William George Maton (1774-1840) and his mineralogical map of the Western Counties of England

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During the summers of 1794 and 1795, William George Maton, a recent graduate of Oxford University, with one or both of his friends Thomas Rackett and Charles Hatchett, toured South-West England. Maton published an account of their journeys which represents the first description of this part of the United Kingdom made by travellers with an interest in science and knowledge of geology. It contains references to mines and quarries they visited and details of the soils, rocks, fossils and minerals they saw along the coast and in the countryside. Maton summarised their observations on a map of the region, later described as the first attempt in England to construct a geological map. Strata were differentiated by shading using lines, rather than by colour, in order to demonstrate the relationship between one rock type and another. Although crude, over-generalised and inaccurate the map is of historic importance as a precursor to the detailed maps which were to appear in the early years of the 19th Century.

Introduction

In the summer of 1794, Charles Hatchett (1765-1847), a mineral chemist and Thomas Rackett (1755-1840), a Church of England clergyman and antiquary, invited their young friend William George Maton (1774-1835), recently graduated from Oxford University, to accompany them on a tour into Cornwall visiting en route, the more southerly parts of Dorset and Devon (Maton, 1797; Paris, 1838). Two years later, Rackett and Maton, this time without Hatchett, completed a second tour, which covered the northern parts of Dorset and Devon, together with Somerset. During these tours, Maton kept a detailed journal, noting the mineralogy, geology, antiquities and natural histories of the districts visited and Rackett drew a series of sketches illustrating some of the scenery and antiquities.

On completion of their tours, Maton recognised that the information he had recorded was worthy of publication, a view supported by the President of the Royal Society, Sir Joseph Banks (Maton, 1797; Paris, 1838). Rackett placed his watercolours at Maton’s disposal and 16 of these were rendered as aquatints by the London engraver, Samuel Alken. Details of the two journeys were published in separate volumes with a dedication to Thomas Rackett (Maton, 1797).

The two volumes provide a contemporary description of the South-West of England during the latter part of the 18th Century. They contain abundant references to the soils and geology of the region and to the mines which the travellers encountered. These geological and mineralogical references were summarised “in the manner of a map, by which a general idea of the several transitions of substances may be obtained at one view” (Maton, 1797, vol. 2, p.201). The map was noted in passing by early workers in South-West England. For example De La Beche records that Maton’s description of his tours “contains a geological map and numerous geological observations” (De la Beche, 1839, p.xxiii), but no further reference to it was made. Subsequently, Maton’s observations and map have been described briefly by historians of Geology (e.g. Butcher, 1968; 1983; Challinor, 1971; Boud, 1975) but their significance as perhaps the first regional geological memoir and map of any part of England remains unrecognised amongst the wider geological community. The objective of this paper is to review Maton’s observations and his map which, although rudimentary and inaccurate, is of considerable historical importance, particularly as we approach August 2015, the 200th anniversary of the publication of William Smith’s great Geological Map.

Keywords: History of Geology, geological maps, William George Maton.

The Tourists

Thomas Rackett, the most senior member of the party, was a graduate of University College, Oxford (BA, 1777; MA 1780) and rector of the Parish of Spettisbury with Charlton Marshall, on the banks of the River Stour about five kilometres west of Blandford Forum in Dorset (Hutchins, 1868). The living, which he held for almost 60 years, provided him with a substantial income and he was able to pursue a range of outside interests. He was an active member of the Linnean, Antiquarian and Royal Societies and a constant presence at lectures of the Royal Institution, spending lengthy periods in London. This led to an accusation, in the House of Lords, that he was neglecting his parochial duties, although this was later withdrawn. Apart from his illustrations for Maton’s book he contributed many drawings and valuable assistance during the preparation of the Second Edition of Hutchins’ History and Antiquities of the County of Dorset (Hutchins, 1796-1815).
Charles Hatchett was the son of a prominent coachbuilder who went into his father’s business. He was a wealthy man and equipped a private chemical laboratory at his home. A self-taught chemist and mineralogist, he established a reputation as a mineral chemist and, in 1800, discovered the element now called niobium (Griffith and Morris, 2003). He was an early member of the Geological Society, elected on 6 January 1809 (membership number 130). Most of his scientific work was carried out between 1796 and 1806, after which, following his father’s death, he had to pay more attention to the family business. He was a prominent member of London Society, a friend of William Hyde Wollaston, Joseph Banks and William Herschel, and frequently sat on public commissions, when scientific expertise was needed.

