

Early speculations about Earth expansion by Alfred Wilks Drayson (1827-1901) and William Thorp (1804-1860)

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Abstract

In 1859, speculations about the possibility of Earth expansion were entertained by the Victorian polymathic scientist Alfred Wilks Drayson and his good friend William Thorp, a respected geologist and founding member of the Yorkshire Geological Society.

Drayson outlined his speculations about Earth expansion in his 1859 book, *The Earth we Inhabit, Its Past, Present and Future*. This seems to be the first book devoted entirely to considering the possibility of Earth expansion. Thorp and Drayson also presented the first known lecture about Earth expansion to geologists at the Yorkshire Geological Society in 1859. Despite the interest shown in Earth expansion at the time these early speculations were essentially forgotten until Drayson's book was briefly mentioned by Professor S. Warren Carey in 1988, whilst Thorp remained overlooked.

Drayson was an officer in the British Royal Artillery, eventually reaching the rank of Major-General. In addition to distinguishing himself in his military profession, he also became a Military Professor at the Royal Military Academy, Woolwich. Drayson later became friends with Arthur Conan Doyle, the world-renowned author and creator of Sherlock Holmes, who was so impressed with Drayson's scientific achievements he immortalised him within his books as various fictional characters.

Key words: biographies - Earth science history - expanding Earth

The early life of Alfred Wilks Drayson

Alfred Wilks Drayson was born at Waltham Abbey, Essex, England on 17th April, 1827. From the age of eleven he was educated at the Rochester Grammar School but he was obliged to discontinue his attendance two

years later due to a severe attack of scarlet fever. During his recovery his elder brother, a civil engineer, took him surveying to give him both healthy outdoor exercise and a useful skill. He had become accustomed to the use of the theodolite, sextant and compass before he was fourteen years old.



Figure 1. The Military Professors and Instructors at Woolwich in 1869, as reproduced in the book, *The Shop: The Story of the Royal Military Academy* published in 1902. The man facing us on the far right is identified as Major Drayson.

After Drayson had recovered he took a three-year course as a gentleman cadet at the Royal Military Academy, Woolwich.

The Royal Military Academy at Woolwich in south-east London was for the training of commissioned officers of the Royal Artillery and Royal Engineers. According to its first Royal Charter the remit of the academy was to produce "good officers of Artillery and perfect Engineers". Woolwich Academy trained ordnance corps in essentially scientific subjects. The "preliminary examination" entailed qualifying in mathematics, a modern language, English composition and dictation, the elements of geometry and geography.

After graduating, Drayson was sent to South Africa as a newly commissioned lieutenant in the Kaffir War in 1847 and the Insurgent Boer War in 1848. His knowledge of the

Kaffir and Zulu languages was of great service in both campaigns. On his return home he was promoted to Captain.

In 1852 Drayson married Mary Catherine Preece, the elder sister of William Henry Preece, an extraordinary Victorian Engineer who was later knighted. In a biography about Sir William Preece, Baker (1976) recounted how both men enjoyed playing billiards together although Drayson was easily able to beat his brother-in-law.

In 1858 Drayson was made adjutant at the Royal Military Academy, Woolwich. His new duties at the Academy included lecturing to the young gentlemen cadets on surveying and astronomy.

Drayson was described as a man sporting a long moustache, a large forehead, receding hairline and deep-lined brows. A book

written by Guggisberg (1902), *“The Shop”*: *the story of the Royal Military Academy*, provides us with a drawing of Drayson relaxing at the Academy in 1869 with the other Military Professors and Instructors.

The book also gives some ideas of the academic duties involved. A Professor “gave one lecture a week to each of the first and second classes in the east lecture room”. About one third of the time was spent on military tactics while briefly dealing with transport and supply, which would have included surveying.

Captain Drayson considers Earth expansion

It would seem that his new duties at Woolwich allowed Captain Drayson enough time to pursue a wide range of other interests, and these often resulted in the publication of an extensive range of books encompassing adventure stories, outlines of interesting scientific theories, and practical text books on surveying and astronomy.

After he took up his new position Drayson (1858) published a story based on his own adventures in South Africa. In the same year Drayson and Binney (1858) obtained a patent and published a monograph with suggestions for future improvements to the recently laid telegraph cables between Britain and Continental Europe, which had recently broken.

The invention was basically a mechanism to allow the telegraph cable to stretch without breaking. It is interesting to note that this invention introduces the possibility that two continents were moving apart, a concept that was later introduced in his book speculating about Earth expansion.

None of these activities seemed to prevent him from being an effective Military Instructor at Woolwich and “The Shop” book indicates that he was promoted from Captain to Major during the next decade. This rise through the ranks would continue for the fifteen years he remained at Woolwich, while he was also elevated to Military Professor in academic standing.

THE EARTH WE INHABIT:

ITS PAST, PRESENT, AND PROBABLE
FUTURE.

BY

CAPTAIN ALFRED W. DRAYSON,
Royal Artillery,
AUTHOR OF “SPORTING SCENES IN SOUTH AFRICA,” &c.

“As yet we are in the infancy of our knowledge. What we have done is but a speck compared to what remains to be done. For what is there that we really know! We are too apt to speak as if we had penetrated into the sanctuary of Truth, and raised the veil of the goddess, when in fact we are still standing, coward-like, trembling before the vestibule, and not daring from very fear to cross the threshold of the temple.”—*A Discourse by HENRY THOMAS BUCKLE.*

LONDON:

A. W. BENNETT, 5, BISHOPSGATE WITHOUT.
EDINBURGH: JOHN MENZIES.

1859.

[The Author reserves the right of translating this book.]

Figure 2. The title page from Drayson's 1859 book.

Drayson (1859a) outlined his thoughts about the possibility of Earth expansion in his book, *The Earth We Inhabit, Its Past, Present and Future*. He tells us he had been investigating this for the previous year and his book appears to be the very first time

logical scientific speculations about Earth expansion ever occupied a complete book.

Drayson clearly outlined what had stimulated his investigations in the introduction to his book.

“DURING several years' experience in practical Surveying, certain inconsistencies with regard to measurement of distances and areas, were perpetually presenting themselves. The study of astronomy enabled me to investigate closely the observations connected with Geodesy, and to compare these observations with the recorded measurements. I could not then avoid noticing, that whilst the most perfect accuracy was supposed to have been attained in astronomy and surveying, still, when the results obtained by the two sciences were compared, the most alarming differences were almost invariably found to exist. The more perfect the instruments, and the more skilful the operators, the more surely was a discordance found.

