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Review

René-Édouard Claparède (1832–1871), Pioneer Protozoologist and Comparative Anatomist

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Abstract: The pioneer Swiss naturalist René-Édouard Claparède (1832–1871), professor at the University of Geneva, left important contributions to diverse areas of natural science, biology, and comparative anatomy, including the structure of infusoria, annelids, and earthworms, the evolution of arthropods, and the embryology of spiders. He also published observations on marine invertebrates. This essay presents a brief overview of his academic life and work and makes the distinction from his nephew with the same name, the neurologist and educational psychologist Édouard Claparède (1873–1840).

Keywords: comparative anatomy; history of biology; neuroscience; zoology

1. Introduction

The Swiss naturalist René-Édouard Claparède (Figure 1A) was one of the most skilful, laborious, and honoured European zoologists [1]. He left important contributions to various areas of biology and natural science, including the structure of infusoria, annelids, and earthworms, the evolution of arthropods, and the embryology of spiders. He also published observations on diverse, mostly marine, invertebrates, including protozoa. His zoological publications left their mark on the evolution of comparative anatomy. There is little information about his life and work in the modern biomedical literature. In some instances, his work is confused with that of his nephew, the neurologist Édouard Claparède (1873–1940). The aim of the present study is to provide a brief outline of the academic life and research work of René-Édouard Claparède, 'senior'.

Figure 1. (**A**) René-Édouard Claparède. Undated, oil on canvas by unknown artist. Credit: Bibliothèque de Genève, Switzerland. https://notrehistoire.ch/entries/2PDBm5mPBbk (accessed on 22 February 2023). Signature from a manuscript dated 11 April 1865. Credit: The Waller Manuscript Collection, Uppsala Universitetsbibliotek, Sweden. http://waller.ub.uu.se/23553.html (accessed on

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22 February 2023). (**B**) Élie Metchnikoff in the early 1910s. Credit: George Grantham Bain Collection, Library of Congress Prints and Photographs, Washington, DC. https://www.loc.gov/pictures/item/2014694632 (accessed on 22 February 2023). Signature from a manuscript dated 28 March 1914. Credit: The Waller Manuscript Collection, Uppsala Universitetsbibliotek, Sweden. http://waller.ub.uu.se/36382.html (accessed on 22 February 2023).

2. Early Life and Academic Career

René-Édouard Claparède lived and worked in an era that witnessed some landmark events in the biological sciences and technology (Table 1). He was born on 24 April 1832 in Chancey, a Swiss village near the French border, not far from Geneva. Of French ancestry, the family had taken refuge after the revocation of the Edict of Nantes, a religious persecution. Claparède's father was a pastor. Although the family was highly cultivated, René-Édouard was the first to be involved in scientific research. Driven by an interest in nature and an inquisitive mind, the meticulous analyst sought precision in the details. Through rational reasoning, René-Édouard delved into the organisation of animals, as well as their similarities and differences [1,2].

Table 1. Chronology of select events in science and technology during Claparède's lifetime.

Year	Event
1832	René-Édouard Claparède born on 24 April; French naturalist Georges Cuvier dies on 13 May
1833	Swedish inventor Alfred Nobel born
1834	German zoologist Ernst Haeckel born
1837	Louis Daguerre invents photography
1838	Theodor Schwann formulates cell theory
1843	Italian pathologist Camillo Golgi born; German physician Robert Koch born
1845	Russian-French microbiologist Élie Metchnikoff born
1849	Hippolyte Fizeau and Léon Foucault measure speed of light; Russian physiologist Ivan P. Pavlov born
1852	Spanish histologist Santiago Ramón y Cajal born
1855	Alfred R. Wallace publishes *Law which has regulated the introduction of new species*
1856	Austrian psychoanalyst Sigmund Freud born; Serbian-American inventor Nikola Tesla born
1857	Russian physiologist Vladimir M. Bekhterev born; English physiologist Charles S. Sherrington born
1859	Charles R. Darwin publishes *Origin of species*; Rudolf Virchow publishes *Die Cellularpathologie*
1863	Thomas H. Huxley publishes *Man's place in nature*
1865	Claude Bernard publishes *Introduction à l'étude de médecine expérimentale*
1866	Gregor Mendel proposes basic principles of heredity
1869	Friedrich Miescher discovers 'nuclein' (now known as DNA)
1871	Charles R. Darwin publishes *Descent of man* on 24 February; Claparède dies on 31 May

In 1852, Claparède began to study natural science, medicine, and northern languages in Berlin, where he became a pupil of the eminent zoologist Johannes Müller (1801–1858) a year later. With Müller, they journeyed to Norway in 1855 on a desolate reef. The young student spent time drawing details of marine animals through the microscope [2].

