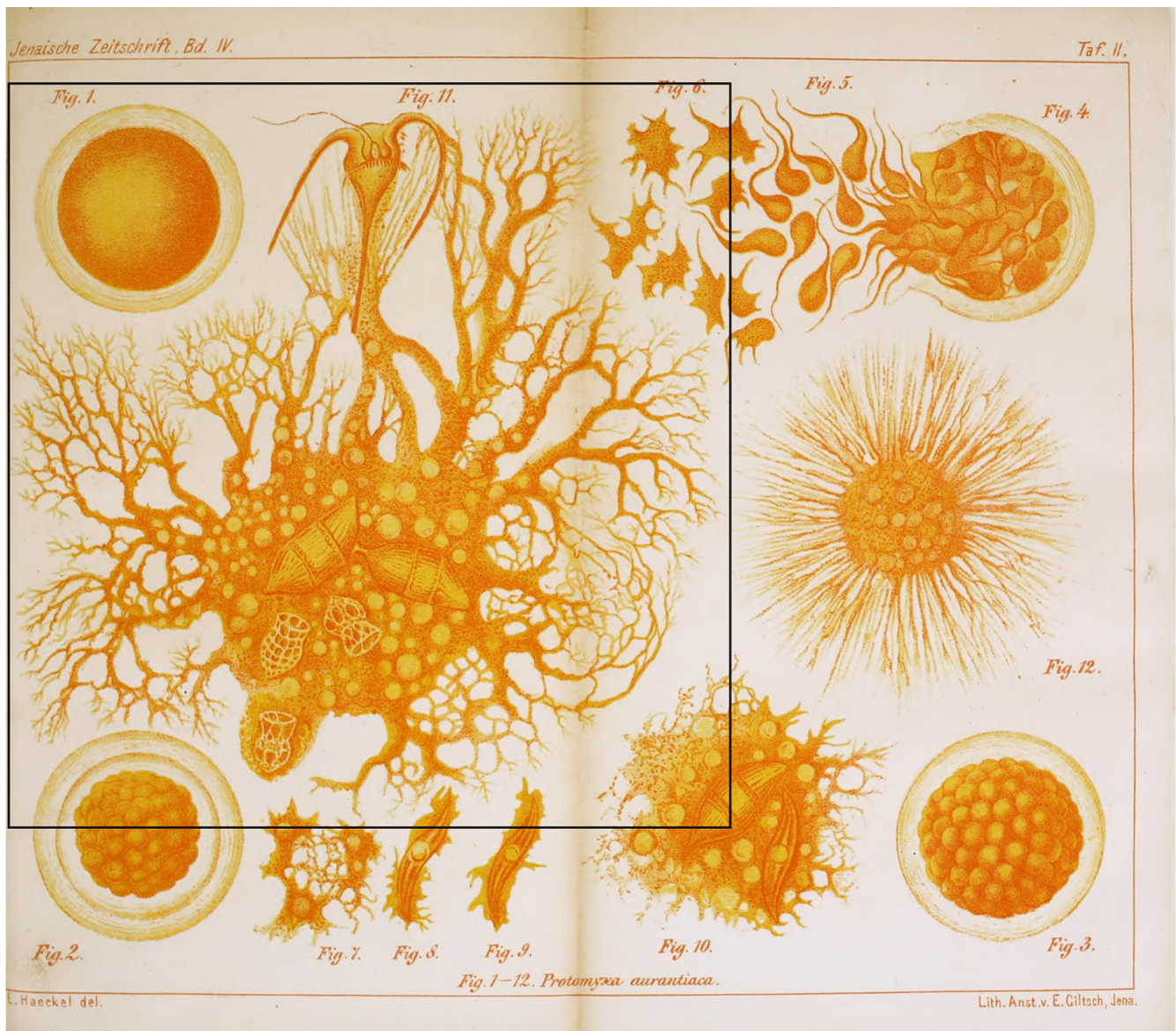


Fig. 6. May 1868. Plate 2 of Haeckel's monograph on the Monera, published on May 1st 1868, showing various life history stages of *Protomyxa aurantiaca*, one of his additions to the most simple living organisms, the Monera (Haeckel 1868b). The etymology of the genus name *Protomyxa* was given as meaning 'first slime' from the Greek, for first "proto", and "myxa" for slime, or the German word for primordial slime "Urschleim". The species name *aurantiaca* denotes its orange color. Haeckel stated that he found it during his 1866-1867 stay in the Canaries. Much like the illustration of the of *Protogenes primordialis* (Fig. 3)) found in Villefranche-sur-Mer, the 'feeding stage' of *P. aurantiaca* (within the added square) is shown having captured and consumed tintinnid ciliates (vase-shaped items in the lower portion) and a spindle-shaped dinoflagellate, and at the top, having immobilized the anchor-shaped dinoflagellate, *Ceratium tripos*. The prey items are all of the marine plankton. Based on the printed size of the figure, and stated magnification, in actual size, the maximum dimension (height) is about 750 μm .

