The early history of the Royal Geological Society of Cornwall 1814-1850

Thesis

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THE EARLY HISTORY
OF THE ROYAL GEOLOGICAL SOCIETY OF CORNWALL:
1814-1850

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Faculty of Arts,
The Open University

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14th September 1990
7 THE HEALTH AND SAFETY OF MINERS

A rather different objective of the RGSC can be demonstrated by examining the efforts the society made to try to reduce the number of injuries and fatalities in mines. Several of the institutions discussed in previous sections concerned themselves with similar problems. In Cornwall attention was directed particularly to the health and safety of miners, and all three of the major scientific societies in the county eventually became involved in this humanitarian question.

7.1 The safety instruments of the RGSC

The RGSC showed a special interest in the injuries caused by the accidental explosion of gunpowder, used for blasting rock. The problems associated with blasting were first raised within four months of the foundation of the society, at its first Quarterly Meeting in May 1814.\(^1\) The minute book recorded that Rose Price spoke "at some length" of the accidents that "are daily happening in the mining districts from the use of iron rammers". He also demonstrated an alloy rammer (tamping bar) which he claimed would "at once remedy the Evil".\(^2\) Rose Price was a local landowner, who had become a close acquaintance of Paris, the secretary to the RGSC, soon after Paris's arrival in Cornwall.\(^3\)

It is possible that Price was initially concerned for the safety of members, for at a meeting in March 1814 some of them had proposed getting permission from a local landowner to
blast a rock near the Logan Stone in order to obtain specimens. Paris later stated that he had first been made aware of blasting accidents by Price, after an unfortunate accident had taken place on one of Price's farms "in blasting the boulders of granite which impeded its cultivation".

The RGSC was not the first geological society to take an interest in the problems of blasting. Woodward stated that the first paper given to the Geological Society of London was read by John Taylor in 1808; "A paper on the subject of facilitating the process of blasting rocks by the employment of clay instead of the ordinary tamping". This paper was mainly about the different materials which could be used to hold a charge of gunpowder in a blasting hole, but it was in part concerned with the safety aspects of blasting. It seems to have been inspired by a lengthy correspondence on the subject, involving Taylor, Nicholson, Jessop, Farey and others, published in editions of the Philosophical Magazine in 1807.

In Cornwall, gunpowder for blasting was first introduced by German mining engineers in the late 17th century. It was used increasingly during the 18th century, as demand for tin and copper rose, and mines became deeper and wider. The methods used by Cornish miners at the beginning of the 19th century have been described in both contemporary and modern sources and can be summarised as follows. Gunpowder (or black powder) was packed into one inch diameter holes, which could be from 18 inches to three feet in depth and were drilled by hand. Often the powder was inserted loose, but in upwards sloping or "back holes", or if the hole was wet, it
was necessary to use a cartridge. These were made on the spot from paper or parchment, and sealed with tallow from a miner's candle. After a wad of oakum or clay had been inserted to hold the powder, a nail or pricker made of iron, or a fuse made of quills, was pushed into the powder until it reached the back of the drill hole, breaking the cartridge if necessary. Then stemming or tamping (usually a mixture of sand and clay) was rammed on top of the wad with a tamping bar, in order to confine the powder. Sometimes a mallet was used to help pack tight the tamping. Finally, if a nail had been used, it was withdrawn, leaving a hole into which a fuse could be inserted.

Accidents occurred frequently when gunpowder was used in this manner. If loose powder was used, traces might adhere to the sides of the hole, and could be ignited by a spark, produced if an iron tool struck quartz or pyrite. The cartridges were flimsy and easily broken, especially when being inserted into a hole. Premature explosion of the gunpowder could result in blinding, mutilation or death. The smoking of pipes near gunpowder was also cited as a cause of many accidents in mines.¹⁰

The RGSC felt that it had to justify its interest this humanitarian problem. In its second Annual Report, for 1816, Paris wrote:¹¹

"...if the chief boast and ornament of Science is its power of increasing the comforts, and of diminishing the evils of life, surely to avert the perils with which those who labour for our benefit are beset, to rescue the fathers and supporters of families from death, or injuries worse than death, is an occupation which must cast a lustre on a Soc-"
iety professing to cultivate a science pre-eminently capable of application to the useful purposes of mankind.

Lord De Dunstanville, the society's first Patron, and well known in Cornwall for his philanthropy towards the mining community, was said by Worth to have encouraged these efforts. Sir Rose Price, initially the most active of the members in pressing for the society to become involved in this matter, also had a number of other philanthropic interests; he was the Chairman of the Governors of Penzance Dispensary in 1815, and was also influential in his own parish of Madron in bringing about improvements in the roads and footpaths. Paris, who seems to have shared Price's concern about mine injuries, was a physician, so it is unlikely that he would personally have dealt with mine accidents. Several of his surgeon colleagues at the Dispensary, however, also worked as mine doctors (see Section 3.3.3), and could have him made aware of the extent of the injuries caused by gunpowder explosions. It is possible that Paris also had other motives for supporting Price's efforts, for he may have seen the campaign as a opportunity to draw attention to the newly formed society, and to gain favourable publicity for it.

The first real steps taken by the RGSC to deal with the problem of premature explosions were taken in November 1814. At a Quarterly Meeting of the society on the 25th November 1814, a letter was read from Sir Ralph Milbanke of the Society for the Prevention of Explosions in Coal Mines of Sunderland, asking for the co-operation of the RGSC in its work; Price responded to the reading of this letter by stating that fire
damp was not a problem in Cornish mines, but that a worse evil existed, the explosions caused by the use of iron rammers. He demonstrated to the meeting a bar made of an alloy of copper and tin, which he claimed would not produce sparks when quartz was struck.15

A week later, at the monthly meeting, Price again demonstrated this tamping bar.16 This time he was able to persuade the society that twelve sample bars should be made at the society's expense, and sent to the captains of "the leading mines" for their opinions.17 No responses to this effort were reported in the minute book, but in his paper in Volume I of the RGSC Transactions, Paris stated that he had sent several of the alloy bars to a member, John Williams of Scorrier, for testing, and he had replied that "they bent, and were unable to withstand the work".18

Meanwhile the society started to pay attention to another means of improving the methods of using gunpowder. In January 1815 Paris read a paper from William Chenhalls, a mine agent from St Just in Penwith, which described an instrument he had invented, and which he called the "shifting cartridge".19 This instrument, made of brass and not unlike a large syringe, was demonstrated at the meeting, and it was claimed that it would deliver a measured charge of gunpowder without leaving traces around the sides of the blasting hole.20 It was resolved that twelve of these should be made, at a cost to the society, and sent to those mines which had been sent sample tamping bars. Paris argued in his 1818 paper that the cartridge would also be more economical in use, since less powder
would be needed than if it were measured by eye alone.\textsuperscript{21} Chenhalls, as a mine agent, would have been more aware than most of the members of the RGSC of the hazards involved in the use of gunpowder. However, he may also have had a financial interest in promoting his safety instrument, as it was common practice for agents to supply equipment to the miners, and to earn commission from this activity.\textsuperscript{22} There is no evidence however that he did benefit from the sale of his invention.

The \textit{West Briton} newspaper gave an account of the January meeting of the RGSC, and concluded by stating:\textsuperscript{23}

\begin{quote}
We hope that these exertions will be the happy means of preventing the occurrence of these accidents, which we have so often the painful task of communicating: at the same time we rejoice to find that scientific body directing its influence to points of such practical importance and benevolence.
\end{quote}

The criticisms made of the tamping bar by John Williams may have been repeated by others, for efforts were made to seek improvements. At some stage Sir Humphry Davy was consulted. In a letter to Henry Boase, written in July 1816, he wrote:\textsuperscript{24}

\begin{quote}
I have tried a few exp\textsuperscript{ts} on bronze and brass with a view to the tamper at the suggestion of Capt Chenals; but I have as yet had no results worth communicating. I will however pursue the subject.
\end{quote}

Davy was at this time involved with his experiments connected with a safety lamp for coal miners, and there is no evidence in the RGSC records to show that he did pursue the matter of the safety bar any further, nor is there any record of relevant experiments in Davy's Laboratory Notebook for the period, kept at the Royal Institution.\textsuperscript{25}
Chenhalls however developed an improved bar with the assistance of Paris and Price.26 A letter from him was read at the monthly meeting in November 1815, in which he described a new version; this was made of iron, but was shod with a copper and tin alloy cap.27 He was able to report to the RGSC that he had introduced the bars capped with alloy into his own mines, and that "Mr Bray" of Redruth was prepared to make "any number of them". Chenhalls also recommended the use of the alloy "known to Mr Bray by No. 1".28 He had already been awarded a special medal by the society for his efforts, at the Anniversary Meeting in October 1815.29 In a letter in the West Briton in November 1816, Paris mentioned that improvements had also been made to the shifting cartridge by John Rule of Redruth (the surveyor of Dolcoath mine, and a member of the RGSC from 1814).30

Having assisted in the development of the new tamping bar and the shifting cartridge, the society proceeded to promote the use of them. It is likely that the members were not averse to seeking publicity, as this would also have helped to promote the society itself. One method adopted was to make public the appalling record of injuries caused by premature explosions. Sir Rose Price had already suggested in February 1815 that "an accurate statement of the Numbers and Nature of the accidents" should be prepared, by collecting information from the "Clergy and Medical Gentlemen and Parish Officers".31 In September 1816, at the Anniversary Meeting, Paris read a paper 'On one hundred cases of accidents occasioned by miners using the common tamping bar made of iron', compiled from the statistics collected.32 Details of 95 such accidents were appended to a
pamphlet published in January 1817, which also contained Paris's paper 'On the accidents...', later printed in Volume I of the society's Transactions. Of those accidents, 13 were fatal, 36 involved the loss of one or both eyes, and 11 the loss of one or more limbs. An advertisement for the pamphlet, in the West Briton of February 1817, stated that the information had been "collected with a view to satisfy the public mind of the frequency as well as severity of such calamities, and of the necessity of an immediate and effective remedy".  