Claparède was also influenced to a great degree by Christian Gottfried Ehrenberg (1795–1876), the German naturalist, zoologist, comparative anatomist, geologist, and microscopist, whose research concerned the anatomy and metamorphoses of echinoderms. Due to the influence of Ehrenberg, Claparède developed a strong interest in micrography.

Between 1851 and 1852, Claparède attended courses taught by renowned experts in paleontology, including Georges Cuvier (1769–1832), Étienne Geoffroy Saint-Hilaire (1772–1844), and Augustin Pyramus de Candolle (1778–1841) [1].

Claparède obtained his M.D. degree in 1857, but he never practised clinical medicine. In 1862, he was appointed professor of comparative anatomy at the University of Geneva. He became a member of the Physical Society, the Medical Society, and the Geneva National Institute. At the Geneva Academy, he was trained by François-Jules Pictet de La Rive (1809–1872), a Swiss zoologist, palaeontologist, and advocate of progressive creationism. As a professor of zoology, next to Pictet who always recognised the academic potential in his apprentice, Claparède, in his lectures, defended opposing views to those of earlier authors, a fact that created great displeasure in the church circles. Moreover, he became involved in editing the series titled 'Universal Library of Sciences, Literature and Arts' (*Bibliothèque Universelle des Sciences, Belles-Lettres et Arts*), and served as a reviewer for the 'Swiss Archives' (*Archives Suisses*), with "his admirable style of writing, especially the reviews and criticisms" [3]. Claparède was one of the most laborious editors of the 'Bulletin of the Archives of the Universal Library' (*Bulletin des Archives de la Bibliothèque Universelle*), publishing numerous scholarly analyses and reviews over a period of 15 years [2]. He had already authored several important papers during his student years, most of them appearing in 'Müller's Archive for Anatomy, Physiology and Scientific Medicine' (*Archiv für Anatomie, Physiologie und Wissenschaftliche Medicin von Dr. Müller*), such as the 'Anatomy and developmental history of *Neritina fluviatilis*' (1857), 'Supplement to a memoir by G.-R. Wagener: On *Dicyema* et cetera' (1857), and 'Contribution to the anatomy of *Cyclostoma elegans*' (1858), which were works that secured him an important place among zoologists of that era. For instance, in a review on *Actinophrys eichhornii*, Claparède documented a large contractile vesicle considered to be a heart-shaped organ [2,4]. He further described the mode of digestion in these animals, capable of enveloping and digesting vegetable and animal matter through any part of their body through an orifice that served either as a mouth or an anus, a feature that would classify them among the rhizopods [2].

René-Édouard could write in French and German equally well; therefore, some of his works are found in German periodicals, others in French, such as in the 'Transactions of the Academy of Geneva'. Being bilingual, he had access to both the French and German scientific literature and, consequently, appeared critical to naturalists who might exhibit superficiality or dishonesty in their field of study. For instance, the research of the French embryologist Édouard-Gérard Balbiani (1823–1899) on the development of *Aphides* became the subject of a three-year investigation by Claparède. After meticulously studying the publications of Balbiani on the embryology of *Aphis* while in Naples, Claparède came to the conclusion that they were unfounded and inconsistent with the work of Balbiani's predecessors. Félix Dujardin (1801–1860) was also treated harshly in *Recherches sur les infusoires*, as was Charles Marie Benjamin Rouget (1824–1904), who appeared to have personally resented Claparède's rectification [3]. In 1860, Claparède married his cousin, Eveline Claparède (1840–1910), and became financially independent. His house became a centre of scientific exchange [2].

Although famous in the scientific world, Claparède was not widely known to the general public. It was in 1860 that he gained renown through a popular course that he offered in Geneva. Without a doubt, he was one of the individuals who contributed the most to overthrowing the old conservative prejudices against modern science [2].

Upon publication of Darwin's *Origin of species*, Claparède became one of the first scientists in Switzerland and the French-speaking world to promote Darwinian natural selection and to further support it with his own observations, especially the detention

organs of certain species of mites. At the end of his article on the development of mites, Claparède devotes a chapter in support of Darwin's theory, by showing that the apparatus which serves as a holdfast in parasitic mites escaped the law of homology. In effect, it was not a fixed organ, fulfilling such functions, but on the contrary, an organ modified in various species by adaptation to similar functions. In some species, it became the forelimb, in others the hindlimb; in *Listophorus larisi*, it is the lower lip that transformed into a fixed organ [2].