Upon examining the records of former measured distances, it appeared that the later operations showed this same distance to contain more feet and inches than formerly. My first idea was, that the measuring metals had contracted, but the great care which each operator had taken to guard against such a contingency, very shortly induced me to search for another cause. After many months, it was suggested to me, that possibly the earth was expanding, instead of the metals contracting; but no sooner did this idea present itself, than it was almost instantly rejected, for I hastily concluded that such a fact could not have escaped observation had it existed. I have always been disinclined to reject any suggestion, however novel, until I had closely examined its various phases. I therefore proceeded to reason upon the possibility of the growth of the Earth.”

Drayson began his investigation into the possibility of Earth expansion by considering “how the growth could be discovered”. He quickly discounted the notion of waiting “at least twenty years” to re-measure distances and explored the

possibility that “other individuals who had lived before” might help his investigations. He could “re-measure their distances” to see if any increase could be found from records extending from approximately 200 BC to 1859.

Looking at Ptolemy’s 137AD observations he noted that a figure of 500 stadia was the calculated length of a degree at that time. Converting to toises (a unit of measurement used in pre-revolutionary France) he found that “Ptolemy’s degree was 56,900. A degree is now said to be 57,060 toises, or 160 toises longer.” Next he considered Fennel, “in 1528, and he finds a degree 56,746 toises ... still 314 toises less than is shown by present calculations”.

Other measurements seemed to show similar results. Drayson tells us he didn’t place any great weight on these results since they were “probably, roughly made” so he couldn’t depend on them but they did seem to indicate expansion.

Having shown that the degree did seem to increase over time, Drayson starts to discuss variations in the measurements of the “base line” used in surveys. He amassed evidence from a large number of surveys showing that the distances between fixed points were longer on more recent surveys. He obviously felt this was perhaps his strongest evidence for expansion “for the investigation becomes important”.

Comparisons between a number of old and new measurements showed: “a difference of little more than an inch in a length of nearly seven miles”, “four feet difference”, “a difference of about 2½ feet *longer* in five miles”.

The Length of a Degree based on the Arc of the Meridian						
Year	Ref. cited	Stadia	Toises [1]	Cubits	Yards	Km [2]
-230	Eratosthenes					
137	Ptolemy [3]	500	56,900			110.898
750	Caliph Abdallah Al Mamoran [4]			56 2/3 miles of 4000		
1528	Fennel		56,746			110.598
1617	Snell		55,100			107.390
1669	Picard		57,060			111.210
1729	Not given [5]		57,033			111.157
1729	Maupertius et al		57,183			111.450
1739	Not given [5]		57,138			111.362
1752	Not given [5]		56,925			110.947
1752	Not given [5]		57,422			111.915
1760	French Atlas		57,060			111.210
1800	Not given [5,6]		56,979			111.052
1801	Gen. Mudge et al				121,640	111.228
1859	Sir J. Herschell				121,650	111.237

Figure 3. Data provided by Drayson

Drayson also presented evidence of similar increases in base lengths during measurement conducted on Salisbury Plain, Misterton Cari and Rhyddlam Marsh.

Drayson pointed out that these were “the most correct measurements that, perhaps, have ever been made on the face of the earth ... all that science could do has been done, but still, the later measurements do not agree with the earlier, but are greater in every case.”

A Universal Expansion

Drayson seems to have come very close to discovering the concept of supercontinents splitting and separating apart as new ocean floor formed between them, as one short sentence indicates.

Notes.

1. Toises is a measurement used in pre-revolutionary France.
2. Drayson's given measurements have been converted to km for reference (the present-day estimate of a latitude degree varies from 110.567 km at the equator to 111.699 km at the poles due to the earth's slightly ellipsoid shape).
3. Drayson uses the conversion of 1 stadia = 113 toises, 5 pi, 5 po.
4. The length of a Cubit is unknown by Drayson. Drayson does not give a date for this measurement but it would presumably have been about 750 AD.
5. Often Drayson simply refers to the meridian as being measured by "another individual" without any further information.
6. Repeat of 1752 (56,925 toises) measurement. Date not given but presumably around 1800 AD.

“But if the earth has increased in size, it is natural to conclude that countries which now are separated by seas, once joined each other, and there should be some similarity in the geological strata of these continents.”

However, he didn't pursue that thought any further. In practice, the worldwide acceptance of continental drift, now rebranded today as plate tectonics, was more than a century in the future.

It is intriguing to note that Antonio Snider-Pellegrini (1858) had proposed that successive geological events on the Earth had split the continents apart in his book, *La Création et ses mystères dévoilés*, in the previous year. However, this book was published in France so it is unlikely Drayson ever saw it.

Drayson also seemed unaware that the possibility of expansion had been briefly considered by Owen (1857) and Green (1857). Both of these authors were unknown to Drayson. Indeed, as far as I can tell all these authors were unaware of each other.

It would be nearly half a century before speculative ideas of continents splitting apart began to be considered by Mantovani (1889, 1889, 1909) and many more years before Wegener (1924) independently popularised the concept of continental drift until it became widely known, enabling later expansionist like Hilgenberg (1933) to marry the concept of continental drift to Earth expansion.

Without the concept of continental drift Drayson began to consider that if Earth expansion occurred at all then it must be universal, operating just as much on the

continents as the oceans and extending throughout all space.

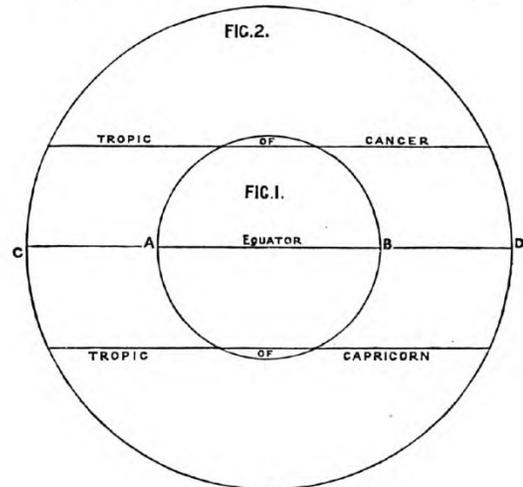


Figure 4. Drayson's illustration of Earth expansion: Fig. 1 is the original Earth size while Fig. 2 is the present size.

A Possible Confirmation in Religious Texts and astronomy

This concept of universal expansion is clearly expressed during a later chapter where Drayson considers that Earth expansion would imply that the orbits of the planets, including Earth, must also have increased over time. Drayson then entertains the possibility that the Earth once occupied an orbit similar to present-day Mercury, implying that Earth would consequently have a much shorter year as it orbited the Sun more rapidly.