The Annual Report of the RGSC for 1816 also referred to the safety instruments, and the need to advertise their use:

...some of the eastern mines still maintain an unjust prejudice against the use of the Safety Bar;... A prejudice so blind and fatal calls for the powerful and steady intervention of this Society, a prejudice which has proved to owe its origin solely to error, and its continuance to the apathy of those whose duty it is to correct it:...

In April 1817, further attempts were made to gain publicity for the safety instruments. The society took the initiative of bringing to the attention of the Judge at the Lent Assizes at Launceston, the record of accidents in mines, and the safety instruments designed to prevent them. The Royal Cornwall Gazette reported that:

...the learned Judge, Sir Charles Abbot, in the course of his charge to the Grand Jury, took the occasion to pay a compliment of the most honourable description to the pamphlet... lately published by Dr Paris... His Lordship said he had met with the publication alluded to in a neighbouring County, and could not help being struck on its perusal, by the humanity and ability which so eminently distinguished it... His Lordship said, that however irrelevant the noticing of this subject might appear with the business then before the Grand Jury, yet feeling as he did, that the lives of so many valuable Members of Society might be preserved by the means so philanthropically recommended by Dr Paris, he hoped he should be excused if he cordially recommended the
pamphlet... and expressed his hope that through the means of its circulation, much human misery would be prevented and an important benefit conferred on Society.

Following this strong recommendation by Judge Abbot, the Grand Jury formulated a lengthy resolution, which was published in local newspapers. The final part of this resolution stated that:

We... feel it to be our duty strongly to recommend the speedy and general introduction of the said 'Safety Instruments' to all Agents of Mines in the said County, and to request the Clergy, Magistrates and Gentlemen to give every possible publicity to this Resolution throughout their respective districts.

It appears that it was necessary for the RGSC to take such steps to make known the new instruments, not just in order to enhance the reputation of the society, but because there was a reluctance on the part of many miners to adopt new developments of any kind. Paris had begun his paper, 'On the accidents...', with a note of caution. He referred to the obstinacy of mankind, and urged the county gentry to help the society in persuading miners to use the safety instruments.

In the same paper he wrote:

I cannot conceal the fact, that the efforts of the Society have been treated by many mine agents with coolness, and by some even with hostility; that the extent and frequency of the calamity arising from the accidental explosion of gunpowder have been denied.

This paragraph was an indirect reference to correspondence about mine safety, critical of Paris, published in the *West Briton* in 1816. Paris, as a "foreigner" in Cornwall, had been an object of criticism and amusement to some people ever since he had begun his work with the RGSC. The letter previously quoted on page 66, from "A Cornish Miner", was probably directed at Paris personally, for the writer also said:
Mining has long employed the mind and hands of thousands in this County, but it is not everyone who had been so employed, that he is qualified to judge of the various expedients that may be resorted to, or to give a proper definition of those in which he has been engaged; how then can a man be expected to do so, who whatever may be his classical attainments, has never been engaged in directing the operations he would facilitate.

Another letter in the West Briton showed more direct criticism of Paris, and questioned his real knowledge of mineralogy:

A short time since, a medical gentleman, who is particularly active in mineralogical pursuits, dined at a neighbouring mine. This circumstance afforded him an opportunity of descanting on his favourite subject, which he did not fail to embrace. In the midst of his declamation, a certain gentleman of the law... slyly left the room... and took up a piece of scoria to which a small piece of copper was attached... he waited until the Doctor had finished... when he produced this rare specimen. The Doctor... recommenced his lecture by a description of this wonderful production of nature... he was at length called to order by a plain sensible gentleman, who told him what it really was, which created no small share of mirth, at the Dr's expense.

A lengthy correspondence in the Truro newspapers in the autumn of 1816 demonstrated the hostility which Paris met when trying to promote the use of the safety instruments. He was also taken to task for not appreciating fully the nature of the problems associated with the use of explosives. In October 1816, Paris had written to the West Briton, in response to a letter in the previous week's edition in which details were given of an accident caused by the premature explosion of gunpowder, in the Chacewater Mine. Paris wrote:

There has ever been, on the part of the Mine Agents, an unaccountable disposition to conceal the extent of the mischief which daily occurs from the use of the common tamping bar, and to represent it as being rather the effect of carelessness, than of unavoidable accident, and to merit censure rather than commiseration... In the name of the Geological Society, of which I have the honour to be the Secretary and which has so laudably excited its energies for the prevention of such accidents, I feel it my duty to call upon the Managers of the Chacewater Mine to state, in the face of this county, their objections to the use of the safety bar.
This letter provoked an angry response from "A Mine Agent" in the next edition of the West Briton: 44

You libel the Mine Agents in general by saying that there has been an unaccountable disposition in them to conceal the extent of the mischief which daily occurs from the use of the common tamping bars. Does then such mischief happen daily? Taking all the mines in Cornwall together, I would ask, if it happens once a week?... The Agents at Chacewater Mine were willing to make trial of the Safety Bar and the principal manager of Wheal Unity mine gave his order for several of them to be sent there: and was told that the order would be executed: had that been done, a part of them would have been tried at Chacewater: and one of the Chacewater Agents inquired, several weeks after the order had been given whether the bars had been sent to Wheal Unity or not, and was told by the Gentleman who gave the order that he had heard nothing more of them...

Three more letters on the same subject were published in following weeks. A second letter from Paris was printed in reply to the one above. Although he gave more details of blasting accidents, he made no response to the problem of the supply of the safety bars to Chacewater mine, and he dwelt, with scorn and at length, on the general stubbornness of some of the mining community. 45 A second letter from "A Mine Agent", which ended the correspondence, was equally intemperate. 46

Paris left Penzance in the autumn of 1817, but for a few years the RGSC continued to promote the use of the safety instruments. At the fifth Anniversary Meeting, on the 6th October 1818, Sir Rose Price again raised the topic of safety in mines. 47 He said that accidents were still occurring because the new tamping bar was not being used everywhere, and proposed the following resolution: 48

That tamping bars be made in Penzance on the plan recommended by Mr Chenalls, under the inspection of the Secret-
ary. That he be requested to cause to be printed, on cheap paper, such an accurate description of the manner of making and repairing them, as will enable any common blacksmith to manufacture them, therefrom; that these papers be transmitted to the Agents of all the great mines in the County, and also to the Ministers of every Parish and that copies of them be inserted in the County Papers, and in Flindell's Weekly Journal, at the expense of the Society.

At the same meeting, Chenhalls reported that he had received orders for his design of tamping bar only from Wales. 49

In October 1819 a paper sent to the society by Paris was read; 'Observations and experiments on the construction and use of the safety bar'. 50 This was followed by a paper from the new secretary, John Forbes, 'On the different procedures employed in blasting rocks, being an Appendix to Dr Paris's'. 51 There were no details of the papers entered in the minute book, and they were not published. Sir Rose Price also spoke on the subject of mine accidents, and recommended that "a list of accidents between this and the next anniversary be kept". 52 If such a list was kept, no details of it were ever reported.

In October 1820 Joseph Carne, a member of the RGSC, read a paper on blasting, and a second was given by John Rule, but no further details remain. 53 In 1834 and 1838, two further papers on blasting were read, but neither was printed in the Transactions of the society, so their content is known only by their titles. 54 With the possible exception of these last two papers, the last mention by the RGSC of the safety instruments was in 1820.

Why did the RGSC apparently lose interest in the safety instruments after about 1820? It does not seem to have been because its campaign had been successful, as deaths and
injuries from premature explosions of gunpowder continued to be reported. Part of the reason may lie in the fact that the main protagonists were no longer so active. Paris had left Cornwall in the autumn of 1817, so no longer had control of the society's activities. His successor, Forbes, found that there was another more serious cause of mortality among miners, and pursued that problem instead, but not, as will be seen, through the medium of the Geological Society. William Chenhalls took no further part in the RGSC proceedings, though it is not known why this should have happened (he died in 1834). Sir Rose Price remained a member of the RGSC, but he acquired other responsibilities, becoming the President of the newly formed Penzance Library in 1818, so he may have had less time to devote to publicising the safety instruments. In 1824, Price became involved in a very public dispute about religious matters with C Val Le Grice (the curate of Penzance, and a member of the RGSC). Le Grice accused Price of Unitarian beliefs, and the arguments between the two men were carried in great detail in letters in the Royal Cornwall Gazette between the 17th January and 21st February 1824; others also joined in the correspondence. After this controversy Price withdrew from public life; he was however also finding it difficult to maintain an expensive life-style, and his increasing debts may have contributed to his reclusion.