He epitomized Darwin's theories in the quote: "It is better to be a perfect ape than a degenerate Adam" [5]. Along with his colleague Carl Vogt (1817–1895), a prominent naturalist in Geneva, and Thomas Henry Huxley (1825–1895) in England [1], Claparède made efforts to popularise Darwinism [6]. Claparède adopted Darwin's theory of natural selection and published a series of pertinent articles on the subject [7]. He further discussed the insight of the leading evolutionary thinker Alfred Wallace on natural selection [8]. Although Darwin hardly considered the various reviews noteworthy, he singled out Claparède with the remark: "There is a favourable and long review in *Revue Germanique*, which is important from coming from so good observer, as Claparède" [4,9].

In 1862, the Society of Sciences in Utrecht awarded Claparède a gold medal for his research on the embryonic development of spiders (dorsal position of the embryo during the first development period, instead of turning over to roll up in the belly as in other arthropods). Claparède further investigated their blood circulation and observed that the blood escaping from the heart circulated not from back to the front, but in the opposite direction, as Franz von Leydig (1821–1908) had already proposed [2,10].

3. Contributions to Zoology and Comparative Anatomy

In Berlin, Claparède, in collaboration with Johannes Lachmann (1832–1860), made a substantial effort to study infusoria and rhizopoda (*Études sur les infusoires et les rhizopodes*, 3 parts, 1859–1868), which was one of the earlier extensive works, and a most impressive monograph, comprising some 200 protist species, most described for the first time [11,12]. In that study, the authors presented parasitic forms (the ciliate *Balantidium*), a variety of invertebrate groups, tintinnid ciliate species, and dinoflagellate species. The observations on dinoflagellates, known as *peridiniens,* led them to state that many forms appeared to contain ingested food items, suggesting that dinoflagellates were more animal-like than plant-like [10]; Claparède and Lachmann submitted their tome *Sur la réproduction des infusoires* in 1855. It consisted of 302 pages and 11 plates containing 192 figures. This work, along with another authored by Nicolaus Lieberkühn, earned the grand prize in the physical sciences from the Academy of Sciences of Paris for the year 1856. Claparède and Lachmann were quite young when they won, both 26 years old, while Lieberkühn was 36, and later became an expert on sponges [3,10,12,13]. Lachmann died before the work was completed, in 1860, having not quite reached his 28th birthday. Additionally, this study immediately placed its authors among the experts in zoology and formed the foundation of the modern views on infusoria. Furthermore, Claparède and Lachmann showed that infusoria are neither as complicated as Ehrenberg had argued, nor as simple as claimed by Félix Dujardin (1801–1860), whose theory had long dominated the field [10]. Although Claparède and Lachmann initially supported the 'polygastric theory' of Ehrenberg, they subsequently made taxonomic refinements and advances, firmly establishing the suctoria as a separate and definitive group. Lachmann [11] proved wrong the view of Friedrich Stein (1818–1885), wherein suctoria were larval stages of peritrichs. They established the affinities of infusoria with the worms and the coelenterates on one hand, and with rhizopods on the other, satisfactorily classifying them for the first time. They also distinguished 10 families, described several species, and extended the knowledge on their organisation [2,9,11].

Although their work was overshadowed by subsequent publications by Georg August Zenker (1855–1922), Ronald Cohn (1943–2022), and other investigators who had better instruments at their disposal, the studies of Claparède and Lachmann are the ones that set the foundations of modern research on infusoria [9].

In the summer of 1859, Claparède visited the English physician William Benjamin Carpenter (1813–1885), an invertebrate zoologist, physiologist, and one of the founders of the modern theory of the adaptive unconscious. They worked together on the microscope in the Hebrides, chiefly on worms and annelids. Their expedition resulted in an account of new marine species related to earthworms, richly illustrated with plates and many observations on turbellarian worms. Papers were published in the *Proceedings of the Royal Physical Society of Edinburgh*, 'Reichert's Archive', and the 'Reviews of the Physical Society and Natural History of Geneva' (*Mémoires de la Société de Physique et d'Histoire Naturelle de Genève*). Jointly, with Carpenter in 1860, Claparède also published certain observations on *Tomopteris onisciformis* in the *Transactions of the Linnean Society of London* [2,3].

In Geneva, Claparède continued to observe the limicolous annelids. In his 'Anatomical research on oligochaetes', published by the Geneva Academy, he described the structure of the worm nervous system and the three large tubular fibres for the first time. This research appeared in print in the 'Reviews of the Physical Society and Natural History of Geneva' (*Mémoires de la Société de Physique et d'Histoire Naturelle de Genève*). With this work, he enriched zoological knowledge with a complete account of anatomical and systematic differences among many worms, such as the demonstration of the homology of the segmental organ with the reproductive ducts. Until then, such details were neglected and misunderstood [2,3].