The youngest of the travellers, William George Maton (Figure 1) was the son of a Salisbury wine merchant. He went up to Oxford in 1790 where he graduated BA in 1794 and MA in 1797. Originally intended for the Church he continued his academic studies before transferring to medicine and gaining his MD in 1801. He was a physician at Westminster Hospital until 1808, resigning when his private practise grew too large. During ‘the season’ he began to reside at Weymouth where he was introduced to the royal family, becoming Physician-Extraordinary to Queen Charlotte in 1816 and subsequently Physician-in-Ordinary to the Duchess of Kent and her infant daughter, who was to become Queen Victoria. His practice increased and he was able to pay off debts incurred by his father, for which he was given the freedom of Salisbury by a grateful corporation. Looking forward to retirement, in 1834, he bought a country seat, Redlynch House, near Downton in Wiltshire, but died within six months (Paris, 1838, Rolleston, 1942).

All three travellers were to become Fellows of the Royal Society; Hatchett was elected in 1797, Maton in 1800 and Rackett in 1803.

**THE TOURS**

Both journeys began and ended in Maton’s home city of Salisbury. The first in 1764 was the longest at 1,173 km with the second at 742 km (Figure 2). References in Maton (1797) and in letters from Hatchett to his wife (Gray, 2000a, b) suggest that the journeys were completed on horseback as rural roads in the West Country were generally narrow and unsuitable for wheeled vehicles (Chope, 1918). In his account of the journeys, as well as comments of scientific interest, Maton provides abundant topographic detail. He had an opinion on most of the towns and villages through which the travellers passed, which were not always complimentary. For example Kimmeridge, in Dorset, was “a miserable village”, St Michael, (now Mitchel), in Cornwall, was “to have been decided as they went along, as Rackett was in Devon, “Regis, in Dorset, was “a very pleasant town” and Torquay, in Devon, was “a most wretched place, unable to afford the smallest accommodation of a decent kind”. In contrast, Lyme Regis, in Dorset, was “a very pleasant town” and Torquay, in Devon, “far exceeded our expectation in every respect instead of the uncomfortable village we had expected”. Their route seems to have been decided as they went along, as Rackett was unable to tell his wife where to direct letters to him “as we are never sure where we are to stop” (Gray, 2000b, p.81).

Maton’s particular interest was in botany and it was Hatchett, the mineral chemist, who had the most knowledge of geology amongst the travellers. Thus there tends to be a more detailed geological commentary in the description of the 1794 journey than in that of 1796 when Hatchett was absent. Reference to the work of prominent neptunists such as the German Werner and the Irishman Kirwan suggest that the travellers looked at rocks they encountered through neptunist eyes, believing that all rocks originally formed from crystallisation of minerals in the earth’s crust. Throughout Maton’s account, local building stones and soils are described together with visits to quarries and mines, where Maton and Hatchett descended leaving Rackett, who refused to go down ladders, at the surface. A wealth of information is presented from which four specific examples are discussed in the following paragraphs.

On both journeys the travellers visited manganese mines some 6 km to the north of Exeter, in Devon. In 1794, not far from the village of Upton Pyne, they found ore being dug from a pit in deep red glutinous clay. The deepest part of the pit was some 6 m deep and the richness of the ore diminished with depth. The ore was in nodules, of variable size, which were generally crystallised in the centre. The black manganese oxide was used in glass making to remove the yellow, green or blue tinge in the production of clear glass. Formerly glass houses had been established in Exeter, but had been undersold by a factory at Bristol, and most of the product was being sent to London. By the time of their second visit in 1796, the Upton Pyne mine had been filled up and production moved to Newton St. Cyres, some 3 km to the west. A further visitor in 1809 observed that there was again active mining at Upton Pyne (Berger, 1811) and it would seem that mining was sporadic and on a small scale. According to Ussher (1902) the mines were worked out by about 1815 although Edwards and Scrivener (1999) suggest that activity continued until 1849.

On their way south from Exeter the travellers diverted to look at some curious coal pits about 1.5 km from the village of Heathfield, north of Newton Abbot. They were surprised to find coal interbedded with a whitish clay and a thick bed of sand. The pits were about 25 m in depth and the clay was used in a nearby pottery, which was one of the largest in the west of England. The coal retained ‘a vegetable structure’ and had exactly the appearance of charred wood, extremely light and flexible. Maton was clear that the coal had once been wood, but was unable to put forward any explanation of how the change from wood to coal had occurred.