The RGSC had also undergone changes since its foundation in 1814. At first meetings had been held monthly, but by 1820 it had become formal policy to make the annual Anniversary Meeting the only event of the year; the reason given for this
alteration was the distance that members had to travel to Penzance, to the society's rooms, although there was in reality a shortage of material available for presentation at meetings (see Section 8). There were thus fewer opportunities for matters to be raised in an informal way, for the anniversary was an event at which visitors were welcome, and at which the order of procedure was planned in advance. The membership of the society was also changing, so that there was a smaller number of members with practical experience of the problems of miners (see above and Figure 17 (p. 168)). The titles of papers read at meetings, and published in the second and third volumes of the RGSC Transactions, suggest that mining was no longer a major subject of interest, except when studies carried out in mines could add to geological knowledge. Volume I contained 20 papers, of which seven were concerned with the practical aspects of mining (and one with practical agriculture); Volume II had only two such papers out of 22, and Volume III, two out of 16 (see Table 6, overleaf). (This change in the type of subject matter included in Transactions will be raised again in Section 8.)

The efforts made by the RGSC to improve the safety of miners when using gunpowder were successful only to a very limited extent. There were probably more than one hundred mines operating in Cornwall at about this time, so that the successful introduction of the safety bar into a few mines in the far west of the county only scratched at the surface of the problem. Although the mines in the St Just area adopted the safety instruments, for Paris in his 1818 paper had added a
### TABLE 6

**SUMMARY OF SUBJECT MATTER OF PAPERS PUBLISHED IN THE TRANSACTIONS OF THE ROYAL GEOLOGICAL SOCIETY OF CORNWALL, 1818-1832**

<table>
<thead>
<tr>
<th>Dominant Subject Matter</th>
<th>Volume Number</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Petrology&lt;sup&gt;1&lt;/sup&gt;</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Stratigraphy&lt;sup&gt;2&lt;/sup&gt;</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Geomorphology</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mining&lt;sup&gt;3&lt;/sup&gt;</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Mineral veins</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Mineral processing</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Stream tin</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Mineralogy</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Historical</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Advice to RGSC&lt;sup&gt;4&lt;/sup&gt;</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Temperatures in mines</td>
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<td>4</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>20</td>
<td>22</td>
</tr>
</tbody>
</table>

**Notes**

1. Papers which described rocks mainly in terms of their mineral content.

2. Papers which discussed rocks mainly in terms of their stratigraphical relations.

3. Papers which dealt with mining in general, covering subjects such as geology, mining technology and the relationship between mining and geology.

4. This group included one paper by Sir Humphry Davy, and three by John Hawkins, which offered advice to the RGSC on the topics which might be studied by members.

*OVER...*
5. Some long papers, which covered two or more subjects, have been counted for each subject, so totals will not agree with the number of papers and notices in each volume. (Eg: the paper by H S Boase, 'Contributions towards a knowledge of the geology of Cornwall' IV, pp. 166-474, is classified under petrology and stratigraphy.)
copy of a testimony from the mine agents of six St Just mines, to the effect that the safety bar was an improvement and afforded security against accidents, there seems to have been greater reluctance to use the bars in the central and eastern mining areas of Cornwall. It was said by Worth in 1878 that iron tamping bars were still in general use in the St Austell district in 1870, more than 50 years after the RGSC had first introduced the safety bar.

The safety instruments of the RGSC would have been more expensive than the common iron varieties. Chenhalls had reported, in a letter to the society's Council in 1816, that the "common bar cost about Thirteen Pence and the Safety bar will cost about Twenty pence". The new tamping bar, in its improved form, needed to be reshed with copper tin alloy about every eighteen months at a "cost of a few pence". The shifting cartridge was made of brass, and therefore also likely to be costly. Most miners were contractors, not direct employees of the mines, and they had to pay for their own tools and other materials out of the money that they earned. The residual earnings of a tributer in the St Just area were 27 to 30 shillings a month; by 1837 these had risen to about 50 shillings. There cannot have been much incentive to invest in expensive equipment unless the need was pressing. The shifting cartridge invented by Chenhalls never seems to have become popular. Worth, writing in 1872, stated that it was first suggested by Chenhalls in 1802, so it is possible that Chenhalls was using the prestige of the RGSC to promote a device which he had not been able to market himself.
Mine agents and adventurers in Cornwall may also have been resistant to the introduction of the new instruments. They were responsible for the supply of materials and equipment to miners, and they made considerable profits from these activities, sometimes being appointed agents for the sale of certain materials. They would have been reluctant to lose income, and might have been suspicious of the motives of the RGSC. The adventurers who invested in mines were primarily interested in profit, and would not have wanted to reduce those profits, which were in any case very uncertain, by having to finance expensive items.

Miners received little formal education or training in their trade. A boy would start as a surface worker at the age of six or seven, and at about ten or twelve would join his father, or another relative, underground. He would learn his trade by working alongside him. There was no school for miners in Cornwall (see section 4). The lack of any formal methods of training in mines would have made the introduction of new practices most difficult. A correspondent writing to the Royal Cornwall Gazette in 1819, and referring to the introduction of a new type of fuse, stated that "the men are averse to the adoption of any new mode or system".

There were other reasons for accidents with explosives, and other causes of poor health in miners, which the society did not pursue. According to Hamilton Jenkin and Earl the main cause of blasting accidents was the unreliability of the fuses used in mines, prior to the invention by Bickford in 1831 of
the safety fuse. 72 This was also the opinion expressed by Dr Charles Barham of Truro in 1842, in his 'Report' to the Children's Employment Commission. 73 Early fuses were commonly made either from rushes or quills filled with fine gunpowder, or alternatively a trail of powder could be laid. The fuses could be broken easily, especially when a long hole was bored, as the practice was to build up a rod of quills, inserting one into another until the required length was reached. 74 The rate at which these fuses burnt was also variable. Hamilton Jenkin said that by far the greatest number of accidents were caused either by fuses burning too quickly and causing a premature blast, or by delayed burning causing the charge to fire as the miner went back to inspect it, suspecting that it had failed. 75 The material used for tamping was also sometimes cited as the cause of premature explosions. If it contained quartz or pyrite, it was as likely to cause sparks as an iron tamping bar; this was the subject of a letter in the Royal Cornwall Gazette in 1819. 76 John Forbes also wrote in 1834: 77

Both of these suggestions [the tamping bar and shifting cartridge] have been only very partially adopted, and their value, as preventives, has been very differently estimated by different practical men. A greater improvement than either of these has been adopted, of late years, namely, the employment of soft tamping-stuff, incapable of yielding sparks on percussion.

The two Truro newspapers frequently carried reports of deaths and serious injuries in Cornish mines. These reports may not have been accurate for statistical purposes, as local matters were often omitted to make room for important national news, but it is possible to obtain an idea of the frequency and
<table>
<thead>
<tr>
<th>Below ground</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In connexion with blasting</td>
<td>8</td>
</tr>
<tr>
<td>By the falling of the miners under various circumstances</td>
<td>25</td>
</tr>
<tr>
<td>By ground or other bodies falling on them</td>
<td>26</td>
</tr>
<tr>
<td>No cause assigned</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Above ground</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bursting of a boiler at Consols</td>
<td>5</td>
</tr>
<tr>
<td>Entanglement in machinery</td>
<td>3</td>
</tr>
<tr>
<td>Other causes</td>
<td>2</td>
</tr>
</tbody>
</table>

| Total                                     | 75     |

1. Statistics from C Barham (1847), (64).
types of accidents that took place. In 1817, for example, the two papers together reported on a total of 19 deaths in mines. Of these, seven were from accidents from explosives, three resulted from falls from ladders, and five from falls of rock or earth; there were four other deaths from a variety of causes. In 1841, Dr Charles Barham read a paper to the RIC on the statistics of accidents in mines in Cornwall, in which he gave details of 75 fatal incidents which had occurred in the previous two years. Only 8 men were killed as a result of blasting (see Table 7).

Thus it appears that although explosives accidents were a cause for concern, other dangers in mining were also a major problem. Most of the other causes of fatalities were never brought up at meetings of the RGSC, although, in May 1817, Paris had made a mention of some problems associated with the use of the "Standard barrow" used to weigh copper ore, at the request of a correspondent in the West Briton. This barrow was said to be so heavy that the use of it frequently caused ruptures. No action appears to have been taken by the society on this issue.

The tamping bar shod with alloy, as recommended by the RGSC, was never really successful despite all the efforts made by the society, and was eventually replaced in most mines by a bar made of wood. Richard Q Couch, a surgeon, and secretary of the RGSC 1850–62, wrote in the Report of the RCPS in 1860:

The most serious of the non-fatal accidents [in mines] arise from blasting, and these most commonly occur from the neglect of recommended caution - the wilful perseverance in the
employment of metallic instead of wooden tamping rods. On this subject, the adventurers are constant in their endeavours to induce the men to use the wooden rods, and the agents are equally solicitous on the subject, but without effect.

The Metalliferous Mines Regulation Act of 1872, which extended existing legislation covering coal mines to include the metalliferous mines of the country, prohibited the use of any bars made of iron or steel, and required that they be substituted by wooden bars.