Having hypothesised that the ancient Earth once had a shorter year, Drayson thought he

saw confirmation in Biblical texts to supports the idea.

“But if the diagram which we constructed be correct, our planet must, at the period referred to as that at which the mammoths roamed over the polar regions, have been even smaller than Mercury, and consequently the year then might have been probably only 30 or 40 days in length, the earth then performing its revolution in that period of time. Is there any evidence to confirm this idea? We will now venture to tread on sacred ground, but in so doing, we disclaim any intention of seeking thereon a sanctuary, for the purpose of avoiding the criticism with which every new assertion ought to be examined. But with all reverence we will state that the Bible will be referred to, in order that certain passages therein, which may have appeared incomprehensible to many readers, may be cited in confirmation ...

Let us suppose that, in the earliest ages, the earth performed its revolution in thirty-six days; the year then would be about one-tenth of its present duration. The fifth chapter of the first book of Genesis tells us: "All the days that Adam lived were nine hundred and thirty years, and he died." Now, without presuming to disallow that a miracle might have been enacted in favour of Adam and others, still, if the growth of the earth be an acknowledged fact, it follows that, upon the foregoing basis of the year's duration, Adam lived about 93 of our years, or rather above the average age of old men of the present day. Or, if we consider that even during Adam's life the years may have increased in length very rapidly, and that we may take forty days as the average, he would then have died at the age of about 103 years. We might yet venture further, and say that, even according to cases now on record, Adam lived 130 of our years; then the year, or which would be the same thing, the earth's revolution, would have been performed in seventy days, or in about one fifth of our year. This, perhaps, was nearer the truth at that time, for we find, in the next verse: "And Seth lived an hundred and five years, and begat Enos." Seth would then have been twenty-one, according to our years.

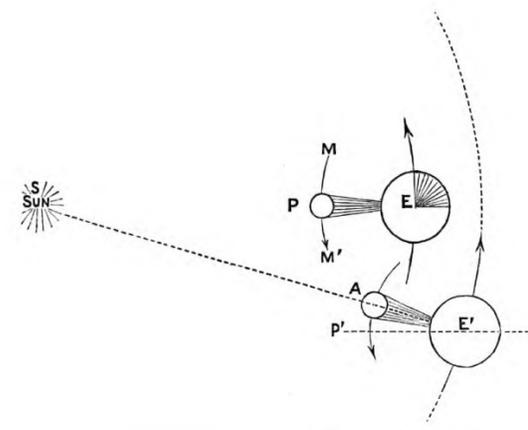
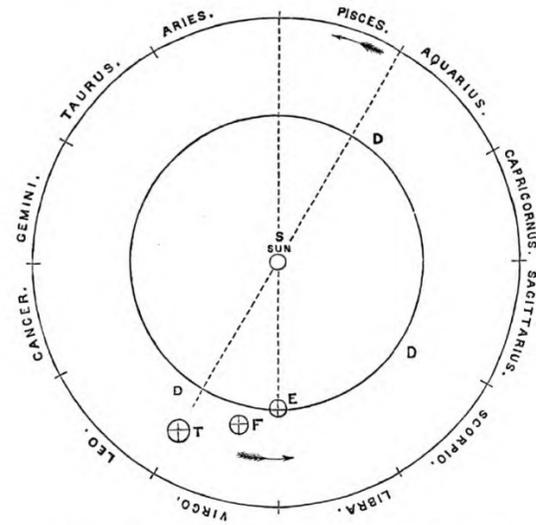


Figure 5. Drayson's diagrams relating astronomical evidence to Earth expansion.

Drayson continued his speculations by presenting astronomical evidence that seemed to indicate that various points on the Earth's surface had moved over time. This too could be explained if the Earth were expanding.

“Many other strange circumstances might be quoted, which show that measured distances will not agree as they ought with astronomical observations; and, in spite of the assertion that the present race of astronomers know everything, it is evident that anomalies and contradictions of the

most serious character are in existence and remain unexplained.

When we observe, in the official "Ephemeris," that the positions of stars, planets, sun, and moon, are given to the one-thousandth part of a second, and when we also remark that the lengths of base lines are known to the one-hundredth part of a foot, it does appear curious that, when the two departments come to be compared, discrepancies of four or five seconds, and of four or five hundred feet, are found not only to exist, but to remain without any satisfactory explanation. Let it but be granted that the earth is growing and its orbit increasing, and nearly every such mystery, which has puzzled the learned for a thousand years, at once vanishes."

A practical method to prove or disprove expansion

In chapter seven Drayson suggests "a practical method to prove or disprove the growth of the earth" by measuring the distance between two continents.

"A METHOD by which to discover the growth of the earth, and which would avoid a chance of errors of observation, would be to procure a non-elastic measuring chain, of about 100 miles in length, fasten the ends firmly from shore to shore of two continents, or upon two stations in land. If the earth were increasing in size, a few years growth would surely cause the chain to snap in twain. But would even this decide the question? Would not individuals rather conclude that the chain itself had shrunk, or that atmospheric phenomena had produced the result, rather than that the earth had expanded, or would they not attribute the fracture to some more wild or untenable cause, which, although unsupported by any sound evidence, would still be considered satisfactory? If the reader doubts that such a conclusion would be arrived at, and think that the fracture of the chain would at once decide the question, we must beg to differ from him; for that which has been stated as a practical method to be adopted, has in reality been adopted for many years; the fractures have taken place some scores of times, but no reason has been assigned for these, other than accident.

It must now be stated how these measuring chains were fastened, how they broke, and the evidence which has been gathered with regard to them. In the first place, the measuring chains are Submarine Telegraph Cables, laid between England and various parts of the Continent fastened at each end, and having what is called a certain amount of slack paid out. Some of these cables exceed one hundred miles in length, and there are very few of them which have escaped being torn asunder after they have been submerged for a short period. From information with which we were favoured by one of the principal officials of the Telegraph, in answer to an enquiry which we made upon the subject, it appears, that suddenly the telegraph ceases to work"

It would be over a century before scientists accepted some continents like North America and Europe were moving apart, although at a much reduced rate than predicted by Drayson. For at least half a century even this small amount of movement was considered unbelievable by the majority of scientists who resisted the acceptance of continental drift.

William Thorp

William Thorp was born in 1804, at Banks Hall, Cawthorne, Yorkshire. After first attending local schools he moved to the office of Messrs. Littledale & Co. of Liverpool.