3.7. Further Additions to the Monera and a formal description of *Protoamoeba primitive*

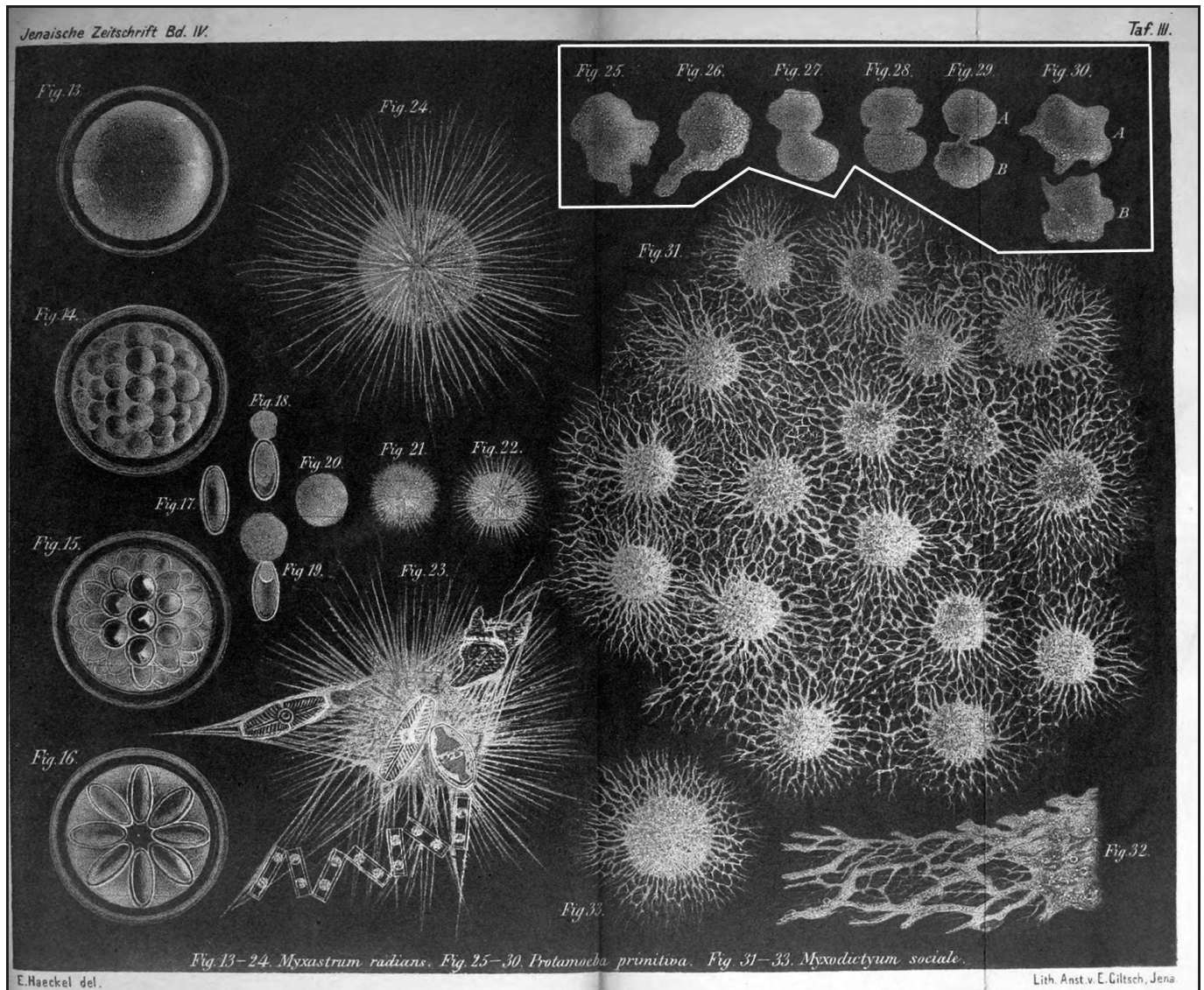


Figure 7. May 1868. Plate 3 of Haeckel's monograph on the Monera. The figures in the left half of the plates (plate fig. 13-24) are various life-history stages of Haeckel's *Myxastrum radians* with the largest figure (23) showing a feeding specimen having captured diatoms and a dinoflagellate. Haeckel found it in the Canaries in 1867 and named it *Myxastrum* for 'mucus stars' (Schleimsternchen). The figures in the left half of the plate (plate figs. 31-33) show *Myxodictyum sociale*: details of cell structure, a single cell, and a multi-cell colony. Haeckel found it in the Bay of Gibraltar on his return trip from the Canaries in 1867, and named it *Myxodictyum* for 'mucus net' (Schliemnetz). At the upper right of the plate, figs. 25-30 enclosed in an added box, show Haeckel's simplest organism, *Protamoeba primitiva*, with illustrations of cell division. Haeckel found it in a pond in the Tauntener Forest, near Jena in 1863 and 1865 and named it *Protamoeba* for 'the first changing form' (die erste Wechselgestalt). Based on the printed sizes and stated magnification given, the *A. primitiva* specimens range in size from 42 to 72 μm in maximum dimension, conforming to size of known species of *Amoeba* (also known to have cell membranes and nuclei), as shown in fig. 2 of this essay.