7.2 John Forbes and the health of miners

John Forbes was appointed in September 1817 both as secretary to the RGSC, and as physician to the Penzance Dispensary. A Scot by birth, he had been educated at Edinburgh, after which he had served as a surgeon in the Royal Navy for nine years until 1816. He came to Penzance recommended by Robert Jameson, who had been asked to assist the RGSC in finding a person suitable to fill the vacant posts of secretary and physician. It seems clear that Forbes considered his work for the Dispensary to be more important than that for the RGSC, although there were no complaints by the society about his performance. However when he resigned in 1822 he was not given a leaving presentation, unlike Paris. The minute book of the RGSC was not kept up as well as it had been when in Paris's care, for Forbes's entries were short, and sometimes incomplete. There were no entries at all between the Anniversary Meeting in 1820, and 17th February 1822, when Forbes tendered his resignation.
When Paris was physician to the Dispensary, the minutes of that institution had recorded the thanks of the Governors in simple terms; in 1815 for example it was resolved:

That the thanks of this Court be Presented to Dr Paris and the other Medical Gentlemen for their humane attention to the Patients during the last year.

The Governors' appreciation of Forbes's work was, however, recorded in glowing terms. At the Annual Meeting of Subscribers to the Dispensary in April 1818, when Forbes had been physician for little more than six months, the minutes recorded that it was:

Resolved - that the thanks of this meeting be given to Dr Forbes, for the very particular attention he has shown to the Patients, both at the Dispensary, and at their own homes, for which this meeting beg to express their highest approbation.

The terms of appointment for the Dispensary physician did not include home visits to patients, only attendance at the rooms of the institution. Forbes was therefore showing more than token care for his patients.

Although Forbes did present one paper to the RGSC on the problems of blasting (see above), he soon began to pay attention to another cause of mortality among miners. While in Penzance, he published his own translation of Laennec's work on the stethoscope, the first in the English language. He also made use of the new diagnostic instrument in Cornwall, especially when carrying out a survey into the lung conditions of the mining community. He was able to show that diseases of the lungs were a more important cause of death among miners than accidents in mines. According to Forbes's biographer "when he went to Penzance, his lungs were affected in some way, and that probably influenced him in choosing that local-
ity". It is possible that Forbes's own illness may also have inspired his interest in the work done by Laennec, and in the lung diseases of miners.

He published no work of his own on chest diseases while in Cornwall, but in 1834 and 1836 the first two parts of 'A sketch of the medical topography of the Hundred of Penwith...' appeared in the Transactions of the Provincial Medical and Surgical Association; the promised third part appears never to have been published. These papers included details of the investigations he had made when in Cornwall into the health of the population. In the introduction to the first part of this work, Forbes explained that he had not been able to publish at an earlier date because:

"...[I] left Cornwall before I had collected much of the information which I considered necessary for the completion of my plan. ...Some few particulars, indeed, I owe to a more recent communication with my Cornish friends..."

In the papers Forbes referred to information that he had received from medical men in Penzance and other parts of west Cornwall. He also made use of the Dispensary Reports, census returns, and statistics that he had gathered himself from Parish registers and Militia returns. He described the work that he had done in connection with miners' lung diseases, both at the dispensary, and when visiting mines. He made a special study of "miners' consumption", or as he preferred to call it, chronic bronchitis. He was able to refute a long held misconception that the Cornish were longer lived than people in the rest of Britain, by showing that in the Hundred of Penwith more men died aged under 39 than in either the rest of Cornwall or the rest of England. This he
attributed to the fact that mining was "a very unhealthy occupation".\textsuperscript{100} He also looked at the working conditions in mines, and analysed the composition of the air that miners had to breathe when below ground. He hinted that dust in the air might be one of the causes of lung disease, and was thus in advance of most contemporary medical opinion; but he gave as the main contributory factors, the expenditure of energy in climbing ladders, and the breathing of "vitiated air".\textsuperscript{101}

7.3 Health and safety in mines: the RCPS and the RIC

Although the RGSC ceased to discuss or publish papers on the safety of miners after about 1820, the other two major scientific societies in Cornwall, the RCPS and the RIC, both made contributions to studies of the health of workers in mining industries. The RCPS was the more active, for almost every Annual Report published in its early years contained some reference to the subject.

Several aspects of the problem were investigated by the Polytechnic Society. In its first year, in 1833, the subject of safe blasting practices was revived, when a premium of ten guineas was offered by Sir Charles Lemon and RW Fox "for the best series of practical experiments, tending to prove how the dangers attendant on blasting rocks, may be most effectually and economically guarded against".\textsuperscript{102} Particular attention was directed towards finding a safer way of tamping, and in the years 1834-38, various suggestions were investigated. The premium was eventually awarded in 1838 to "Captain Dunstan, of
Wheal Vyvyan mine, for a report of a complete series of experiments made with the wedge for blasting rocks". 103

Also in 1833, Charles Fox offered three premiums, for ten, five and three guineas respectively, to be awarded for plans for "the best improvement on the present method of ascending and descending in mines". 104 The search for an alternative to ladders was undertaken because it was believed that the laborious effort involved in climbing them was a contributory factor to the poor health of miners. The problem was partially solved when the man-engine was introduced into Tresavean Mine in 1842, a mine in which the Fox family were major shareholders. 105 The man-engine was only a partial solution, because it could only be installed in those mines which had straight shafts.

In 1834 a premium was offered for the best method which could be used to improve ventilation in mines, in order to minimise the problem of foul air, caused by exhaustion of oxygen and the fumes from gunpowder blasting. 106 In 1835 the society received a "valuable communication" on the diseases of miners, from Dr Clement Carlyon of Truro, in which he discussed lung diseases, the effects of climbing ladders, the effect of "strong drink", the high mine temperatures and the need for baths and changing rooms. 107 This prompted the Committee of the RCPS to urge that "medico mining statistics" should be collected: 108

Among the most prominent desiderata, are the following; the means of medical relief, afforded in case of sickness or accident to the miners; how such relief is paid for; what is the annual cost to each miner; how many accidents have occurred in the last year, or aggregate of five years;
what nature, and from what cause, were such accidents;...
and what is the proportion of deaths to the whole popula-
tion, in mining districts compared with others?

Premiums were offered for the best essays on these topics, and
in the next few years, most Annual Reports contained essays on
the topic, several of them by surgeons in mining districts.

In 1839 the RCPS set up a committee which was to enquire into
the diseases of miners; it was instructed to co-operate with
the RIC when undertaking its researches. At the end of
1840 it was reported that headings had been drawn up to assist
the enquiry; the committee continued to exist until 1842, but
no action was taken which would have led to better working
conditions in mining.

The influence of the Quaker Foxes can be seen in these humani-
tarian efforts, both in their donations of premiums, and in
their general encouragement of such projects. In 1842, the
family withdrew all its investments from mining, because of
its reputation for being the cause of poor health. It is
possible that they took this decision because of the increas-
ing amount of information being made available through the
RCPS.

The RIC also became involved in discussions of the causes of
ill health and death in the mining community, but only after
the RCPS had made the subject topical. Two papers on the
ventilation of mines were read in 1838 and 1839, by the
engineer of Chacewater mine, Samuel Moyle; he made various
proposals for the ventilation of the air in mines in order to
improve the health of miners. However most papers were
less practical, being more concerned with the problems of the accurate collection of statistics, and less with the means of preventing illness or death. For example, Sir Charles Lemon read a paper in 1839 on the new statistics provided in the Report of the Registrar General, saying that:

[the diseases of miners] are chiefly diseases of the respiratory organs; but the extent of their ravages could hardly be appreciated without the information which is now first communicated in the Report.

Dr Charles Barham, of the Truro Infirmary, was a member of the Children's Employment Commission appointed to look into the conditions in which children worked, especially in mines. He made use of his office to investigate conditions in mines generally, and presented the results in two papers to the RIC in 1841 and 1847. He was able to show that mining had the worst record for fatal accidents of all occupations, the only comparable type of employment being service in the Royal and Merchant Navies.

7.4 Health and safety in mines: other provincial societies

Of the other provincial societies with which the RGSC has been compared in earlier sections, the two Newcastle societies seem to have been the most active in promoting the safety of miners. The Rev William Turner, in 1793, had proposed that one of the subjects that should be studied by the members of the new Literary and Philosophical Society should be "the means of preserving the health, and providing for the safety of miners". A proposal by the same society for the preservation of mining records was also made partly with the safety of
miners in mind, as the first call for such records came soon after a mine flooding accident at Slatyford in 1796, and was prompted by the loss of life involved. The society also tested a safety lamp for mines made by George Stephenson.

The Society for the Prevention of Accidents in Coal Mines was established in Sunderland in 1813. In pursuit of its aims, it wrote to other societies in the country asking for their assistance, including the RGSC (see above). It also appealed to Sir Humphry Davy, and this call for help led to his experiments on the safety lamp. Davy, like the RGSC in its attempts to persuade miners to use the safety bar, found that miners were equally reluctant to believe that his lamp was safe.

The Natural History Society of Northumberland was also concerned for the safety of miners, and in particular the fatalities caused by explosions in coal mines due to methane or "firedamp". Two papers in Volume I of the society's Transactions were concerned with explosions that had taken place at collieries, at Jarrow and Harraton. Volume II contained two more papers, this time prompted by an accident at Wallsend Colliery in 1835.