From 1854 to 1857, Claparède and Lachmann were members of a study group in Berlin under Müller's guidance. Another member of that group, who later became a lifelong friend, was the zoologist and naturalist Ernst Haeckel (1834–1919), who promoted Darwin's work in Germany. Claparède and Lachmann had a great influence on Haeckel's work on protists, as well as Radiolaria, in particular [10].

In the winter of 1866, despite his severe health problems, Claparède devoted himself to his immense studies on the annelids of the Gulf on Naples and other seacoasts (Normandy, Hebrides), a "most striking discovery" [3] that largely filled volumes 19 and 20 of the *Mémoires de la Société de Physique et d'Histoire Naturelle de Genève.* This work presented many new forms and a wealth of anatomical and physiological facts depicted in more than 50 heavy plates. Claparède found that *Nereis dumerilii* lays sexually-fertilised ova, which produce a worm that belongs to a distinct genus (*Heteronereis*) after hatching. This worm lays similar ova, which sometimes produce a second kind of *Heteronereis*, or in other seasons, the original form of *Nereis dumerilii* again. This is a real case of alternation of 'sexual generations' on record [3]. His research on the structure of sedentary annelids (*Recherches sur la structure des Annélides sédentaires*) was posthumously published in 1873 [4,12].

In 1867, Claparède published a study on the nervous system of the earthworm (*Lumbricidae*), where he also observed the arrangement of the dorsal intromittent organ (*cirrus*) and announced its developmental history at the Congress of the Swiss Natural Research Society, held in Einsiedeln [9]. Moreover, between 1867 and 1869, Claparède collaborated with Élie Metchnikoff (1845–1916), who was working in Odessa at the time, on the developmental history of the chaetopods, publishing an early and rare work with six plates [13] (Figure 2).

Metchnikoff (Figure 1B), a Russian-French zoologist, cytologist, embryologist, and immunologist, is considered the 'father of natural immunity'. In 1882, he discovered phagocytes or macrophages, the differentiated form of mononuclear leukocytes, when they migrate from the blood into other tissues. In 1908, he was jointly awarded the 1908 Nobel prize in physiology or medicine with the German physician Paul Ehrlich (1854–1915) for their discoveries concerning immunity. Metchnikoff established the concept of cellular immunity, while Ehrlich established the concept of humoral immunity. Having graduated from the University of Kharkov in 1864, Metchnikoff studied invertebrate and fish embryology at several European centres and earned his doctorate from the University of Saint Petersburg in 1867. After teaching and conducting research in Saint Petersburg and Odessa for a year, he occupied a post in Messina, Italy. It was there that he began his immunological studies. He hypothesized that there were cells that become actively

mobilised against foreign bodies to either kill and assimilate them or to destroy themselves in the process. On his way back to Odessa, he stopped in Vienna, where Carl Claus (1835–1899), the professor of zoology, suggested to him the terms 'phagocyte' and 'phagocytosis'. Metchnikoff confirmed the defence role of phagocytes by conducting experiments with the freshwater crustacean *Daphnia* after administering spores of the parasitic fungus *Monospora bicuspidata*, which were attacked by the host's phagocytes.