His niece remarked that he was "a very handsome man, and of remarkable strength". One feat he accomplished as a wager was to swim across the River Mersey against the tide. This became part of their family folklore since "it was a greater feat of strength than Lord Byron swimming the Hellespout".

Later, Thorp decided to take Holy Orders and went to Jesus College, Cambridge,

where he would have met many distinguished young scientists.

After he was ordained he became Curate of Womersley in about 1833, bringing his new wife with him. In the coming years they had eight children, two sons and six daughters.

The Thorp family had worked the Gawber Hall Collieries for a long time and the young William Thorp became a partner with his brother in the Gawber Colliery. It was probably here that he first derived his taste for the new science of geology.

Thorp was one of the founders of the Geological and Polytechnic Society of the West Riding of Yorkshire in 1837. Today it's just known as the Yorkshire Geological Society. This was the first geological society in the North of England and Thorp took the liveliest of interest in its proceedings. He was one of the original members of the council and held the office of secretary and treasurer for a period covering ten years, as well as a short period as vice-president.

The objective of the Society was to promote and record the results of research in geosciences in Yorkshire. This was achieved primarily through a mixture of public lectures, field meetings and articles within the Society's main publication, *Proceedings of the Yorkshire Geological Society*. The Society is still very active today and they still publish their proceedings.

It is due to the diligence of the early members of the Yorkshire Geological Society (1859, 1889) that we have a written record of the first known lecture considering Earth expansion and a biography of Thorp

produced 30 years later as part of the history of the Society.

Thorp soon made an impression on other members of the Society. Professor John Phillips had been requested to prepare a report on the geology of Yorkshire but was obliged to decline the work due to other commitments. William Thorp agreed to complete the work and presented a series of well received papers to Professor Adam Sedgwick and others at a meeting in October 1840.

Thorp's scientific and literary labours became well-known to all the Society members and his name appeared frequently in the Society publications. Thorp's lectures were often attended by well-known geologists such as Professor Phillips, Sir Roderick Murchison, Dr. Buckland, Professor Liebig and Dr. Lyon Playfair. Phillips also accompanied Thorp on his travels to view the local geology.

At a meeting of 1844 it was resolved "That the Council have seen with great pleasure the prospectus of a publication by the Rev. W. Thorp, illustrative of the Geology of the Yorkshire Coal-field, ... [they recommend] the work to all persons interested in Science and Manufactures."

In 1848 a friend of Thorp asked him to ascertain the probability of finding coal in the Vale of Pickering. He exceeded the land owner's wildest hopes when he established there was 3,000,000 tons of a rich seam of ironstone, instantly making the owner very wealthy. In the same year, the influence of Lord Fitzwilliam, who was the president of the Yorkshire Geological Society, helped Thorp to become Reverend at St. John the

Baptist, in Misson, Nottinghamshire, a position he held until his death.

The Southwell & Nottingham Church History Project (2017) relates that Misson is the second largest parish in the diocese of Southwell. In a religious census of 1851 Reverend Thorp gives a detailed breakdown of the income of Vicarage of Misson. The lands given to the church provided £245 per annum at this time, with about £100 additional from tithes.



Figure 6. This is the Thorp family home where the two good friends enjoyed discussing the latest scientific theories when the house was newly built in the 1850s. Photo as provided by Google Maps.

The Rev. Thorp's new church duties didn't stop him from continuing his geological studies. In 1855 Thorp compared the oolitic iron-stones of North Yorkshire with those of the Yorkshire coal-field. It is clear that by 1859 Thorp was widely considered to be a very able geologist.

Drayson was good friends with William Thorp, probably because of their shared interest in scientific matters. Thorp's niece

later recollected that Captain Drayson often stayed at the Thorp family home discussing various scientific questions with her uncle.

There is no record of how Thorp first became acquainted with Drayson. One of Thorp's two sons, William, was a Captain in the 78th Highlanders, and a daughter was married to Captain Furnivall, Lancashire Militia, so perhaps a family connection facilitated a meeting between Captain Drayson and the Rev. Thorp.

In any event, Thorp was greatly interested in chemistry, astronomy and medicine as well as geology, so it can certainly be no surprise that he soon became close friends with Drayson, who also had a great interest in astronomy and geology.

A lecture about Earth expansion to the Yorkshire Geological Society

History doesn't record who first suggested presenting a joint lecture about Earth expansion but since Thorp was one of the founding members of the Yorkshire Geological Society it was almost certainly his suggestion. It was soon arranged that Thorp and Drayson should present papers to the Society members at the July meeting in 1859. To the best of my knowledge this is the first lecture about Earth expansion presented to geologists.

The paper discussing Drayson's speculations about Earth expansion was read to members of the Yorkshire Geological Society in Doncaster, at midday on Friday, 1st July 1859.

William Thorp was first called to present *On the Geological Evidence of the Secular*

Expansion of the Crust of the Earth, the Effects produced thereby, as propounded by Captain Drayson. The lecture by Thorp (1859) was later published in the Yorkshire Geological Society's journal, and the start of the lecture shows the scope of the talk.

“Geology is closely allied with nearly all the sister sciences: with botany, enabling her to decipher the fossil flora; with zoology, as teaching the affinities of her fossil fauna; with chemistry, as determining the constituents of her minerals, earths, and salts; while hitherto she has had little connection with astronomy. It may be, however, that the new light thrown on astronomy by Captain Drayson, in his published book “The Earth we Inhabit,” may enable us to unravel many of the mysteries connected with the early history of this planet; for if Captain Drayson’s theory explain the origin of the magnificent flora of the carboniferous era and its extension to Melville Island,—a gradually decreasing climate through the immense periods of the Permian, Saliferous, Oolitic, and Cretaceous systems up to the Tertiary—the reasons why probably the solar year has been formerly shorter; and also if it explains the presence in our island of large icebergs and an arctic climate, then this theory must inevitably have also an important bearing on practical astronomy; for, if in this northern hemisphere the expansion of the earth’s crust is causing land to recede from the equator, it must be causing the latitudes of places, as measured by the stars, to periodically vary, and this is the case. Thus, between the years 1845 and 1858 (13 years) the Observatory of Durham moved 290 yards; that of Oxford 133 yards; between 1827 and 1858 (31 years) that of Edinburgh moved 1,373 yards...