In Yorkshire, the initial membership of the Geological Society was predominantly composed of coal mine owners. J F W Johnston, who had been asked to advise the society on its programme, had recommended that the safety, drainage and ventilation of mines should be studied, and that a mining records office be set up. In the early years of the society, bet-
ween 1838 and 1843, one-third of the papers presented was on mining technology, and particular attention was paid to the problems of ventilating mines. 124 The Manchester Geological Society, formed in 1838, also became concerned about mining fatalities; a history of the society, written in 1908, stated that "improvements [in mining] of every description — and especially those designed to minimise the heavy death toll amongst the workers underground — have been regularly brought before the Society, and encouraged by its approval". 125 Francis Looney, described as an "artisan with broad scientific interests", gave lectures on the explosive gases and the use of the Davy lamp, to large audiences, "of whom a large proportion were working colliers". 126 Both Looney and one of the Honorary Secretaries of the society, Edward Binney, are said to have had some influence on the Earl of Shaftesbury, leading to the banning of the employment of women and children underground. 127

The British Association for the Advancement of Science was another institution which showed concern about mining accidents. At the Newcastle meeting in 1838, John Taylor and Sir Charles Lemon were among the members of a committee formed to approach the government and ask it to set up a mining records office. 128 Davies Gilbert and J S Enys (also a Cornishman and a member of the RGSC and RCPS) were also appointed to this committee. Burt suggests that the reasons for this approach to government were both humanitarian and financial. 129 In 1840 the Mining Records Office was established in London, the first indication that government was taking interest in the safety of miners. In 1842 the first mines inspectorate was
established, also for humanitarian reasons, although the act creating this post applied only to coal mines. 130 The first inspector of mines to be appointed was Hugh Seymour Tremereere who was of Cornish ancestry, and would later become a President of the RGSC. 131

7.5 Health and safety in mines: the reasons for the involvement of learned societies

It seems to have been the case that learned societies became involved in questions of health and safety only in mining, but did not show concern about conditions in other occupations or industries. Members of Lit and Phils, especially in the new industrial towns, were frequently radical in their ideas, and many came from the dissenting groups. However, even where members of the Society of Friends belonged to such societies, and their efforts for reform of prisons, lunatic asylums, and of working conditions for workers employed by them have been frequently described, 132 these appear not to have become issues that they brought to the attention of the societies. This sort of activity was instead left to the social reformers like Robert Owen and the Earl of Shaftesbury.

One possible exception to the case that societies did not get involved in factory reform was the part played by Manchester men in the first Factory Act of 1802. T S Ashton suggests that it was the physician Thomas Percival, one of the founders of the Manchester Lit and Phil, who persuaded the first Sir Robert Peel to sponsor this piece of legislation. 133 It has not been possible to find any direct connection between the
Manchester Lit and Phil and the first Factory Act.

It may be that the issue of factory reform was perceived to be political, and therefore outside the remit of scientific societies, which commonly included clauses in their rules forbidding the discussion of politics. Intervention by such institutions in the organisation of work might also have been seen as interference in the *laissez-faire* principles which governed the conduct of industry at the beginning of the nineteenth century.

The evils of the industrial system in factories were generally slow and insidious in their effects, leading to chronic illness or general ill-health; they did not catch the attention of the public in the same way as did disasters in coal mines. The large fatality lists associated with mining disasters were often prominent features in the newspapers of the time. There appears to have been a close correlation between mine disasters and the various proposals made by the Newcastle Lit and Phil, the Society for the Prevention of Accidents in Coal Mines and the Natural History Society of Northumberland (see above).

Some of the proposals, made to prevent loss of life in mines and put forward by these societies, involved the application of science to the problems of the mining industry. The analyses made of gases in coal mines, and the experiments made by the Newcastle Lit and Phil and Sir Humphry Davy in connection with a miners' safety lamp, involved chemistry. The work done
by the RGSC on the safety bar, and the investigations of the RCPS into the wedge for blasting and the man-engine, could also be described as the application of science. It is less likely that this type of investigation would have been seen as having political implications. Economic considerations must also be taken into account, however, as the flooding of a mine, or the destruction caused by a major explosion involving methane, could lead to the temporary or even permanent closure of a mine. Most of the societies discussed included mine owners among their members.

Concern by the public about mine accidents does not seem to have motivated the RGSC in its campaign for the safety instruments, even though newspaper reports of such events were often made locally. Mine accidents in the metalliferous mines of Cornwall did not occur on the same large scale as in the deep coal mines of the north east, because methane gas is not a problem in the Cornish mines, due to the absence of carbonaceous rocks. Accidents caused by the misfiring of explosives rarely involved more than two or three men. Only the accidental flooding of mines, when old workings were breached, could cause accidents on a scale similar to those of the coal mining areas, and this problem was not addressed by the RGSC. Only the latter kind of accident could have had major economic implications for the owners of metalliferous mines.

It may be significant that it was only after the RGSC had received a letter from the Society for the Prevention of Accidents in Coal Mines, that a resolution was taken to involve the society in research into the effectiveness of the new
alloy tamping bars. Although philanthropy must be one of the reasons for the interest of the RGSC in mining accidents, it is unlikely to have been a major reason. The most probable reason must have been the desire of Paris to seek publicity, both for the society, and for himself.

By the time that the RCPS had begun to take an interest in the health problems of miners in 1833, the political climate was changing, and *laissez-faire* politics were slowly being abandoned. In 1833 the first major Factory Act became law, and despite the fact that most of its provisions applied only to children, the efforts made by the RCPS to try to improve conditions in mines for adult workers must have been more acceptable politically. The measures proposed by the RIC, the Yorkshire and Manchester Geological Societies were also made at dates later than those of the RGSC and Newcastle Lit and phil. Was this perhaps the reason why the RCPS felt able to take up the subject of the poor health of miners, and why Forbes had not used the medium of the RGSC *Transactions*, but had waited until 1834 before publishing his own observations on miners' health?
NOTES AND REFERENCES

1. Quarterly Meeting. The entry in the minute book was undated, but the meeting was probably held in late May. RGSC Minute Book No.1

2. Ibid.

3. G C Boase (1976), (84-5). Price was created a baronet in December 1814. His income was derived from estates in Jamaica, but the family had settled in west Cornwall, after his father had returned to England because of poor health. His friendship with Paris is referred to in: Paris (1818C), (88).


5. Paris (1818C), (88).

6. H B Woodward (1907), (22).

7. John Taylor (1808), (97, 99).


9. Paris (1818C), (81-5); Earl (1978), (21-4); Hamilton Jenkin (1962), (217-8).

10. Andrews (1975), (3).

11. RGSC Annual Report 1816.

12. Worth (1872), (18).

13. Price was Chairman of the Dispensary Governors in 1815; Penzance Dispensary Minute Book 1809-1828, X 439/1 (76). His influence in the parish of Madron is described in G C Boase (1976), (86).


15. Ibid. The society does not appear to have responded in any way to Milbanke's appeal for assistance. There is no correspondence from the RGSC in the archives of the Society for the Prevention of Explosions in Coalmines.


17. Ibid.

18. Paris (1818C), (88-9).

19. Monthly Meeting, 4th January 1815, RGSC Minute Book No.1. Variations in the spelling of the name Chenhalls can be found in contemporary documents, eg: Chynalls, Chenalls, Chinalls.

20. An illustration of the shifting cartridge can be found in Transactions, Royal Geological Soc., Cornwall, I, 1818, (Plate 3).


23. **West Briton** 6th January 1815.


26. A letter from Chenhalls, printed in the RGSC Annual Report for 1816, included the following words: "after repeated experiments in which Sir Rose Price and yourself took so active a part, the proper proportions of tin and copper have been hit upon".

27. Monthly Meeting 3rd November 1815, RGSC Minute Book No.1.

28. Ibid.

29. Anniversary Meeting, 10th October 1815, RGSC Minute Book No.1.

30. Ibid. 8th November 1816.

31. Quarterly Meeting, 17th February 1815, RGSC Minute Book No.1.

32. Anniversary Meeting, 10th September 1816, RGSC Minute Book No.1.

33. Paris (1815B).

34. **West Briton** 21st February 1817.

35. RGSC Annual Report 1816.

36. **Royal Cornwall Gazette** 5th April 1817.

37. Ibid.


39. Paris (1818C), (78-9).

40. Paris (1818C), (80).

41. **West Briton** 1st August 1814.

42. **West Briton** 12th August 1814.

43. Paris's letter is in the **West Briton** 11th October 1816. The earlier letter, from Mr J Bond, is in the same paper, for 4th October 1816.
44. West Briton 18th October 1816.
45. West Briton 8th November 1816.
46. West Briton 22nd November 1816.
47. Anniversary Meeting 6th October 1818, RGSC Minute Book No.1.
48. Anniversary Meeting 6th October 1818, RGSC Minute Book No.1. "Flindell's Weekly Journal" was a reference to the Western Luminary, published in Exeter, and edited by Mr Flindell.
49. Anniversary Meeting 6th October 1818, RGSC Minute Book No.1.
50. Anniversary Meeting 21st September 1819, RGSC Minute Book No.1.
51. Anniversary Meeting 21st September 1819, RGSC Minute Book No.1.
52. Anniversary Meeting 21st September 1819, RGSC Minute Book No.1.
53. RGSC Annual Report 1820.
55. There were regular reports of such accidents in the two Truro newspapers. More details were also given in a paper by Robert Blee, jun, 'On the comparative longevity of Cornish Miners' Annual Report of the Royal Cornwall Polytechnic Society, 1848 (15).
56. A tablet giving the date of Chenhall's death (1834) is fixed to the wall in the church at St Just.
57. Noall (1968), (7).
58. A total of 22 letters was published between these dates, and the series was halted only by a statement from the editor that he would publish no more. The West Briton was more restrained, including letters only in the editions for the 30th January and 6th February 1824.
59. G C Boase (1976), (87).
60. Royal Cornwall Gazette 14th October 1820.
61. It is not easy to get an exact number for the operating mines in Cornwall in the early 19th century. Thomas (1819), (74) listed the names of 34 mines in the central district. Paris (1816), (125) said that there were about 130 in the
whole of the county, not including stream works, but he was not always reliable. Hamilton Jenkin (1962), (171) estimated that there were 75 mines in 1801, employing about 16,000 men and women.