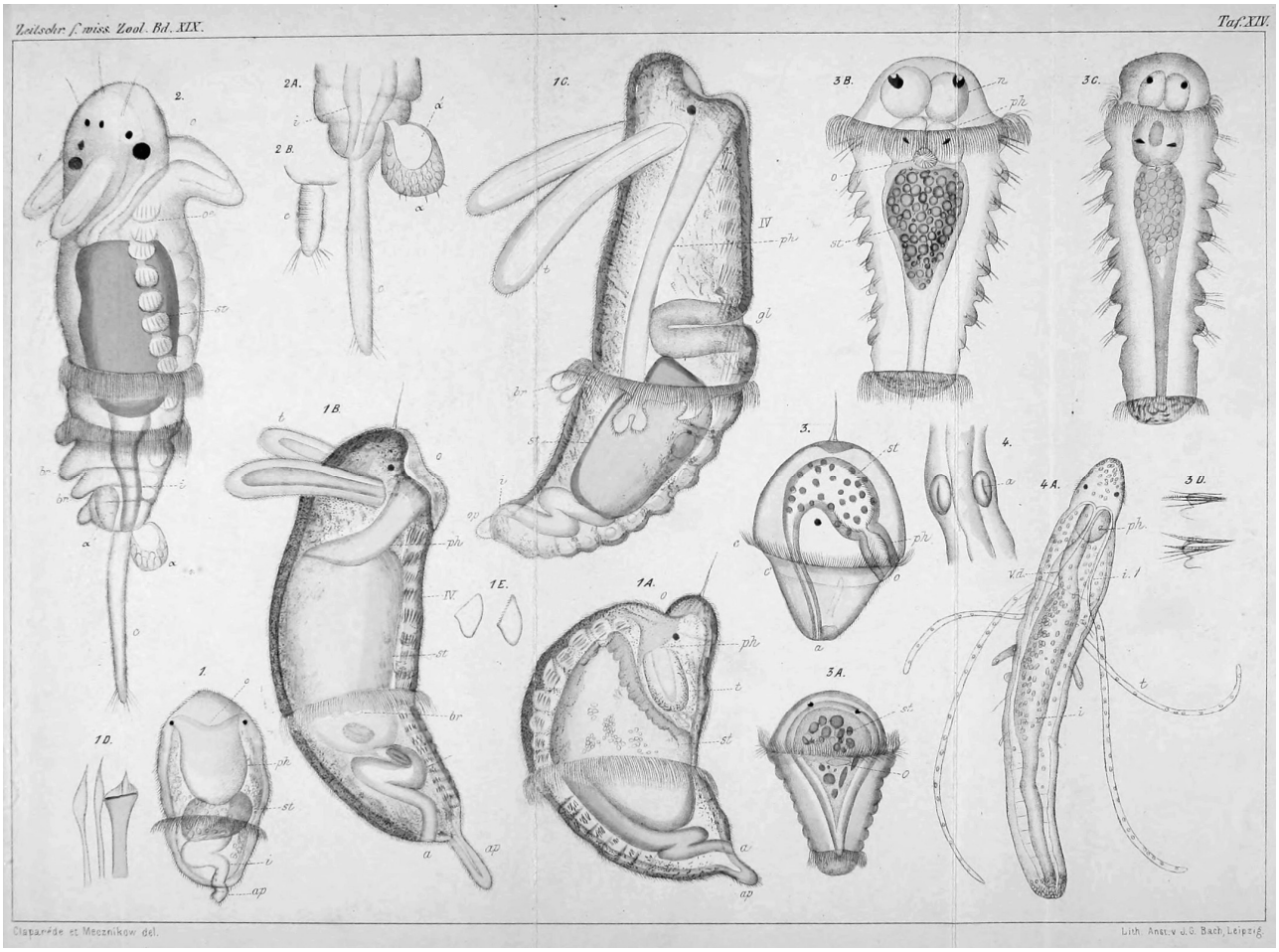

Figure 2. A plate from the study by Claparède and Metchnikoff [14] depicting the larval and later developmental stages in several indigenous marine worms from the Gulf of Naples. Drawings *1–1E*: *Telepsavus Costarum Claparède*. ×75 (*1*), ×40 (*1A*, *1B*, *1E*), ×35 (*1C*), ×150 (*1D*). Drawing *2*: A larva probably belonging to *Phyllochaetopterus socialis Claparède*. ×50. Drawings *3–3D*: Development of *Nephthys scolopendroides Delle Chiaje*. ×130 (*3*), ×150 (*3A–3D*). Drawings *4–4A*: Developmental stages of *Cirratulus spectabilis Kinberg*. ×20. Source: The Biodiversity Heritage Library. https://www.biodiversitylibrary.org/item/159258 (accessed on 22 February 2023).

Metchnikoff and Claparède were both influenced by Darwin's theory of natural selection and by Haeckel's biogenetic principle. In the last phase of his career, Metchnikoff delved into the study of the ageing of organisms and the extension of life. He is the investigator who introduced in medicine the term 'Gerontology' for the emerging science of ageing and longevity. Moreover, he found that certain bacteria (today's 'probiotics') may protect against pathogenic microbes in the intestinal flora.

Although Claparède had a predilection for lower species, he occupied himself with the most varied subjects and often wrote extensive notices aimed at offering a summary of recent work on diverse scientific topics. One finds many reviews of this kind related to

topics in physiology, zoology, geology, and even archaeology, while in other articles, he addressed advanced problems of natural philosophy [2].

In 1858, Claparède made certain comments on the theory of binocular vision and the horopter, leading him to study the visual physiology of the compound eye and publish various reviews. By completing numerous experiments, he confirmed the demonstrations of Jean-Louis Prévost (1838–1927) regarding the visual area covered by the two eyes through the aiming point and the optical centres. These studies led him to the study of the compound eye of arthropods, the evolution of which he followed in various nymphs. The resulting paper was published in 1863 in Leipzig [2,9,15]. He concluded that the theory of vision in insects, as formulated by Müller, was not tenable, as the animal would be so nearsighted that it could barely see a few feet away.