Thorp took his lead from the thoughts of Drayson, examining the geological evidence to see if it supported Drayson’s concept of expansion. Drayson had reasoned that the Earth was denser in the past before gradually relaxing to enable the Earth to become a larger and less dense planet. Thorp seemed to have little doubt that this was true since he stated that, “it is certain that the pressure upon these central masses and their

condensations has been, before the expansions and elevations of the crust of the earth, enormously greater than at the present time.” Thorp saw evidence that portions of the Earth had been raised and attributed this to the internal pressure and density being relieved and lessened within the Earth.

Thorp also added the new thought that the geological evidence indicated that the ancient land had been under water and had risen to become dry land. Once again this seemed to confirm thoughts about a denser ancient Earth that had since expanded. As Thorp reasoned, “at this early period of the Earth’s history, there had been as yet no elevation of land or breakage of its crust, the pressure upon the internal and central parts of the globe must have been at its *maximum*.” Thorp was able to point to the “map of Lyell, which shows the immense area converted from sea into dry land, and in some cases from deep sea into mountains of great altitude...” There were also many raised beaches also indicating that the sea had once been much higher.

The distribution of ancient life across the Earth was also a problem which seemed to be solved by expansion. The forests that formed the coal fields of Greenland obviously enjoyed a much warmer climate than today. Although “various hypotheses, both astronomical and geological” had been suggested, Drayson’s astronomical calculations seemed to show that these warmer conditions would be present on his reduced diameter ancient Earth.

Thorp saw signs of more recent expansions. “In 1822 a tract of country [at the foot of the Andes and larger than Great Britain] was elevated from two to seven feet...” Land

was still rising in Chile and the “whole west coast of South America, 800 miles in length, has been elevated within a period geologically modern...”

One of the most interesting geological indications of expansion advanced by Thorp was something he called “The “Hade” in throws”, which is an old geological term to describe the inclination of a geological fault from the vertical. He illustrated this with a new diagram that clearly demonstrates the concept (See Thorp's Plate 3 – Hade in Throws). The inclination of a geological fault was always found over the raised crust, never under. Thorp described how this had been a great puzzle for many years, especially to mining men. The effect was readily explained by an expansion of the crust, naturally forcing the fault to form in this way. If the inclination of the fault had been found under the raised side then the crust would have *contracted*, but this was never found to be the case.

Thorp also saw similar indications of expansion of the crust within veins of mineral found in rocks since they “gave indications of successive rents in the same general direction” and also illustrated these (see Thorp's plate 3 – Mineral Veins).

After Thorp had finished his lecture, Drayson (1859b) presented additional corroboration with “The Astronomical Evidence”. Drayson started,

In the commencement of Mr. Thorp's interesting paper, he states that as yet there has been no aid derived by geology from astronomy. Mr. Thorp very truly says that the botanist, the naturalist, and the chemist, have each given their assistance, but that astronomy has hitherto stood alone.

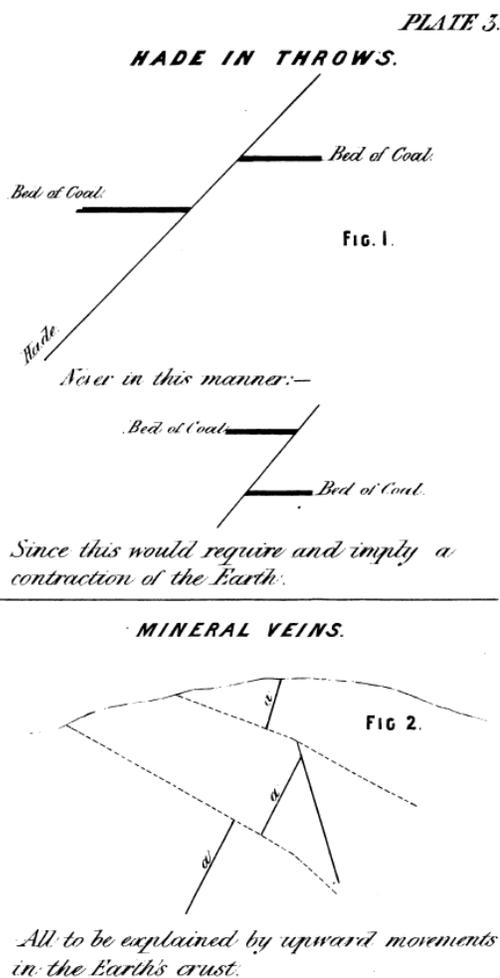


Figure 7. Thorp's plate 3 illustrating the geological evidence for expansion.

When, however, we astronomers stand alone, it is quite within the bounds of possibility, that we may ere long be left alone, and the crowd which was once behind us, may soon be before us.

Geology, which is comparatively quite a modern science, has made more rapid progress than probably any similar science during the same time. And this must be the case with all those sciences, the foundation of which is firm, and where stubborn facts take the place of what we may term questionable theories.

No lengthy mathematical formula can stand against the testimony of the hard granite rocks, of the coal

beds, and of the remains of animals and vegetables, whose habitat is now only within those bounds of the earth known as the tropics.

Here, then, is a science, formed upon granite, supported by slate, and bearing above it the evidences which could not be contradicted...

There is no record of the reaction of the Yorkshire Geological Society members to the Earth expansion lectures.

A review of Drayson and Thorp's Earth expansion concept compared with present-day knowledge

Whilst Drayson was loth to wait "at least twenty years" to re-measure distances, we have the luxury of re-examining his evidence after 158 years in the light of present-day scientific knowledge.

There have now been numerous scientific papers and books considering the concept of Earth expansion since the initial speculations of these two friends in 1859, although many modern expansionists were ignorant of Drayson and Thorp.

In the 1950s to 80s the scientific community began to take a renewed interest in Earth expansion with numerous papers appearing in many science publications. Even the leading science publishes like *Nature*, the *Royal Society of London* and *Science* began discussing Earth expansion. See for example: Barnett (1969), Carey (1975), Crawford (1979), Creer (1965), Egyed (1956,1960,1963), Fairbridge (1964), Heezen (1962), Meservey (1969), Owen (1976,1981,1983,1984) and Vogel (1981).

Giancarlo Scalera (2003), an Italian geoscientist, compiled *The expanding Earth*

bibliographic database, which listed about a thousand scientific papers and books exploring the increasing interest in the concept of Earth expansion. Interestingly, this extensive database included neither Drayson nor Thorp, surely indicating just how overlooked their initial speculations had been.