3.8. Haeckel's Tree of Animal Life showing Moneren as the root organisms giving direct rise to Amoeba

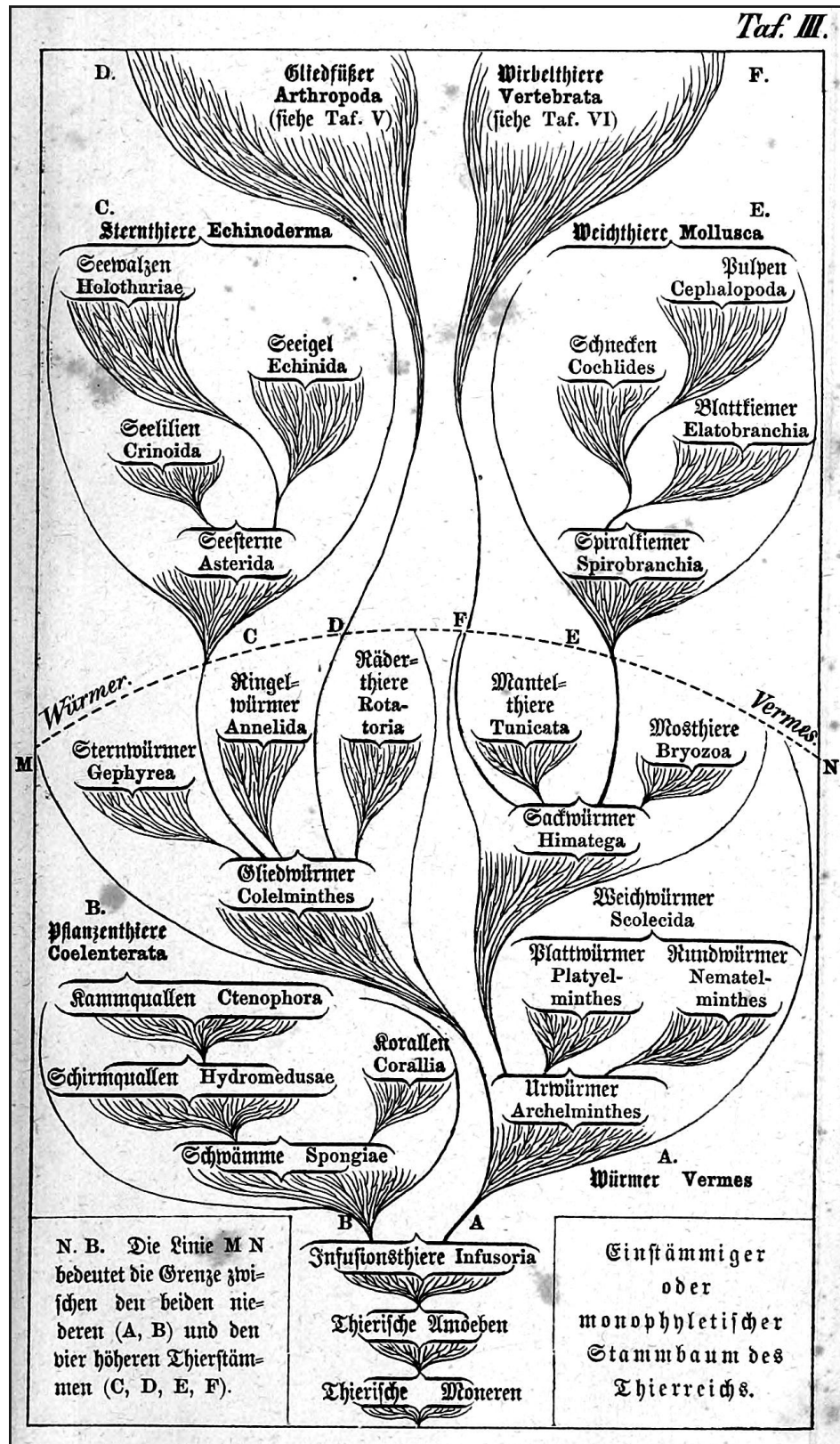


Figure 8. August 1868. Plate III from the first edition of Haeckel's popular account of the evolution of life "Natürliche Schöpfungsgeschichte.;" (Haeckel 1868c). It is the first tree in which the Moneren are explicitly portrayed as first life forms. At the bottom of the tree, the Moneren give rise to Amoeba, who in turn give rise to the large group of one-celled forms 'Infusoria'. In the book text, the plate legend is given as "Monophyletic family tree of the animal kingdom, illustrating a possible hypothesis regarding the common ancestry of all animals. According to this view, animal amoebae, and subsequently infusoria, could have originated from a single primordial animal (an animal moneron formed via spontaneous generation)."