Additionally, there was a collection of miscellaneous observations, finely illustrated and published on zootomic gleanings (*Glanures zootomiques*) and observations on invertebrates (*Beobachtungen über wirbelloser Thiere*) about annelids, free-living worms, and forms of paradoxical marine larvae. His works covered the circulation of spiders (transparent young of the genus *Lycosia*), new modes of reproduction, new anatomical details and physiological observations of rare forms, and the development of the marine gastropod *Neritina fluviatilis*. Claparède showed that this gastropod was not a hermaphrodite, and its testaceous operculum had a different structure from that of the shell. Such a claim went against the view of John Edward Gray (1800–1875), who argued that the operculum was a second atrophied valve [9].

Claparède's doctoral dissertation centred on *Cyclostoma elegans*, a freshwater bivalve, a gastropod, in which he described a calcareous organ composed of concentric layers, an organ that had remained unknown until then in gastropods; it appeared in Müller's *Archiv für Anatomie und Physiologie* [2,12] (Figure 3A). Moreover, Claparède produced an elaborate work on the development of nematode worms, with many new and detailed facts (including the significance of the parts of their ova), in German. His studies on the anatomy of acarids provided new details, such as the modification of dissimilar parts in different genera to form identical organs, which Claparède explained satisfactorily through Darwinian evolutionary theory [2,3]. He also clarified the special conditions of the blood circulation in *Acarina* mites (the existence of lateral openings in the heart that gape during diastole) [9].

Another study, abundant with curious facts, concerned the particular discovery of a double and even triple interlocking of the egg, a phenomenon that the author designated with the terms *deutovum* and *tritovum*. However, such a singular phase of development is not found in all species; it is lacking in *Tetranychus*, which lives on plants; the *deutovum* is observed in *Unionicola bonzi* (*Atax bonzi*), common parasites of freshwater mussels living on the gills or mantle of their hosts, and the *tritovum* appears in *Myobia*, in particular *Tyrophagus muris*, a parasite that infects mice [2].

His last published work was in the 'Journal of Scientific Zoology' (*Zeitchrift für Wissenschaftliche Zoologie*) and consisted of observations on the anatomy and reproduction of marine polyzoa, accompanied by three colour plates. The minutest and most careful piece of work that he ever produced was a review on the histology of the earthworm, illustrated with six colour plates [3,16]. The biologist Émile Yung (1854–1918) compiled, in 1904, some of Claparède's works. Henri de Saussure (1829–1905), a Swiss mineralogist and entomologist and a prolific taxonomist, in his 'Notice sur Édouard Claparède' (1871), listed 58 published and unpublished works by Claparède, including analyses of works of other authors by Claparède for the 'Bulletin of the Archives of the Universal Library' [1,2]. Due to Claparède's premature death, a large work on the embryology of insects and microscopic preparations on the histology of annelids remained unpublished [2,3].