![Figure 1. Reproduction of an engraving of William George Maton, from the frontispiece in Paris (1838).](image-url)
Maton accurately identified the minerals in the south-west granites, noting that "The granite of Ivybridge [on the southern margin of Dartmoor] is a dead white colour, and is composed of a very large proportion of feldspar (which appears for the most part in long narrow crystals), pellucid quartz, some schoorl [black tourmaline], and a few scarcely discernable specks of mica" (Maton, 1797, 1, footnote on p.128). He also visited Roche Rock in Cornwall, about 10 km west of Bodmin, just south of the Truro road, noting that it was composed of white sparpy quartz, mixed with tourmaline in the form of needle-like crystals. Two or three varieties were observed, differing in their tourmaline content. He noted that M. d’Aubenton [the French naturalist Louis-Jean-Marie Daubenton (1716-1799)] had called a rock of this type a granitello and that Mr Kirwan [Richard Kirwan (1733-1812) the prominent Irish neptunist] had proposed that this name be applied to "all binary aggregates of the granitic kind" (Maton, 1797, 1, p.168). Maton showed this rock type on his mineralogical map, but the name does not seem to have come into general usage.

Following their journey through the Cornish mining districts, Maton summarised their observations on the mineralogy of the ores as follows:

1) Tin was present commonly as the oxide, whereas the copper ores were mainly sulphides.
2) The tin ores were most frequently associated with oxides of iron and arsenic [in practice arsenic oxide does not occur naturally and the common arsenic mineral is arsenopyrite].
3) There were no calcareous minerals associated with the tin ores apart from fluor spar.
4) The rock occurring in the walls of a lode, the ‘cape’ [or capell], could be ‘argillaceous’ or ‘siliceous’, but the country rock itself was most frequently granite.
5) Copper lodes lay deeper than those bearing tin and were generally leached and oxidised near the surface forming gossen.

THE MINERALOGICAL MAP

Maton summarised the comments on soils, minerals and rocks, scattered through the two volumes of his Observations, on what he called a mineralogical map (Figure 3). He recognised that, during his journeys, he had not been able to examine every part of the area and that in consequence, his map showed only "the grand stretch of the different strata and the most prevalent substance in the composition of each" (Maton, 1797, 2, p.202). Where his route had not allowed him to adequately trace the extent of some of the strata he had been forced to rely on other sources. However, he considered that this had rarely happened as the gaps in his own observations were few!

The map, engraved in London by B. Longmate of 11 Noel Street, Soho, is tipped in between pages 208 and 209 of volume 2 of Maton’s Observations. Barak Longmate Jnr. (1768-1836) was a skilled heraldic engraver who assisted a number of antiquarians with drawings in the late 18th/early 19th Centuries. Measuring 31.5 cm by 17.3 cm, the map shows the geology of Cornwall, Devon, Dorset and Somerset and extends as far west as the Scilly Islands. The latter were not visited by the tourists and are excluded from Figure 3. No scale is shown on his map but this is about 1:1,150,000.

Maton noted that colour had been used by others to distinguish different strata on maps, but felt that this could express neither gradual changes in composition nor the connection of one rock type with another. A second method involved shading, where strata were differentiated by contrasting orientations and combinations of lines. He favoured the use of lines, but felt that their use could be extended beyond showing the extent of strata to demonstrating the relationship between them. The key to his map (Figure 4) shows that four strata types were represented by simple straight lines, horizontal lines for clay, vertical for chalk, diagonal lines proceeding downwards from the right (forward-facing) for quartz and proceeding from the left (backward-facing) for serpentine. However, apart from being used separately the lines were also used as ‘mineralogical signs’ which, in...
combination, characterised the mineralogy of a particular rock type. Thus the horizontal lines were also used to represent the argillaceous component of a rock, the vertical lines the calcareous component, the forward-facing diagonal lines the quartzose component and the backward-facing diagonal lines the magnesian component.

Figures 5 and 6 illustrate the ways in which these lines were combined and/or modified to represent a range of rock types and their interrelationships. The area to the north of Exmouth, with a north/south trending stratum of clay (horizontal lines) is shown in Figure 5. To the east the vertical straight lines of chalk are undulated to represent limestone, which has no affinity to the clay, and the junction between the two rock types is sharp and well-defined. However, the clay and the gritstone to the west both have an argillaceous component. In consequence, the horizontal lines of clay, now used to characterise that argillaceous component, are continued laterally, where they are combined with forward-facing diagonals, characterising a quartzose component, to represent argillaceous gritstone. To the west of this gritstone, the horizontal lines continue but are undulated to show the slaty or schistose nature of the argillaceous rocks. The continuation of the horizontal lines across strata boundaries indicates similarities in mineralogy between one rock type and another. Taking this principle further, the forward-facing diagonals in the argillaceous gritstone continue across the junction with the granite, indicating that both rock types have a quartzose component. The opposing diagonal lines in the granite represent its magnesian component, present as mica.