3.9. Huxley's depictions of Bathybius from his original description - an organism??

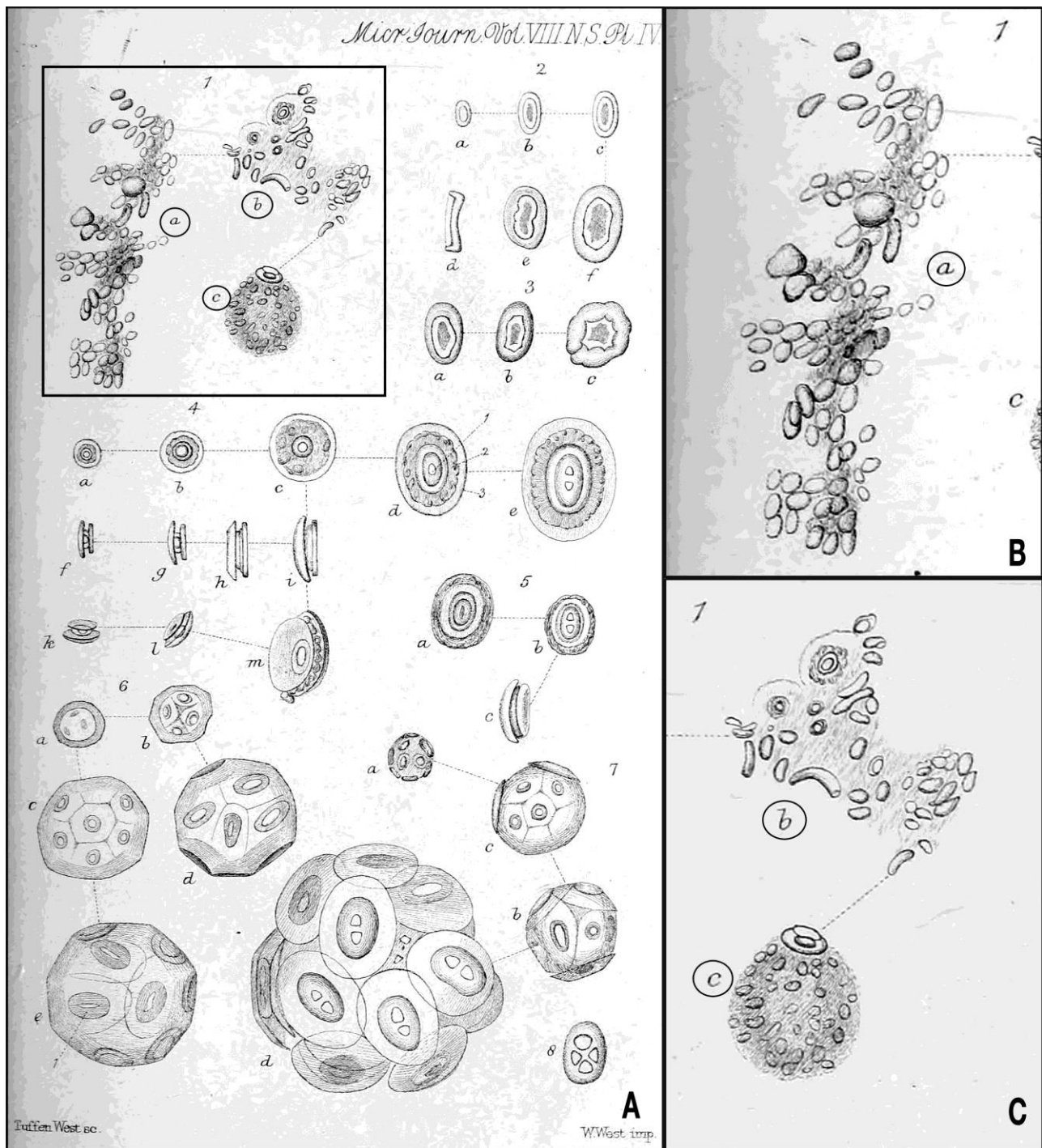


Figure 9. October 1868. A. The plate of Huxley's 1868 article with the first illustrations of *Bathybius Haeckelii*, described as "granule-heaps and the transparent gelatinous matter in which they are embedded...". He proposed them to be an organism "as a new form of those simple animated beings which have recently been so well described by Haeckel in his "Monographie der Moneren", citing Haeckel's 1868 monograph. In Huxley's plate, they are shown in figure 1 (square and circles added), given in the plate legend as "Masses of gelatinous the gelatinous substance". B. Enlarged view of the figure labeled 'a' in the plate. C. Enlarged view of the figures labeled 'b' and 'c' in the plate. The plate legend states "All the figures are drawn to the same scale, and are supposed to be magnified 1200 diameters". Based on the printed sizes of the figures, the large mass in B would be about 50 μm in height. The sizes of the masses shown in C would be about 25 μm for the oblong mass, and 15 μm for the spherical mass, in maximum dimensions. Huxley's illustrations of *Bathybius* did not resemble any known organism, including Haeckel's forms of *Monera* shown above, nor any known inanimate object. The other figure in the plate are illustrations of 'coccoliths', small lens-shaped platelets of calcium carbonate that cover the cells of coccolithophorid micro-algae, known, at the time, as the sphere-shaped 'coccospheres'.