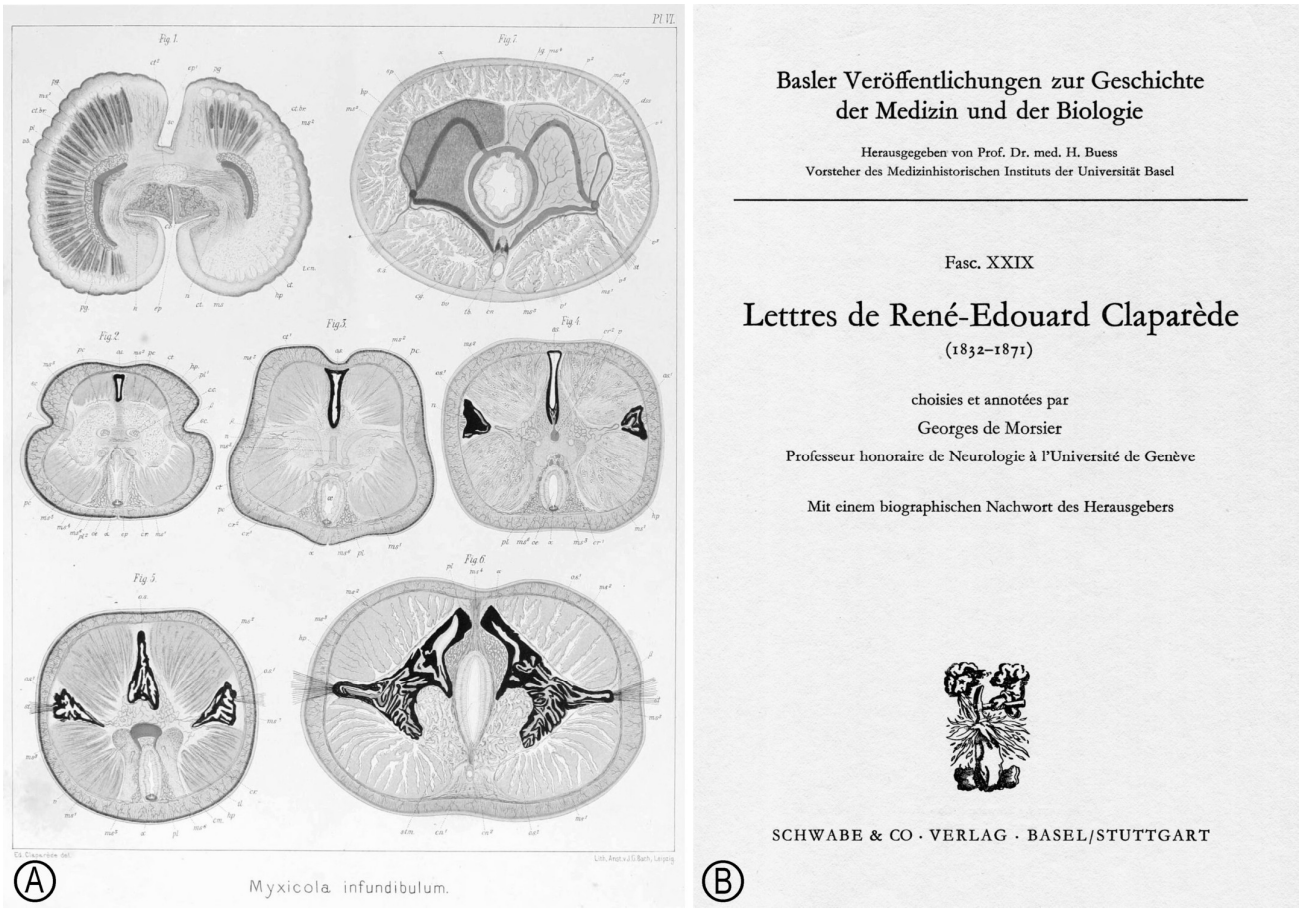

Figure 3. (**A**) Histological structure of the polychaete worm *Myxicola infundibulum*, from Claparède's posthumous work on sedentary annelids [12]. Source: The Internet Archive. (**B**) The book of Claparède's correspondence to his family, compiled and edited by the French-Swiss neurologist Georges de Morsier (1894–1982), former director of the Geneva University Neurological Clinic, including a biographical note by the Swiss gynaecologist and medical historian Heinrich Buess (1911–1984), former director of the Department of Medical History at the University of Basel [9]. (Author's private library).

4. Personal Life

Table 2 summarises the chronicle of main events in Claparède's life and scientific work. To commemorate the centenary of the death of Claparède, Georges de Morsier (1894–1982), a French-Swiss neurologist and honorary professor at the University of Geneva, produced a booklet with extracts from 231 of Claparède's letters, written between 1855 and 1871 and addressed to family members (Figure 3B). In those letters there were ironic allusions to Samuel Hahnemann (1755–1843), a German physician, known as the founder of homeopathy, to Müller and to Louis-Napoleon Bonaparte (1808–1873), the future Napoleon III and first President of France. Additionally, in some of these correspondence items, Claparède, similar to many Swiss citizens, made satirical remarks about Prussian politics, when relations between Switzerland and Prussia were quite tense because of the Neuchâtel Affair [9,15]. There is an afterword by Heinrich Buess (1911–1984), a Swiss gynaecologist and head of the Medical History Institute of the University of Basel. It is written in German, while the rest of the book is written in French [15].

Table 2. Chronology of events in the life and scientific career of René-Édouard Claparède.

Year	Events
1832	Born in Chancey, Switzerland
1852	Enters Friedrich Wilhelm University in Berlin
1853	Studies under Johannes Müller
1855	Journeys to Norway; completes study on infusoria with Johannes Lachmann
1856	Awarded *Grand Prix* from the French Academy of Sciences
1857	Earns M.D. degree from Berlin University
1858	Comments on theory of binocular vision
1860	Marries Eveline Claparède
1862	Appointed professor of comparative anatomy in Geneva; receives Gold Medal from Utrecht Society of Sciences
1866	Investigates coastal annelids from Naples, Normandy, and Hebrides
1867	Publishes on the nervous system of the earthworm; begins collaboration with Élie Metchnikoff
1871	Dies in Siena, Italy

Claparède was a resolute advocate of the philosophy of Immanuel Kant (1724–1804) and a convinced subjectivist. He seemed to lean toward dynamic pantheism, in other words, the argument that repulsive force is required for matter to fill space. Such a trend was common among naturalists, and led, early in his career, to frequent disagreement with persons adhering to dogma. Nevertheless, a few years later, as he gained fame, Claparède became appreciated by his critics [2].