62. Paris (1818C), (90). The six mines named were: Botallack, Borvorlas Moor, Ding Dong, Park Noweth, Little Bounds and Huel Olds.

63. Hamilton Jenkin (1962), (184); Worth (1872), (18).

64. RGSC Annual Report 1816.

65. Ibid.


67. Hamilton Jenkin (1962), (140, 205).

68. Worth (1872), (18).

69. John Taylor (1814), (26).

70. Hamilton Jenkin (1962), (273).

71. Royal Cornwall Gazette 23rd October 1819.


73. Charles Barham (1842), (746).

74. Hamilton Jenkin (1962), (218).

75. Hamilton Jenkin (1962), (218).

76. Royal Cornwall Gazette 23rd October 1819.

77. Forbes (1834), (93).

78. A summary of Barham's paper was given in the RIC Report 1841 (30). The statistics were repeated in fuller detail in a paper read by him in 1847; C Barham (1847), (64-74).

79. Quarterly Meeting 23rd May 1817, RGSC Minute Book No.1. The letter is in the West Briton 25th April 1817.

80. Couch (1860), (18).

81. Williams (1987), (26).

82. Munk's Roll, IV, (34).

83. Parkes (1862), (16).

84. Quarterly Meeting 17th February 1822, RGSC Minute Book No.1.

85. Minutes of meetings between 1814 and 1817 were generally written up by Paris, and gave short details of the contents of
papers, etc. The records for 1817-22 were much briefer with no information about the content of papers, and in some cases dates were omitted, as in June (?1818), when the entry read "Monthly Meeting June". At anniversary meetings, the records were made in another hand (probably that of Richard Moyle jun. the assistant secretary). The Anniversary Meeting for 1819 was minuted, but there is nothing between that and the Anniversary for the following year. RGSC Minute Book No. 1.

86. Penzance Dispensary Minute Book 1809-1828 CRO X 439/1 (77).
87. Ibid. (116).
88. Edwards (1945), (6).
89. Forbes (1821B).
90. Forbes (1836). A description of the case of Samuel Curtis included the words "Examined by the stethoscope." (252).
91. Ibid. (193).
92. Parkes (1862), (68-9).
93. John Forbes (1834), and Forbes (1836). The map included with the first part showed the geology of west Cornwall, and was adapted from that in H S Boase (1832).
94. Forbes (1834), (33-4).
95. Forbes (1836). See quotations from letters he had received (227-236).
96. Forbes (1834), (71, 105-12); Forbes (1836), (152-3).
97. Forbes (1836), referred to a table (on pp. 217-9) "of the actual state of health of the men employed in a mine, from a personal examination made on the spot by myself, in the year 1821" (216).
98. Forbes (1836), (225).
99. Forbes (1834), (115). Borlase (1758) had referred to and accepted the idea that the Cornish were exceptionally long-lived (292).
100. Forbes (1836), (216).
101. Forbes (1836), (223). The role of air-borne dust in miners' lung diseases was not fully understood until studies had been made by Clement Le Neve Foster in 1879 (Williams (1987), (27).
105. For details of the man engine, see RCPS Annual Report 1838, Appendix (176). The Royal Cornwall Gazette for the 4th November 1842 had a report of the installation, and first use of this device. The Fox interest in Tresavean Mine is referred to in Bradley (1987), (16).


111. Freeborn (1986), (30).

112. S Moyle (1838), (26-8); S Moyle (1839).

113. Lemon (1839), (50).

114. Barham (1841), and Barham (1847).

115. Barham (1847), (68).

116. Watson (1897), (36).

117. Watson (1897), (142-3).


119. Paris (1831), (74-5).

120. Sir Humphry Davy (1818A), (132-3).


122. John Buddle 'Narrative of the explosion at Wallsend Colliery'; Edward Turner 'Chemical examination of fire damp from the mines near Newcastle' Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, Transactions, II, 1838.


125. Manchester Geological Society (1908), (vi).

126. Manchester Geological Society (1908), (vii). The description of Looney can be found in Kargon (1977), (925).


128. Report of the eighth meeting of the British Association for the Advancement of Science: held at Newcastle in August

129. Burt (1977), (72).

130. Porter (1973), (334).


132. Raistrick (1938).

133. Ashton (1968), (920).
8 THE RGSC IN A GEOLOGICAL CONTEXT

8.1 The geological objectives of the RGSC

As argued in the Introduction, the RGSC was founded at a time when the science of geology in England was in its infancy. The Geological Society of London had been started in 1807, less than seven years before the Cornish society, and was just beginning to shape the future of English geology. Did the RGSC therefore derive its ideas and motivation from the London society, or from other sources? What was the intellectual background to the geology of the early years of the society? One of its stated aims, as discussed in Section 4, was original research in geology. Other questions therefore which need to be asked are: was there original work to be done on the geology of Cornwall, and was it capable of being done by the kind of men who became members of the society? What were the reasons for deciding to support research; was it to increase geological knowledge, or did the proposals have economic implications, especially for the mining industry of Cornwall? It will also be appropriate to make a brief assessment of the society's contributions to the geology of Cornwall in the period up to about 1845. In order to discuss these problems, it will be necessary to look at the kinds of questions which were being posed at the beginning of the nineteenth century, and to find out which were applicable to Cornwall.

As shown in Sections 2 and 4, the origins of the society are not too easy to establish. Few documents remain which give a clue to the ideas of the founders. Perhaps surprisingly, the Laws of the society, published in 1814, did not include a
formal statement of the objectives of the new institution. The document began with the following announcement:¹

The COUNCIL being fully impressed with the high importance of this society, deem it their duty to give every possible publicity to its objectives, and have therefore resolved, that the proceedings of the meeting held for the purpose of constituting the said society, shall be printed, and circulated with the laws.

The minutes of the first meeting, held on the 11th February 1814, then followed, and these included the full text of the speeches made by Paris, C Val Le Grice and Davies Gilbert. The 'Laws', which were printed after the minutes, consisted of details about the officers, and types of membership and the modes of their election, and of meetings of the society. The pamphlet was completed with some notes about "Visitors", the "Mineralogical Cabinet and Library", "The Powers and Duty of the Council", and "Committees".

A printed document with the title Proposed Rules of the Royal Geological Society of Cornwall still exists. This included the words:²

SECTION I. - OBJECT.

The Royal Geological Society of Cornwall was instituted in the [blank] for the purpose of investigating the structure of the earth.

There is no date or watermark on the document, so it is not possible to establish exactly when this was produced, but the inclusion of the word "Royal" in the title makes it certain that it does not relate to the foundation of the society. The booklet may have been drafted in response to a resolution formulated at a Quarterly Meeting of the society held in February 1822, when it was resolved that:³
Many alterations having been made from time to time in the laws of this Society, the Secretary [be] requested to draw a copy to lay before the next Quarterly Meeting.

Whether any alterations were adopted is not known, as there were no records for a subsequent meeting at which they might have been approved, not does a final version of these Rules exist.

The next published version of Laws and Rules dates from 1869, and consisted of laws adopted at a Special General Meeting of the Society held on 5th November of that year. The authors went back to the 1814 version and referred, with the use of footnotes, to the speeches made at the founding meeting. The new edition began:

1. Object.

The Royal Geological Society of Cornwall was instituted for the purpose of encouraging the study of Geology with especial reference to the mining interests of the county;* and for affording opportunities for instruction in the sciences indispensable to the progress of geological knowledge.†

* See the first Laws of the Society (1814) pp.6, 10.
† See the first Laws pp.6, 9.

(The footnote references were to pages which included parts of the speeches made by Paris and Davies Gilbert in February 1814.)

Long after he left Cornwall, Paris wrote a more explicit account of what he believed the objectives of the RGSC to be in his book, The life of Sir Humphry Davy (1831). This account needs to be read with a certain amount of scepticism, as Paris's motives for including information about the RGSC in a biography of Davy must be suspect, since Davy had had few connections with the society, and had had no hand in establishing
its objectives. Paris was most probably promoting his own interests here. He wrote:  

Its objects are to cultivate the sciences of Mineralogy and Geology, in a district better calculated perhaps for such pursuits than any other spot in Europe, - to register the new facts which are continuously presenting themselves in the mines, and to place upon permanent record, the history of phaenomena which had hitherto been entrusted to oral tradition; but, above all, its object was to bring science in alliance with art; to prevent the accidents which had frequently occurred in blasting rocks; and, in short, to render all the resources of speculative truths subservient to the ends of practical improvement.

It was suggested at the beginning of this section that a possible model for the Penzance society could have been the Geological Society of London, founded seven years earlier, and of which several of the new members of the RGSC were already members. The lack of detailed geological objectives for the Cornish society does however imply that little real thought was given to establishing a formal programme. The Geological Society of London was different; the Regulations of that society (drawn up in 1808) had began with a much more precise statement of its objects:  

This Society is instituted for the purpose of making geologists acquainted with each other, of stimulating their zeal, of inducing them to adopt one nomenclature, of facilitating the communication of new facts, and of contributing to the advancement of Geological Science, more particularly as connected with the Mineral History of the British Isles.