3.10. The very different depictions of *Bathybius* by Haeckel

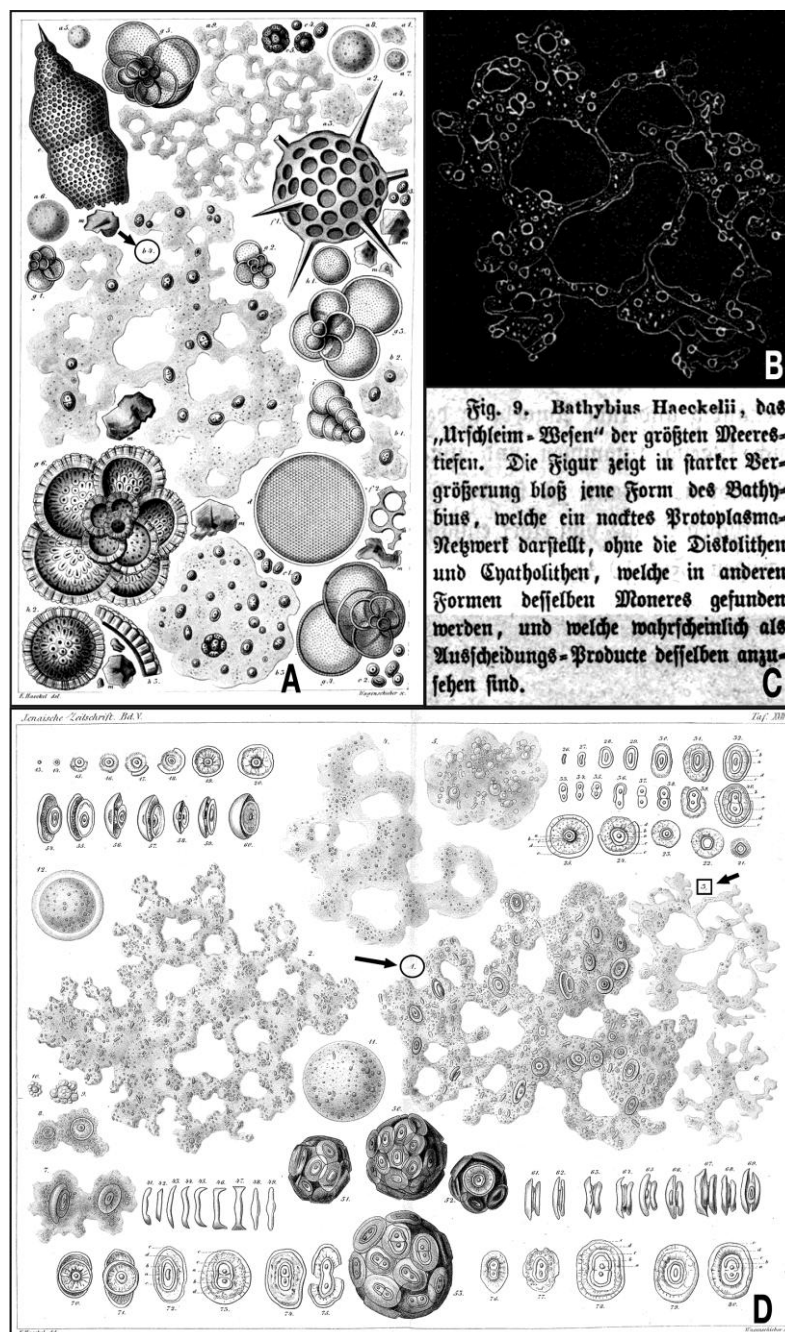


Figure 10. 1870. Haeckel obtained a preserved sample of deep-sea mud in autumn 1869, and his illustrations of *Bathybius* appeared in 1870 (exact dates unknown). They did not resemble Huxley's drawings, nor any known species of *Amoeba* A. The plate, titled "A small sample of *Bathybius* ooze at a magnification of 280" from the booklet "Life in the Greatest Ocean Depths", a lecture on March 2, 1870 (Haeckel 1870b). In the plate, the largest specimen shown, labeled "b.4" (circle & arrow added), is described as "A large, net-like piece of *Bathybius*, composed of many thin, fused strands of protoplasm, with numerous coccoliths. Given the stated magnification, and printed size of the figure, the actual size is about 270 μm in maximum dimension (height). B. Figure 9 from the 1870 edition of his book "Natürliche Schöpfungsgeschichte" C. The figure legend for "B": "*Bathybius haeckelii*, the "primordial slime" organism of the greatest ocean depths. The figure shows, at high magnification, only that form of *Bathybius* which constitutes a naked protoplasmic network- without the discoliths and cyatholiths that are found in other forms of the same moneron, and which are likely to be regarded as excretory products thereof" (Haeckel 1870c). D. The plate from "Beiträge zur blastidentheorie" (Haeckel 1870a), showing coccoliths, coccospheres and *Bathybius haeckelii*. According to magnification factor given, and actual plate size, the actual size of the largest *Bathybius* specimen, labeled 1 in the plate (long arrow) is 140 μm in longest dimension (width), and the specimen labeled 2 (short arrow) is 64 μm (height). The latter specimen appears to be the same as that shown in B, using white lines on a black background.

3.11. The first (and poor) adaptation of one of Haeckel's figures of *Bathybius*. Here 'adaptation' refers to a figure re-drawn that is significantly different from the original, in contrast to an exact copy.