Based on a series of unpublished letters, Claparède reportedly suffered from various illnesses over two decades, beginning in his student years, when he was stricken by arthritis, which also affected his heart and led to further complications in 1854. Despite the lack of effective remedies at the time, Claparède responded to his treatment by internist Heinrich Quincke (1842–1922), who is known for the introduction of lumbar puncture as a diagnostic and therapeutic method. Claparède also underwent squint surgery by Albrecht von Graefe (1828–1870), the Prussian pioneer in ophthalmology [9]. The strict diet that Claparède followed in order to bring about some relief of symptoms only worsened his weakness and led to further complications that even his physicians could not predict. A frequent neuralgia caused excruciating pain and, to cope with it, Claparède resorted to extreme means [2]. Shortly before his final exams in 1857, he suffered a severe episode of heart failure. In 1865–1866, he survived typhoid fever, and his work was interrupted. He also suffered from rheumatic pain in the right knee, which worsened as a result of incorrect medical treatment, and from haemorrhagic cough, in addition to hearing problems. Yet, the researcher in him presented one treatise after another and gained international reputation. He died on 31 May 1871 in Siena, one month after his 39th birthday, most likely of tuberculosis. He was survived by his wife and their two young children [2,4,9,10].

Claparède bequeathed his scientific library of books and documents to the City of Geneva by a deed of will. The rich collection filled an important gap, which had long occurred in the Geneva Public Library. His wish was that, at the conclusion of his own career, others would continue to benefit from the records that he had accumulated during a lifetime of research work. Moreover, he also wished to promote scientific development of his native city. Thus, through this act of beneficence, future generations would have a chance to become aware of his personal efforts [2].

In Geveva, the Claparède Plaza was dedicated in his memory. Furthermore, the Lacustrine Zoological Station, created by Yung, was also named after Édouard Claparède senior. In October 1911, a fund was raised by Claparède's daughter, which allowed the

purchase of a motorboat for lake searches. There is an old postcard, from the Julien Brothers personal collection, which depicts that boat.

Claparède's nephew, the pioneer neurologist, psychologist, and educator Édouard Claparède (Figure 4B) had also a distinguished career [17,18]. Details on his life and work from a historical and a modern perspective will form the subject of a separate study. In brief, he earned his M.D. degree in 1897 from the University of Geneva, and he left important contributions to diverse areas, including hemiplegia, the association of ideas, the nature of sleep, stereopsis, synaesthesia, memory systems in the brain, psychoanalysis, animal behaviour, comparative and evolutionary psychology, and the developmental human psychology. In 1912, he co-founded, with Pierre Bovet (1878–1965), the *Jean-Jacques Rousseau Institute*, devoted to experimental research on child development and educational methods. While René-Édouard Claparède 'senior' (Figure 4A) promoted Darwin's ideas in the French-speaking world [7], Édouard Claparède 'junior' played a key role as the mentor of developmental psychologist Jean Piaget (1896–1980) [19].

Figure 4. (**A**) Portrait of the zoologist René-Édouard Claparède (1832–1871), circa 1870. Photograph by Attilio Runcaldier (1801–1884) and François Artus (1823–1909). Credit: Bibliothèque de Genève, Switzerland. https://bge-geneve.ch/iconographie/oeuvre.icon-o-1924-47 (accessed 22 February 2023). (**B**) Portrait of the neurologist Édouard Claparède (1873–1940), sitting in his office. Photo contributed by Elphège Gobet. Galeries de l'Institut J.-J.Rousseau. Credit: Bibliothèque de Genève, Switzerland. https://notrehistoire.ch/entries/bl3Wxnd0B9m (accessed 21 March 2023).

5. Conclusions

Claparède was an extraordinary researcher and one of the greatest Swiss zoologists [1,15]. With his "indomitable spirit" [11], he enriched science. One can only speculate about the work that he might have produced had he lived longer. An ardent explorer, he served zoology and comparative anatomy with passion and unravelled scientific facts hitherto unknown. His scientific exploits set the tone for further research by his contemporaries and by future scholars.

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