There is still a continuing high level of scientific interest in the idea of Earth expansion. A symposium was held in 2011 and selected papers from that symposium were published in a book by Boschi, Cwojdzinski & Scalera (2012), further adding to the already extensive list of publications about Earth expansion. Last year the geologists Cwojdzinski (2016), Khan & Tewari (2016abc) and Maxlow (2016b) all had scientific papers discussing modern speculations concerning Earth expansion published by a number of respected geological bodies including: *The Geological Society of London*, *Journal of Applied Geology and Geophysics*, *Geosciences Research*, *Journal of Geosciences* and *AIG News*.

So how does the 19th century speculations of Drayson and Thorp compare to the 21st century theory of Earth expansion?

Drayson's initial reasoning is highly logical. Comparing old and new measurements of the degree should certainly indicate any Earth expansion, and this method enabled him to produce a seemingly remarkable set of measurements to back up his claim.

However, it is obvious that much of the evidence Drayson presented isn't confirmed by present-day scientific measurements. One major source of error unrecognised by

Drayson is a variation in the length of the degree caused by the Earth's oblate spheroid shape. Drayson assumed that the Earth was a spherical shape, and this error would have been sufficient to corrupt his results.

At the time the exact shape of the Earth was unknown. It wasn't until a few decades later that early attempts to derive an international ellipsoid for the shape of the Earth began to show positive results. Many years later in 1919 *The International Union of Geodesy and Geophysics* was founded and this institution eventually adopted the "international ellipsoid 1924" to represent the shape of the Earth to an accuracy of 200 metres.

There is also the strange change in "base length" that Drayson reported. Again, if any large variations existed, present-day measurement should have detected the change Drayson detailed.

In later life Drayson continued his investigations about variations in the length of the degree and other astronomical evidence. These eventually led him to another science discovery that will be discussed shortly. His new thoughts would also have shown him that much of his astronomical evidence for expansion was better explained by these newer hypotheses.

The unexplained breaks in telegraph cables, which Drayson interpreted as a widening of the ocean, are now accounted for by submarine slides triggered by earthquakes, but it was nearly a century before Heezen & Ewing (1952) confirmed these submarine slides with modern studies of the ocean floor. Coincidentally, Bruce Heezen (1962) also suggested that his modern studies of the

ocean floor indicated the continents of North America and Europe were moving apart and this could be most easily explained if the Earth was expanding.

It is now possible to measure an ongoing increase in length between Great Britain and North America and I'm sure Drayson and Thorp would have felt vindicated to learn that the two continents are moving apart. They would probably be less happy to find that even this has not been generally considered enough evidence to prove Earth expansion and has resulted in the *ad hoc* introduction of complementally contraction at subduction zones to reduce this expansion to zero.

Drayson looked for expansion on land but today expansionists generally consider the vast majority of expansion occurs in oceans at the mid-ocean ridges. This has the profound effect that expansion is not universal, as Drayson thought. It is generally considered that there is no universal expansion. This would imply that continents do not expand (or if they do it is at a much reduced rate to the ocean floor expansion) and the planets do not move further from the Sun.

Drayson's astronomical observations do not indicate expansion and are caused by modifications in various elements in the Earth's orbit. Again, Drayson is unaware of this in 1859, although he obviously continued his studies in this area because when he realized his error a few decades later he refined his ideas and presented the hypothesis that these permutations caused the last Ice Age. It was a hypothesis that caused much interest at the time and can be correlated to the much later ideas of Milutin

Milanković. This aspect of Drayson's future career is discussed later in more detail.

The actual rate of expansion Drayson predicted is astonishingly fast. He talks of a doubling in the size of the Earth from the time "mammoths roamed over the polar regions" and also growth going on for "perhaps 40,000 years". It is clear his rate of expansion is much more extreme than any modern measurements could possibly allow.

Much of this high rate of expansion is due to Drayson's error in estimating the age of the Earth. In the 1850s there was a great debate about the age of the Earth, with no definitive answer. The uniformitarians were beginning to argue that the Earth was "immensely old" but this contradicted the Biblical account of creation at 4004 BC. Drayson's estimate of "perhaps 40,000 years" seems somewhere between the two extremes and was probably considered a rational estimate for Victorian times. Even by the early 1900s Lord Kelvin, a highly regarded scientific authority, estimated that the Earth was only about 20 million years old. Our modern period has been marked by an enormous increase in the detailed knowledge of the geological age of the Earth, so it is now generally calculated to be about 4,600 million years old.

It is perhaps interesting to note that if we replace Drayson's estimate of the Earth's age with modern estimates, his expansion rate is vastly reduced until it is closer to modern estimates of Earth expansion. Today's "fast" expansionists predict an approximate doubling of the Earth's diameter in the last 150 million years, while "slow" expansionists predict an even gentler expansion rate.

Thorp presented many geological indications that the Earth is expanding. Certainly the most interesting is what he called the "Hade in Throws" since most geological faults do seem to be formed due to expansion of the crust. Today these common types of faults are known as Normal Faults, while the rare faults indicating contraction are known as Reverse Faults.

Ott. C. Hilgenberg (1933) independently considered the effect of expansion on continental crust 74 years after Thorp's lecture in his book, *Vom wachsenden Erdball (The Expanding Earth)*. Hilgenberg's ideas were much more exhaustive and he was able to detail how the various deformations in the crust would tend to form mountains.

The effect of expansion on continental crust is still the subject of extensive research in the 21st century. The most comprehensive recent study was by Stephan Cwojdzinski (2003), a Polish professor of geology, in his paper *The tectonic structure of the continental lithosphere considered in the light of the expanding Earth theory—a proposal of a new interpretation of deep seismic data*, published by the Polish Geological Institute.

Thorp's observation that ancient land seems to have gradually emerged from the sea was forgotten until it was rediscovered by Laszlo Egyed (1956, 1960, 1963), a Hungarian professor of geophysics, who used the data to calculate a relatively slow expansion rate in the late 1950s to early 1960s.

Drayson and Thorp's conclusion that expansion implies a denser ancient Earth

also has an interesting history. Historians such as Frankel (2012) and Kragh (2016) have recording the evolution of the expansion concept, from the 1950s to 1970s, in their extensive historical books. Many expansionists of that time first considered the Earth must have been denser before expanding to its present size, without appreciating that this concept had also been proposed by Drayson and Thorp in the previous century.

One of the best known of these expansionists was once again Egyed (1956, 1960, 1963) who independently came to a similar conclusion as Drayson and Thorp when he proposed that the Earth's core consisted of matter in an ultra-phase high-pressure state. He believed this ultra-phase state was unstable and therefore producing a steady increase of the Earth's volume.