It is possible that the founders of the RGSC were not aware of the Regulations of the London society or chose to ignore them. No words similar to those quoted above were used in the speeches made in February 1814 in Penzance, or in the Laws published in later in the same year. On the other hand, some phrases contained in the 'Preface' to the first volume of the Transactions of the Geological Society of London (1811) were
echoed in Paris's introductory speech. The references in both extracts quoted below to coastal exposures, and to mines, seem to suggest that Paris may have borrowed some of his ideas from this source. The London society's 'Preface' had stated that:

No country contains, within an equal space, a greater variety of mineral substances; while our long and broken line of coast, and our numerous mines, furnish the most ample opportunities of making geological observations.

Paris had said:

It was its proximity to an extensive and interesting coast which rendered Penzance so desirable [for the study of geology], as well as it being surrounded by mines of most singular geological interest.

The Laws which were presented to the initial meeting by Paris had also included details of two committees which were to be created, a Chart Committee, and a Committee of Nomenclature. These strongly resembled two established earlier by the London society, a Committee of Nomenclature (1808) and a Committee of Maps (1809). A proposal made in the Cornish Laws to publish annual Transactions (see pp.91-2) was also very similar to the original intentions of the Geological Society of London. Somewhat later, a close relationship with the metropolitan society was more openly implied. A toast given at the dinner following the Annual Meeting of 1841 used the following words: "prosperity to their fostering parent, the Geological Society of London". Whether this was a toast which had also been used in previous years is not known since detailed reports of the annual dinner were not included in newspapers until 1839.

Alternative models for the RGSC might have been the provincial scientific societies, but none of them seem to have been used.
In the speeches made on the 11th February in Penzance, the only references to other societies were made by Davies Gilbert. In the extract already quoted on p. 90 he referred only to the "Royal Society and the Institutes abroad" as appropriate models for the RGSC. There were no references to provincial societies on which the new one might be modelled, not even those formed shortly beforehand in Exeter and Plymouth. This should be contrasted with the references to other Lit and Phils made in the documents of the Cornish Mining Society and the Cornwall Library, quoted in Section 2 (see pp. 12-3 and pp. 13-4). None of the officers of other provincial societies were included among the honorary members in the early years, unlike some of the northern institutions, which frequently honoured men from other philosophical societies. One reason for ignoring provincial models may have been because the RGSC was the first provincial society to specialise in geology, and very nearly the first specialist provincial society of any kind, so that it had no provincial counterparts. It is tempting therefore to suggest that the Geological Society of London might have been selected as a preferred model, even though its Regulations had not been copied. Cornish connections with the English capital add some weight to this suggestion.

Cornwall had strong and continuing links with London. Before the Reform Act of 1832, Cornwall had had 44 Members of Parliament. Members with Cornish roots, such as Davies Gilbert, Sir Christopher Hawkins, Sir William Lemon and Sir John St Aubyn, all members of the RGSC, maintained homes in both London and Cornwall, and most had connections with scientific
circles in the capital. Many of the Cornish seats were however "pocket boroughs", whose representatives had no connections with Cornwall, and who visited the county only when an election was due.

There were others among the gentry and business community who made regular visits to London. A handwritten list of members of the London Cornish Club for 1817-8 included 22 members of the RGSC from a total of 55 members. Several of these were MPs or peers, but others had business interests, such as banking, in the capital; for example members of the Grenfell, Praed and Vivian families. Henry Boase, also a banker, and one of the probable initiators of the plan for a geological society, had lived and worked in London until 1809. Paris and Majendie, two of the most active founding members, both had links with the capital, for Paris had held a post at the Westminster Hospital before coming to Penzance, while Majendie had a home in Park Lane.

A number of members of the RGSC also belonged to the Geological Society of London (see Appendix 1). Although as Honorary Members of that institution, they were not necessarily regular participants in its activities, certain of them were, particularly Davies Gilbert and Robert Were Fox. Several of these men also were, or would become, Fellows of the Royal Society, and Paris was a member of the Linnean Society. All these facts suggest that it was to London and its scientific societies that these Cornishmen turned when seeking an intellectual model for the new geological society.
Links between the provinces and Cornwall were on the whole less strong, although there were some exceptions. There were important business connections with south Wales, for this was the centre for the smelting of Cornish copper, and the Williams, Fox, Grenfell and Vivian families had financial interests in businesses there. John Henry Vivian had moved from Truro to Swansea for that purpose in about 1818, and later became MP for Swansea; he was involved in the foundation of a scientific society there in 1835, the Swansea Royal Institution. He had also been one of the chief proposers of a scientific society in Truro (see Section 3), and had contributed papers to the first volume of the RGSC Transactions.

Cornwall also had trade links with the Midlands, especially Birmingham. However that city was associated with the firm of Boulton and Watt, and the steam engines used to pump Cornish mines. The profits made on the Boulton and Watt engine in the 18th century had been resented by many Cornish mining concerns, and an extension of their patent was felt to be restrictive of Cornish improvements. Even though the patent had expired in 1800, it seems unlikely that Birmingham would have been a welcome source of scientific inspiration.

The distance from the northern industrial cities, and the lack of important trade links with them, must be a reason why the Lit and Phils of these areas seem not to have been used as models for the Penzance society. Another factor may be the traditional Cornish dislike of "foreigners". This may be the explanation for the omission of references to the two soc-
ieties founded in Devon. The negative response of the Council of the RGSC to an invitation from the founders of the BAAS in 1831 may also be an example of this attitude. The secretary, E C Giddy, wrote that the society was unable to send deputies to a meeting because it always held its anniversary meeting in early October. London on the other hand was the capital city, and the home of the Royal Society, the Geological Society and the Royal Institution; Cornish influences in these institutions, through men such as Sir Humphry Davy and Davies Gilbert, were significant, and therefore their "foreignness" would not have been so apparent.

In contrast to the lack of contacts with northern industrial Lit and Phils, the Cornish Geological Society did have intellectual links with Scotland, and especially its universities. The first three secretaries of the RGSC, Paris, Forbes and H S Boase, had all completed part of their education in Edinburgh. All three men may have attended lectures by Robert Jameson, and his teaching may have influenced their geological thinking, although it has only been possible firmly to establish that one of them, Forbes, had been taught by Jameson. In 1817, when it had become clear that Paris was about to resign his post as RGSC secretary, it was to Scotland that the members looked to seek a replacement. Joseph Carne wrote to Dr Thomas Brown of Glasgow in the summer of 1817 requesting his assistance, and the latter gentleman referred this request to Robert Jameson in Edinburgh, who recommended that John Forbes should be considered.

There were also contacts between several RGSC members and
Thomas Thomson, editor of *Annals of Philosophy*, who later became professor of chemistry at the University of Glasgow (in 1817). He was one of the first Honorary Members to be appointed, at the initial meeting in February 1814. Thomson had made a geological tour of Cornwall in 1813, when he had met the Rev John Rogers of Mawnan. It is possible that he became acquainted with the Giddys at the same time, for E C Giddy and his father Thomas sent regular meteorological reports to Thomson, which were included in *Annals of Philosophy*. Some of the reports of meetings of the RGSC in early editions of *Annals of Philosophy* differed in minor details from the minuted versions, which suggests that Thomson was receiving information from a different source, possibly also the Giddys. There was nothing however to show who was the author of these reports.

There may have been some transfer of geological ideas from Ireland, for there were several sources of information available to the members of the RGSC. Richard Griffiths, the Irish geological map maker, had visited Cornwall in 1804, and had met there the future Vice Patron of the society, Lord De Dunstanville. Edmund Davy, cousin of Sir Humphry, was Professor of Chemistry at the Cork Institute; he corresponded with Henry Boase, who sent him details about the progress of the Cornish society. Although in his letters Davy advised Boase not to expect "anything in geology" from him, he visited Penzance in 1817, when he was entertained to dinner by Henry Boase. It seems possible that Davy was able to inform his host of the progress of geology in Ireland, and perhaps especi-
ially of the efforts that were proceeding there to achieve the
publication of a geological map of the island. There is
little evidence however to confirm that Irish ideas were
influential, although a report in the West Briton newspaper in
December 1814 did describe the society's Museum as being
arranged "like the Leskean Collection"; this collection had
been purchased by the Dublin Society in 1792 from the German
mineralogist, Nathaniel Gottfried Leske.

It is likely also that there were continental influences on
the early geology of the RGSC, but these are less easy to
establish. Eighteenth century and earlier German assistance
to Cornish mining is well documented (see Section 6.1). Two
members of the RGSC had studied in Freiberg; John Henry Vivian
and John Hawkins. However neither of them was influential in
the initial development of the society. Vivian had visited
Freiberg and other places on the continent in 1804 and 1815. He
did not however join the RGSC until January 1816, and
contributed only four papers to the society, three of them in
1817. The three read in 1817 were accounts of his observations of mines and mining technology, made in Saxony, Poland
and Hungary.

John Hawkins had also studied in Germany, although his visits
had been made very much earlier than Vivian's, in 1786, 1793
and 1798. Some of his papers may have been influential in
guiding the work of the RGSC during its formative years, for
he wrote not only about his own experiences and knowledge of
continental geology and mining, but also of his ideas about
how the study of geology should proceed in Cornwall. However
because his home was in Sussex, and he did not return to Cornwall until 1828, he was not available to give first hand advice; his only attendance at a meeting of the society was in 1830.\(^3\) His contributions will be discussed in more detail below.