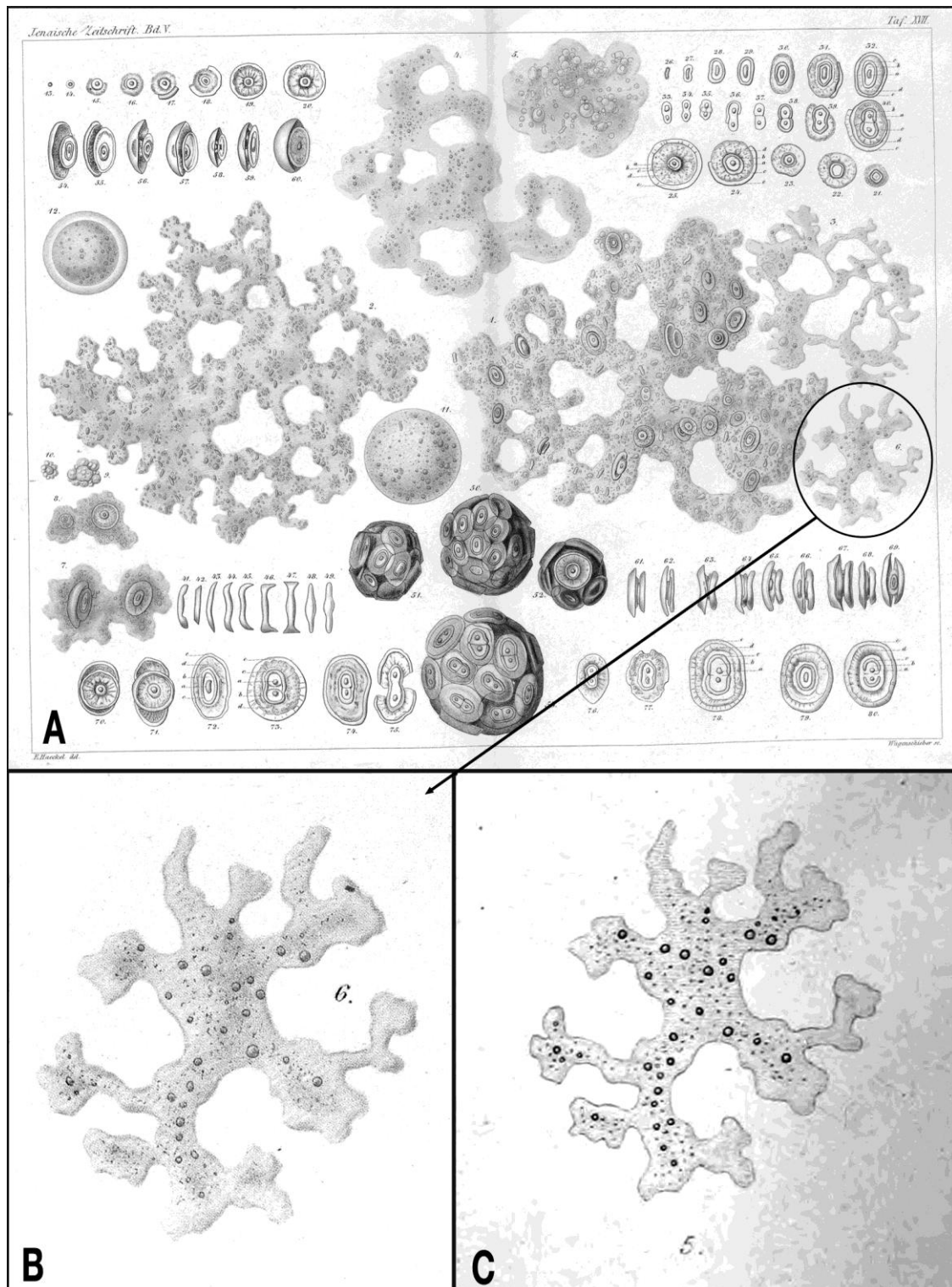


Figure 11. 1870->1871. The first adaptation of one of Haeckel's 1870 illustrations of *Bathybius* appeared in a plate in the *Quarterly Journal of Microscopical Science*, in the first issue of 1871, presumably January, 1871. It accompanied a review of Haeckel's 1870 "*Beiträge zur blastidentheorie*" (Anon. 1871) and showed an adaptation of one of the small illustrations in the original plate of Haeckel, shown here circled in "A", and enlarged in "B". The 1871 adaptation shown in "C", differs from the original in lacking the range of grey scale darkness, small contrasting dots added, and a greater definition of the outline. Nonetheless, it was the first of Haeckel's figures of *Bathybius* published in an English language journal, and it was more plausibly life-like, resembling an *Amoeba*, than the figures in Huxley's description (see fig. 9). Note that it lacks the empty spaces evident in Haeckel's other figures of *Bathybius*.

3.12. John Wild's 1873 most successful adaptation of Haeckel's 1870 central figure

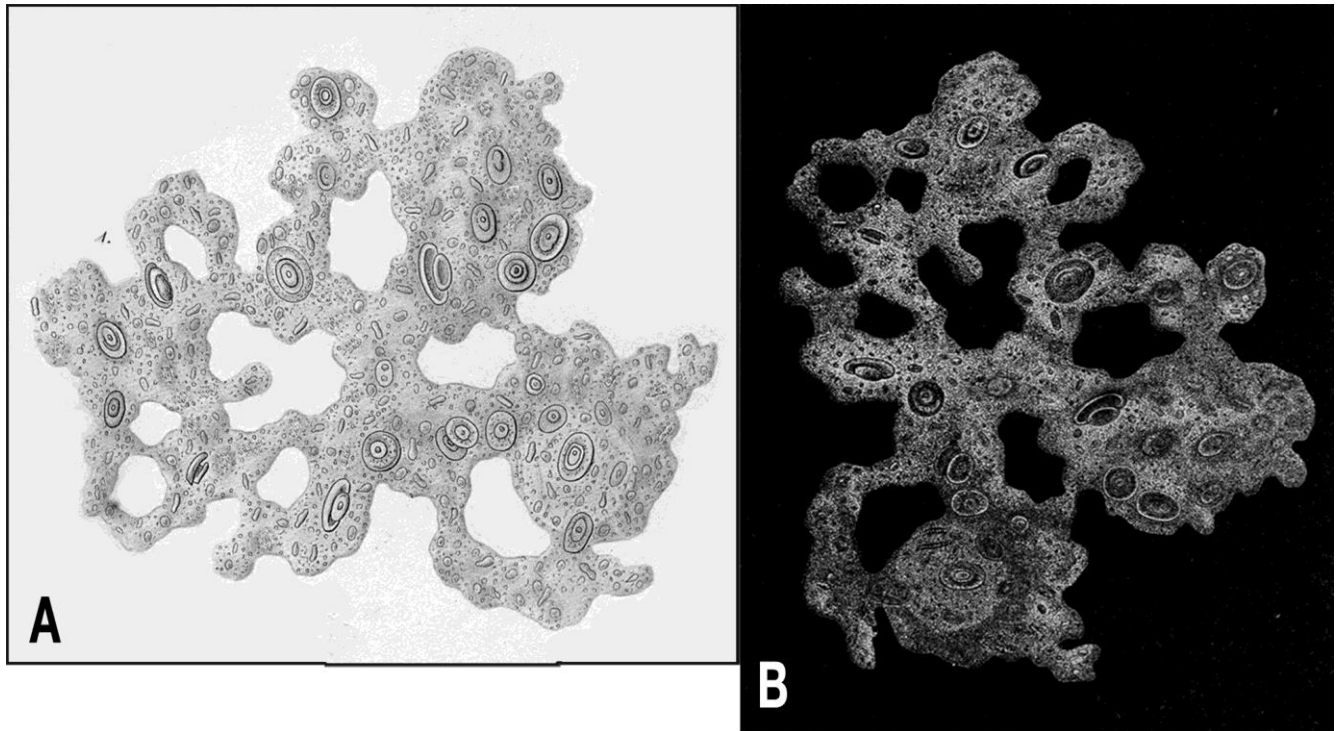


Figure 12. 1873 from 1870. Among the most significant, and widely distributed, adaptations of Haeckel's 1870 illustrations of *Bathybius* was the version very different from the original by John Wild. **A.** Haeckel's original large central illustration (see Fig. 4). **B.** The most widely copied illustration of *Bathybius*. It was drawn by John Wild, a professional illustrator (see Dolan 2026) and first appeared in the 1873 book, *The Depths of the Sea* (Wyville Thomson 1873). Wild altered the landscape orientation of the original, rotating the figure 90° clockwise to a portrait orientation, and used a black background. The viewer of an illustration in a landscape orientation most often examines the illustration from side to side while a portrait orientation is more likely viewed from top to bottom, or bottom to top. In the portrait orientation of Wild, the empty spots in the "mass" appear less evident than in Haeckel's landscape-oriented figure as attention is drawn to the top or bottom of the illustration. In known *Amoeba*, empty areas in the protoplasm do not exist (see Fig. 2). In addition Wild used a black background, with the figure drawn in gray-scale, a well known as an artistic device to give depth to a figure (e.g., Beck 1865). Wild's version of Haeckel's illustrations appears more *Amoeba*-like than the original as it is more three dimensional, and with empty spaces within the mass less evident. It appeared in publications during the 'life-time' of *Bathybius* (e.g. Anon. 1873; Packard 1874), and in a book published after the demise of *Bathybius* (Packard 1876). Wild's figure was pointed out as an excellent figure in a history of oceanography (Herdman 1923), and was the only illustration in a historian's article on *Bathybius* (Rehbock 1975).