More recent work has shown that a denser ancient Earth cannot be correct because ancient gravity would have been four times the present for an Earth half its present diameter. Since ancient life clearly did not live in such a high gravity the Earth cannot have been denser. Today various biomechanical calculations indicate ancient life lived in a reduced gravity and this in turn implies that Earth expansion is caused by a mass increase of the Earth. This more modern view has been maintained by a number of current workers in the field: See Carey (2000), Hurrell (1994, 2011, 2012, 2014), Mardfar (2012), Maxlow (2014, 2016ab), Scalera (2003ab, 2004), Strutinski (2012, 2016ab) and others for a more extensive discussion.

Drayson and Thorp's rational examination of Earth expansion was constrained by

Victorian scientific knowledge and many of their speculations aren't support by modern expansionists. Yet, many of their initial thoughts were clearly repeated by new expansionists over a century later. Our modern views on Earth expansion have evolved from the critical examination of these early speculations, so the logic of many of the initial thoughts of Drayson and Thorp will be familiar to anyone who has ever tried to push back the boundaries of human knowledge.

Drayson's later life

Drayson continued with various other speculations besides the concept of Earth expansion. Towards the end of the year Drayson (1859c) was wondering why geological fossils indicated Britain had once been in the tropics in his book, *Great Britain has been and will be again within the tropics*.

Drayson (1860, 1861) continued to present more lectures to the Yorkshire Geological Society covering a range of speculative topics.

William Thorp died only a year after the joint Thorp and Drayson lecture about Earth expansion at the Yorkshire Geological Society. Thorp had gone to Doncaster to arrange coals for the poor when he suddenly became ill, soon dying of heart disease on 16th December 1860. He was only 57 when he died, becoming the first man to be buried in the new churchyard. Many of his ideas about expansion were original and we can only wonder what he might have achieved with more time.

Despite the interest shown in Drayson's Earth expansion ideas at the Yorkshire Geological Society, and some awareness in other publications by authors such as Bodichon (1865), Drayson never seemed to revisit his speculations about Earth expansion in later life. Perhaps the general verdict of the time is expressed by a contemporary witty writer who made a hobby of collecting evidence of paradoxical and illogical thinking. Augustus De Morgan (1872) restricted his comments to a restrained "Capt. Drayson professes to prove his point by results of observation; and I think he does not succeed."

Drayson found many other interests to occupy him. By the early 1860s Drayson was involved in the spiritualist movement. This association enabled him to meet the well-known Victorian art critic John Ruskin.

Drayson was soon promoted to Professor of Surveying and Topographical Drawing at the Royal Military Academy. Prince Arthur, a son of Queen Victoria, developed military ambitions and was enrolled as a gentleman cadet at the Royal Military Academy in 1866, graduating as a lieutenant two years later. Whilst he was there Drayson was given the task of educating the prince. After the prince had graduated Queen Victoria presented Drayson with a coloured portrait of the prince in cadet's uniform. Prince Arthur served for many years in the Army.

In addition to his work at the Royal Military Academy Drayson worked part-time at Greenwich Observatory and was elected a Fellow of the Royal Astronomical Society on the 20th of January 1868.

Drayson spent at least ten years developing an astronomical hypothesis for the cause of Ice Ages. This later astronomical hypothesis considered that there was a fatal mistake in the concept that the precession of the Earth described a simple circle in the heavens. Drayson had calculated that it is really a wider circle round a different centre, and this correction enabled the explanation of several things that seemed inexplicable, thereby making astronomy a more exact science. His hypothesis predicted the recurrent glacial epochs and he was able to present evidence that the dates fitted his predictions.

Since Drayson was by then well aware that the initial reaction to his astronomical hypothesis would be rejection, he carefully laid plans for presenting his solution to the scientific authorities. First he read a paper to the Royal Astronomical Society while arranging for a second to be read before the Geological Society of London.

The members of the Geological Society of London seem to have discussed Drayson's theory about the Glacial Epoch in some detail. When Alfred Tylor (1871) presented the abstract of Drayson's theory, *On the probable Cause, Date, and Duration of the Glacial Epoch of Geology*, to the society members the ensuing discussion produced responses from Professor Ramsay, Osmond Fisher and the President of the Geological Society.

Having presented outlines of his astronomical hypothesis to the two main scientific bodies Drayson published two books discussing the theory in greater detail. The first book, *On the Cause, Date, and Duration of the Last Glacial Epoch of*

Geology, was published in 1873 whilst the second book, *The Cause of the Proper Motion of the Fixed Stars*, was published in 1874.

Drayson left the Royal Military Academy in 1873 when his military service first took him to India, where his experiences with the Indian mystics renewed his interest in Spiritualism, until he started to be considered an expert in that field as well. Later his military service took him to North America.

In 1882 Drayson retired on his military pension with the rank of Major-General and moved to Southsea, a Victorian seaside resort located to the south of Portsmouth, England. During this time he continued to produce books ranging through adventure, science and practical subjects. He was also a frequent contributor to magazines and scientific journals and took a keen interest in the local science societies in the Portsmouth area.

A personal record of his time as a Professor at Woolwich was recorded in his later 1886 book, *Experiences of a Woolwich Professor*. He never mentions his early thoughts about the hypothesis of Earth expansion. Instead, he mainly takes us through his experience of teaching and the development of his astronomical hypothesis for the cause of Ice Ages. Various observations are recounted illustrating how he was eventually forced to conclude that taught knowledge often fails when applied to an original problem that needs to be solved by logical reasoning.

The reception given to his astronomical hypothesis, to which he had devoted ten

years before presenting it, is discussed in detail.



Figure 8. A photograph of the older General Drayson, still sporting his long moustache. (As provided by the Morgan Family History Blog).

Drayson found that despite all this preparation many people still didn't seem to even grasp his ideas. One of the first reviews of his work completely mistook his objective by claiming he intended to prove the earth was flat rather than round! Drayson wondered if this was a "malicious falsehood ... for the sole purpose of endeavouring to prevent people from reading the book" or complete incompetence. He soon found that most of his critics seemed to be incapable of reasoning. Some opponents "attempted to swagger, others to hiss, several confined

themselves to personal abuse, or sneers.” Yet he failed to find “one single sound or logical objection” to his ideas.

All the travelling in India and America had obliged Drayson to reduce his baggage to a minimum. The *History of the Yorkshire Geological Society* (1889) records by chance that he had not even been able to retain a record of the Doncaster lecture he had given with William Thorp, but he remembered that Thorp had “very advanced views on geology, which, as usual, were ignored at the time, but have since been generally received”. Drayson recalled that during his various visits to Thorp thirty years previously they enjoyed discussing many of the unsolved problems in geology.