Figure 6 shows an area which includes Land’s End and the Lizard Peninsula. The granite forms the central spine with its ornament of opposing diagonal lines. To the south, the forward-facing diagonal lines continue across the junction with quartz, indicating the quartzose component they have in common. To the north, the backward facing diagonals continue across the junction with the killas, whose principal component is an argillaceous one, represented by horizontal
lines. However, the backward facing diagonals "point out the other prevailing earth in killas, viz. the magnesian, and connects the killas with granite" (Maton, 1797, p.205).

Maton considered that the use of line shading to characterise strata was more effective than using colours as permutations could be varied to infinity by merely undulating, doubling or interrupting the lines. To produce a map whilst travelling, the only materials necessary for a traveller to carry, were a ruler and pen or pencil and he concluded his Observations with the hope that "very shortly a complete picture of the mineral face of the whole island" might be available (Maton, 1797, p.208).

DISCUSSION AND CONCLUSIONS

Despite Maton’s claims that the gaps in his own observations were few, Figure 2 shows that the travellers’ route followed the coast with only a limited number of traverses across the South-West Peninsula. This lack of observations inland is reflected on his map where, for example, granite is shown as a continuous outcrop down the spine of the Peninsula rather than a series of discrete intrusions. He shows the presence of limestones along the south coast around Plymouth, Torquay, Portland and the Isle of Purbeck, but most inland features which he describes in his text are omitted from his map. These include the Somerset Coalfield, the coal pits north of Newton Abbot, the red sandstones and breccias of the Crediton Trough and the marls around Lyme Regis where he noted the cliffs abounding with “skeletons of fishes and other animals in a fossil state” (Maton, 1797, p.75). Overall the map is a very poor representation of the geology as it is known today. It is over-generalised and inaccurate, and the positions of strata on the map often bear no relationship to statements made by Maton in his Observations. No attempt was made to group the rocks into a stratigraphical sequence, not even into Primitive, Secondary and Tertiary, divisions which infer relative ages and which were becoming accepted by the end of the 18th Century.

The map also illustrates one of the problems Maton experienced during his travels which was the meaning of some of the terms used by the miners. He misinterpreted words such as elvan and capel, treating them as names for specific rock types rather than words describing the position the rock occupied in relation to a mineral lode or host rock. Thus he bemoaned the fact that he could never get a satisfactory definition of "elvan stone" which he found encompassed a range of different intrusive rocks. Killas was a term the miners used for the clay slate or, to use Maton’s term, the argillaceous slate of Cornwall and Devon, and was used whether or not the slate was within the metamorphic aureole of the granite. However, Maton associated the killas with the contact between granite and sediments and his map shows the granite, over much of its outcrop, bordered by a halo of killas. The association was emphasised by the backward-facing diagonal lines, connecting killas and granite.

Despite Maton’s preference for shading with lines over the use of colour, most subsequent British geological maps used watercolour until colour printing started to be applied to geological maps in 1853 (Butcher, 1983). It is not difficult to see why lines did not become popular. Without the use of a lens, on the scale at which the map was reproduced in Maton’s book, it is almost impossible to distinguish between the shading characterising granite, argillaceous gritstone and killas. If more rock types were to be shown, with a greater number of line combinations, differentiation would be impossible. Maton advocated lines as he felt that they could not only delineate strata but demonstrate their interrelationships. However, continuing lines across strata boundaries, confirmed only that adjacent rock types had minerals in common. The forward-facing diagonal that was used in part to characterise argillaceous gritstone and granite merely showed that both had quartz as a dominant mineral but provided no useful information about their interrelationship.

Maton’s Observations represent the first description of South-West England written by observant travellers with an interest in science and a knowledge of geology and have been described as “the first regional geology” of any large part of the country (Challinor, 1971). This seems rather an inflated claim as in many parts of his account geological and mineralogical descriptions take a subservient place to descriptions of vegetation, buildings and local history. The map in turn has been credited as “the first attempt in England to construct a geological map” (Paris, 1838). Whether or not such a claim can be substantiated, the fact that an attempt was made to distil geological observations into a regional map, marks it as of considerable historic importance. Although crude and inaccurate it represents another step between Martin Lister’s proposal “for a new sort of maps of countries” in 1684 (Lister, 1684), and the publication of William Smith’s wonderfully detailed map in August 1815.

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REFERENCES