3.13. Haeckel's 1874 iconic phylogenetic tree of humans showing evolution from primordial Moneren

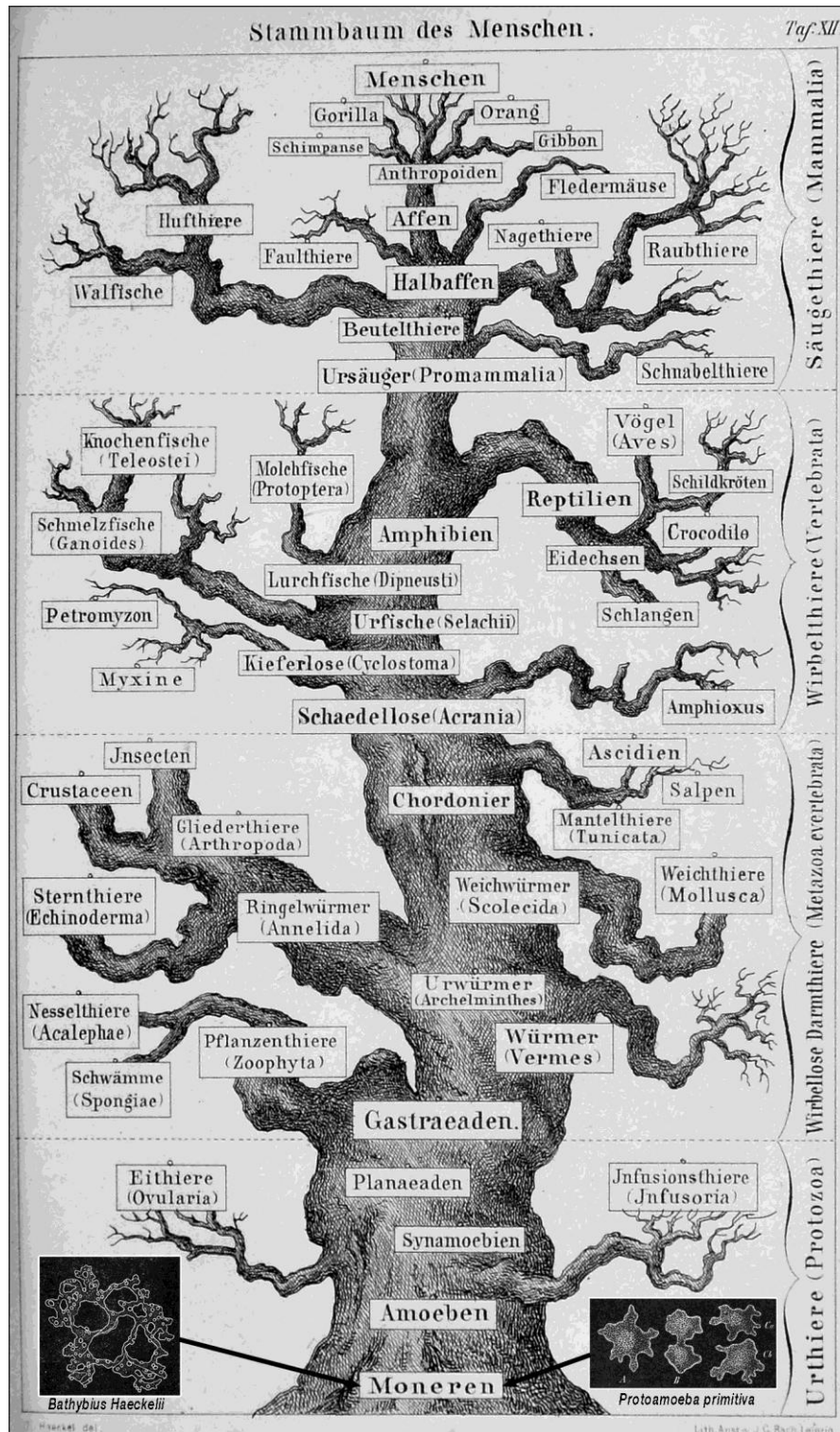


Figure 13. 1874. The phylogenetic tree of humanity from Haeckel's *Anthropogenie* (Haeckel 1874). The Moneren are at the base of the tree and humans are at the top. Of all of Haeckel's phylogenetic trees, it is the only one he drew as an actual tree with a thick base, and it has become iconic (Dayrat 2003). Notably, in the book, the only illustrations of Moneren Haeckel provided were those of *Bathybius* and *Protamoeba* (the illustrations from the book are added here to the tree, with lines connecting them to the Moneren). The figure of *Bathybius* first appeared in the 1870 edition of Haeckel's book "*Natürliche Schöpfungsgeschichte*" (Natural History of Creation), shown here in Fig. 7.B. The figures of *Protamoeba* appear to have been new drawings. Note that Moneren give rise to *Amoeba* as in Haeckel's 1868 tree (see Fig. 8.) but the Infusoria are depicted as branching off the *Amoeba* before the appearance of a group named "*Synamoeben*" a group giving rise to 'primitive multicellular' forms such as sponges (Reynolds & Hülsmann 2008). The images of *Bathybius* and *Protamoeba*, as well the tree, also appeared in the 1879 English translation of *Anthropogenie* (Haeckel 1879).

3.14. William Carpenter's 1875 adaptation of Haeckel's 1870 central figure.

The adaptation of Haeckel's illustration of Bathybius was published in 1875, in the fifth edition of a well-known book, the year that Bathybius was found to be an artifact. However, the forward to the book is dated December 1874. It was likely then the book was already available when Huxley announced the true nature of Bathybius in August of 1875. The adaptation of Haeckel's figure is then probably the last widely distributed drawing of Bathybius published just before it was revealed to be a mistake, and continuously distributed up to 1901 in later editions.