By that time Drayson had also become a great authority on the game of whist and a number of books on the subject were held in high regard. Butler (1898) had high praise for Drayson in his book, *The Whist Reference Book*, stating that "General Drayson must ever be held in high and honored [sic] remembrance [for bringing his] genius and scholarship to bear upon the elucidation of whist."

While Drayson was resident at Southsea, from 1882 onwards, he became friends with Arthur Conan Doyle, the famous author of Sherlock Holmes and other well-known books. Doyle tells us he was “most impressed” by General Drayson and his scientific ideas. In his autobiography Doyle says he "had known Drayson first as an astronomer" and found that his "views impressed me much at the time". It was his belief that "Drayson will make a great permanent name" once his ideas became better known.

Doyle also found that Drayson's own curiosity about Spiritualism ignited a similar interest, so that in 1887 Doyle wrote an account in the psychic weekly paper, *Light*, thereby placing himself on public record as a student of those matters.

In the book, *The Captain of the Pole Star*, Doyle (1890) confirmed their friendship by dedicating the volume ‘To my friend Major General A. W. Drayson as a slight token of my admiration for his great and as yet unrecognized services to astronomy’. Doyle (1924) still remembered his friend over three decades later when he wrote about Drayson in his autobiography, again calling him "my friend, the late General Drayson".

Many of the fictional scientific characters Doyle created are reputed to have based on Drayson. In the *Dictionary of Real People and Places in Fiction*, Rintoul (2014) describes how the most famous fictional character reputed to have been inspired by Major-General Drayson is the genius portion of Professor James Moriarty, the evil nemesis of Sherlock Holmes.

Most people who knew Drayson personally seemed to hold him in very high regard. In his book, *Reminiscences of a Municipal Engineer*, Boulnois (1920) described how he had made "many personal friends at Portsmouth - one of my greatest was the late Major-General Drayson, R.A., who was one of the most able and talented men I have ever met". Boulnois remembered how he and Drayson would visit "Doyle's house after dinner, and, in his smoking room, discuss all sorts of subjects, from metaphysics to more mundane matters. How well can I remember those enjoyable

evenings when we settled mighty problems to our own satisfaction."

By the time Drayson died at his Southsea residence on 27th September 1901, at the age of 75, he had achieved a significant reputation. Notices of General Drayson's death appeared in the Portsmouth News (1901), the Times (1901) and the Royal Astronomical Society (1902). Drayson had asked for a quiet funeral but the man and his ideas were remembered for some time afterwards.

His astronomical hypothesis was also called the "Drayson Problem" and had been discussed in the British Astronomical Association in the 1890s. [See Journal of the British Astronomical Association, Volume 4]. After his death in 1901, this astronomical theory continued to interest astronomers.

A book, *Draysonia*, was published to help publicize the Drayson Problem by Sir Algernon Frederick Rous de Horsey (1911), who tells us he adopted "the title 'Draysonia' in honour of a man whose scientific attainments have been little known or recognised ... who in future days will, I think, be acknowledged as having been a remarkable discoverer." The book only discussed Drayson's later interests in astronomy, decades after his early interest in Earth expansion, but it clearly shows Drayson commanded respect for his scientific writing, even if he was "little known" amongst the general public. The Drayson hypothesis was discussed in the science journals *Nature* and the *Geographic Review* in 1914. A few years later Millis (1921) was still discussing the problem in his article, *The Glacial Period and Drayson's Hypothesis*, published in *Popular*

Astronomy. Millis (1945) continued writing about it until at least the 1940s.

By the 1950s, authors like Miller (1953) in his popular text book, *Climatology*, (8th edn), began grouping Drayson's hypothesis together with a range of other new theories proposing climate change due to modifications in various elements in the Earth's orbit. By this time, the most recent advocate of these ideas was Milutin Milanković, an Austria-Hungary (now in Croatia) mathematician and geophysicist. It was Milanković who became widely known for his work linking long-term changes in climate to astronomical factors affecting the amount of solar energy received at Earth's surface, with Drayson relegated to the footnotes.

Later authors discover the expanding Earth concept of Drayson

Despite the Yorkshire Geological Society interest in Drayson's theory of Earth Expansion in 1859 it seems to have been gradually forgotten. Other people started to conceive their own ideas about Earth expansion whilst Drayson was still alive without even being aware of him, including the Russian Jean Yarkovsky (1888, 1889) and the Italian geologist Roberto Mantovani (1888, 1889).

One coincidence is that Mantovani travelled from Le Reunion to Great Britain in the late 19th century, so he must have been tantalisingly close to Drayson at this time. In his biography of Mantovani, Scalera (2009) relates how in the 1890s "Mantovani made numerous trips to France and London - where he lived for three years with his family" Since Drayson lived until 1901 he

must have only been a few hours travel from Mantovani. However, according to Scalera (2009), Mantovani was never aware of Drayson and considered himself to be the first to conceive of Earth expansion.

The early speculations of Drayson and Thorp seem to have been completely forgotten for at least a century. The first documented person to rediscover Drayson was S. Warren Carey, an Australian Professor of Geology at the University of Tasmania. Carey (1988) gave a short account of Drayson's ideas in his book, *Theories of the Earth and Universe*.

Carey (1975, 1976) had written previous descriptions of Earth expansion in a science paper and his text book, *The Expanding Earth*, which included a comprehensive account of the history of expansion, but he hadn't included any reference to Drayson in those early publications. When Carey (1981) edited various science papers in the book, *The Expanding Earth Symposium*, there was still no mention of Drayson by anyone. Presumably Carey discovered Drayson sometime between 1981 and 1988.

After Carey (1988) revealed Drayson's (1859) book some other authors, such as Noel (1989) and Scalera (2009), followed Carey's lead by briefly mentioning Drayson as an early expansionist, but nobody seemed inclined to say much more than Carey.

The Thorp and Drayson (1859) lectures presented to the Yorkshire Geological Society still remained completely unnoticed and forgotten.

In the 19th century a copy of Drayson's book about Earth expansion had been lodged with

the Bodleian Libraries, University of Oxford, England. In the 21st century Google Books decided to digitize this book, which had been "preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online" (See Google Books Online). Today, a digitized copy of Drayson's book can be read for free on the Bodleian Library web site and Google Books.

The minutes and early history of the Yorkshire Geological Society are also available in good university libraries such as the Liverpool University Library, where I read the early speculations of Drayson and Thorp.

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