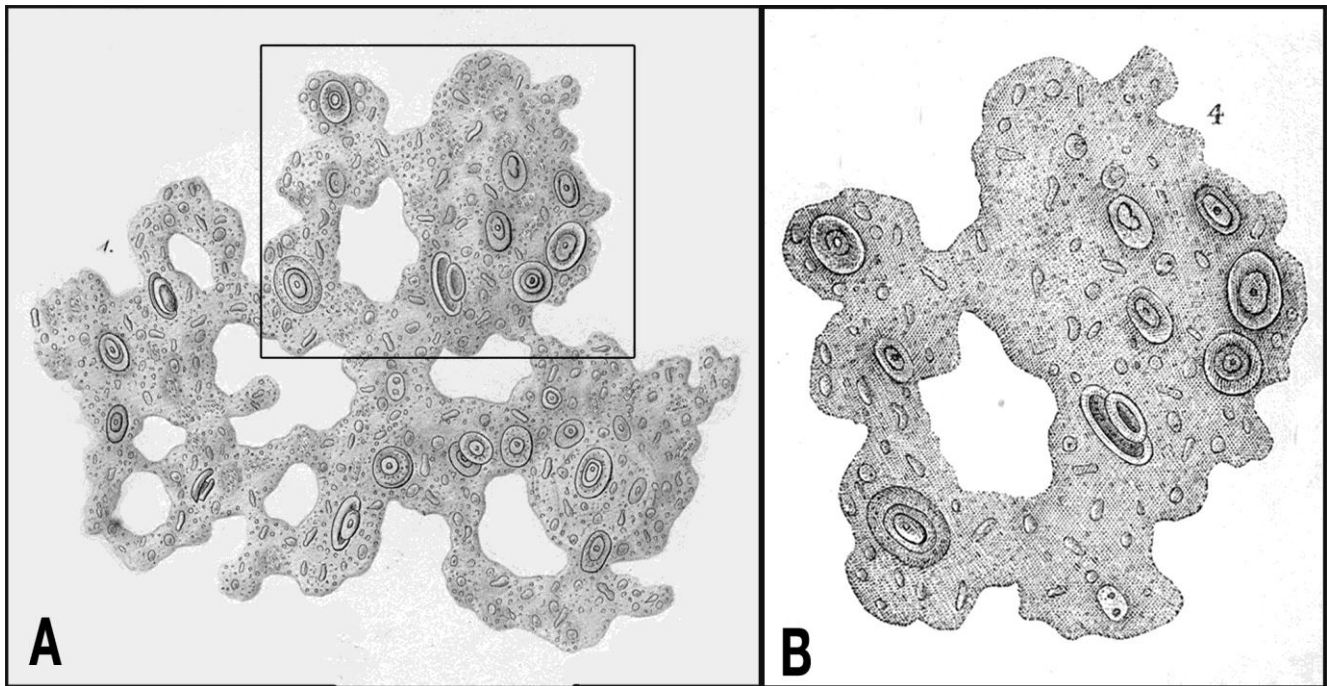


Figure 14. 1875 from 1870. The last significant, and widely distributed, adaptation of Haeckel's 1870 illustrations of Bathybius was the one that appeared in the 5th edition of William Carpenter's classic manual of microscopy, *"The Microscope and its Revelations"* (Carpenter 1875). **A.** Haeckel's original large central illustration (see Fig. 4), with a square added indicating the portion copied and shown in B. **B.** The Bathybius illustration first appeared in the 5th edition of *"The Microscope and its Revelations"* in 1875. In the adaptation, a portion of Haeckel's figure, shown in the square in A, was re-drawn as a separate, independent mass. The portion redrawn was rotated 10° anti-clockwise yielding a portrait orientation, and the edges at the bottom added. The empty portion in the figure is relatively small compared to empty portions in the entire figure of Haeckel. As mentioned in the legend of Figure 7, in known *Amoeba*, empty areas in the protoplasm do not exist (see Fig. 2). Nonetheless, the adaptation is the illustration of Bathybius most resembling known *Amoeba*. Oddly, in the text the figure is falsely stated to be after Haeckel's figure of a "living specimen". Recall that Haeckel's illustrations were all from his examination of the preserved mud sample he obtained in the autumn of 1869. The illustration and text description, as a live specimen, appeared for many years as it was reprinted in the 6th, 7th, and the 8th edition of 1901, the last edition of *"The Microscope and its Revelations"* (Carpenter, 1881, 1891, 1901).

4. Conclusions

Here, a novel approach was taken to telling the story of Bathybius, that of presenting a series of scientific illustrations. Among the illustrations shown are those that were presented to not only to the scientific community, but also the general public. Belief in the existence Bathybius, albeit temporary, of something living, which no one could possibly see alive in its alleged deep sea habitat, required evidence such as illustrations of something possibly life-like, by an authoritative personality. Huxley, just such a personality, discovered Bathybius, and declared it to be living gelatinous masses covering the bottom of sea. Such a discovery was only plausible because Haeckel had promoted the view that

gelatinous amoeboid microorganisms exist, and are the primordial forms which eventually gave rise to the diversity of life on earth. Left then to provide by Huxley was some evidence that living microscopic gelatinous masses exist on the bottom of the sea. However his illustrations showed nothing life-like. Notably, Huxley's illustrations were never reproduced. All the illustrations of *Bathybius* which appeared after Huxley's 1868 article were copies of Haeckel's illustrations, or adaptations of his illustrations. The personal opinion given here is that the 1873 and 1875 adaptations of Haeckel's illustrations of *Bathybius*, appeared more life-like because they resembled known amoeboid microorganisms, much more so than Haeckel's originals, and thereby significantly contributed to the acceptance of *Bathybius*.

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Google Translate, which uses generative AI, was employed to translate various texts. Some of the ideas presented here first appeared in my 2020 blog post on the website of the International Commission of the History of Oceanography: <https://oceansciencehistory.com/2020/07/13/the-famous-and-lesser-known-illustrations-of-thomas-huxleys-bathybius/>

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