It is not clear why Hawkins should have decided that the members of the RGSC should be in need of advice from him. Very little of his work had been published previously, even though he took great pride in a survey of Greece, on which he had spent four years, beginning in 1793.\(^4\) Although he was a founding member, his first paper for the RGSC, 'On the history of submarine mines', was not read until September 1817.\(^5\) Sir Christopher Hawkins served as the medium for the transmission of John's papers to the RGSC, so John may have been pressed by his elder brother to contribute to the society.\(^6\) As Sir Christopher was also a founding member, it might however have been expected that he would have asked for contributions from his brother at an earlier date. John Hawkins was a close friend of Davies Gilbert, and the two families visited each other regularly.\(^7\) Gilbert may have been responsible for recruiting Hawkins as a contributor of papers; but again this explanation does not account for the delay of three years before the first paper was received. There were however signs by 1816 that the RGSC was not finding it easy to provide interesting matters to be discussed at every meeting. An entry in the first Minute Book in the spring of 1816 read: \(^8\)

No attendance. Let it be recorded to the disgrace of the Residents of Penzance that four members of the Society came from Truro and its vicinity for the purpose of attending this meeting and found with the exception of the Secretary and Assistant Secretary and two others [entry ceases here]
"No attendance" was also recorded for the Monthly Meeting on the 5th of July 1816. In May 1816, at the Quarterly Meeting, Paris decided to read a paper heard already by at least some of the members. The minutes recorded that:

Dr Paris said that as there was no communication before the meeting he had to offer a paper on a new system of Geology which had been submitted to the Society in a rough state at some of the Monthly Meetings, but as there were then present some Gentlemen who had not attended these meetings, he would read it again.

A letter written in 1833 by Hawkins referred to the contributions he had made to the society, and implied that his papers had been sent to help when there had been a shortage of appropriate material. He wrote: "I have done what I could to promote [the society], when it most needed assistance".

Another possible explanation for the date of Hawkins' first paper for the RGSC lies with a relationship which had developed between Hawkins and Paris in the summer of 1817. In July 1817 Hawkins met Paris, apparently for the first time, at a dinner party in London; Hawkins' letter to his wife described "A Dr Paris from Cornwall, a very ingenious well informed Physician". Paris later became physician to the Hawkins family when they stayed in London, and he also visited the family home near Chichester. It is therefore possible that Paris was the person who persuaded Hawkins that the RGSC could use contributions from him. In July 1817, Paris was about to leave Penzance, but he kept an interest in the progress of the geological society after leaving the town (see Section 3.1.1).

Links between French geologists and mineralogists and the RGSC are even less easy to identify than are German influen-
ces. There may have been contact with French émigrés from the Wars on the continent, for there were groups of such people in Cornwall, but it has not been possible to discover positive evidence of their influence on the RGSC. A few members of the society had business links with the French. Henry Boase had spent some time in Morlaix in France in 1785, in order to learn the language. He had then moved to London in 1787 to join the banking firm of Ransom, Morland and Hammersley, where "it fell to his lot to conduct much of the correspondence of the emigrants who fled to England during the revolution". There is nothing in Boase's "Memoirs", or elsewhere, which suggests that he might have maintained the contacts that he had made with emigres, after he returned to Penzance. Another founding member of the RGSC, Richard Edmonds (an attorney of Penzance), escorted his sons to Brittany in 1818, where they were to attend the College at St Pol de Léon, but there are no records which indicate that he had business links with France.

Sir Humphry Davy also had influence in France, and used it to introduce Élie de Beaumont and P A Dufreynoy to the RGSC in 1823 (see Section 6.1). This was the only suggestion in the Minute Book that Davy was able to use his influence to advance the RGSC. In 1815, a request from the "Royal Institute of France" was passed to the RGSC through Davies-Gilbert, but there was nothing in the minutes to suggest that Davy was involved.

A communication was made through the medium of the President to the Society, from the Royal Institute of France, in which that Body requested to obtain from the Royal Geological Society of Cornwall a series of their metalliferous rocks,
especially the different varieties of the Killas of the Cornish Miner.

It was resolved that a series of Specimens should be collected and that the President be requested to forward them to the R.I. accompanied by a Letter explanatory of the Views and Objects of our Society, and that a Report of the Proceedings of last year be also included.

Davies Gilbert had offered, in September 1814, to help in forming links with countries across the English Channel, "since the reestablishment [sic] of the communications with the continent". 55

The discussion above, of possible sources of ideas for the geological work of the RGSC, tends to support the argument, already proposed in Section 3, that the real reasons for the formation of the society had little connection with the advancement of geological science. There appears to have been little thought given to a formal programme of work for members, and although the closest model for the Penzance society seems to have been the Geological Society of London, its objectives did not match those of its prestigious London counterpart. It seems most probable that the real motive of the founders was the establishment of a new source of middle class amusement in Penzance, even though this could not be openly acknowledged.

There is an alternative way of trying to determine the sources to which the society looked for geological ideas; by examination of the lists of Honorary Members elected to the RGSC in its early years. This list was so comprehensive however that it is impossible to glean many ideas from it, other than the apparent importance of Edinburgh. Most Honorary Members seem
to have been chosen in order to honour distinguished contributors to geology, and so that the society could acquire status through the inclusion of their names in its Annual Reports etc. The list also included some men who lived outside Cornwall but had connections with the county. The minutes of the Initial Meeting recorded that seven people had been elected. The first three were Sir Humphry Davy, an obvious candidate because of his connections with Penzance, G B Greenough, the President of the Geological Society of London, and Sir Joseph Banks, President of the Royal Society. Two men from Edinburgh were included, Sir James Hall and "Professor Playfair", both proponents of the Huttonian school of geological thought. The final two were "Dr Thomson" (the connections with Thomas Thomson have been discussed above), and Lord Webb Seymour, the Duke of Somerset and an honorary member of the Geological Society of London. There were however differences, which cannot be explained, between this list and one printed in the West Briton a fortnight later, in an account of the initial meeting of the society. The men listed in this account were: "Lord Webb Seymour, H. Davy, Sir J. Hall, Dr Clarke of Cambridge, Messrs Werner, Playfair, Allen, Arthur Young, Greenough and Stackhouse sen". Some of these men were elected in later months.

A further seven Honorary Members had been chosen by the end of 1814. At the Anniversary Meeting in September the following five were elected: Sir James Edward Smith, President of the Linnean Society, Edward Daniel Clarke, Professor of Mineralogy at Cambridge, John Hailstone, Woodwardian Professor at Cambridge, John Kidd, Professor of Mineralogy at Oxford and
William Hyde Wollaston, Secretary of the Royal Society. At the Quarterly Meeting on the 25th November 1814 there were added Robert Jameson of Edinburgh and William Maton, a London physician and Paris's patron. Hailstone, Jameson and Maton were all adherents of Wernerian views. A List of Members printed in 1815 included A. G. Werner among the Honorary Members. By 1818 more names had been included, including the Rev. William Buckland, John MacCulloch (a Scottish geologist who held Huttonian views, and was President of the Geological Society of London in 1816-18), William Maclure of Philadelphia (an American geologist who had contributed a copy of his map to the society), and Charles Koenig of the British Museum.

No particular schools of geological thought seem to have influenced the choice of honorary members, for Huttonians and Wernerians alike were elected. Only the "scriptural" geologists, such as De Luc, seem to have been ignored. It appears that the status of the individual, and the honour apparently conveyed by the appearance of his name on the list of members, was more important to the society. Mining interests do not seem to have been represented either; John Taylor, who had connections with the Tavistock mining area, as well as being a prominent member of the Geological Society of London, might seem to have been an obvious candidate, but was not elected (see also p.398).

Further sources which could be examined for ideas about the proposed programme for the new Geological Society include the books bought for the Library, the annual addresses given to
members by the society's Presidents, and the annual reports of the RGSC Council. The titles of books to be found in the Library of the RGSC might be used to suggest the lines upon which the Council was thinking. Most books were however not bought, but were presented, some by the authors themselves. A list of Donations, appended to the first volume of Transactions, did not include purchases by the society. There was only one entry, in the Minutes for April 1814, which listed proposed purchases:

The Society directed the Secretary to procure

- Dr Thomson's Annals of Philosophy
- Abbé Hauy's Crystellography [sic]
- Geological Transactions of London
- Pinkerton's Petralogy [sic]
- Davy's Elements of Chemistry [sic]

Some of these books may have been chosen by Paris, in order that he could consult them for his lectures in chemistry, which he began in the spring of 1815 (see above), and for use when undertaking analyses of rocks and soils. Rather more significantly, in 1839, not long after the discovery of fossil material in the sediments of Cornwall, the Council, in its Annual Report, referred to the purchase of "Goldfuss, Deshayes and Brongniart's admirable works on fossil geology".

A list of books in Volume II of the society's Transactions also comprised only donations. The first printed Library Catalogue still existing in the society's archives was dated 1882, and nothing has been found which suggests that an earlier one was ever published. A handwritten list of books in the library also exists, but this was not dated; it appears from the contents to have been compiled after 1870. The first Librarian of the RGSC, C Val Le Grice, was the perpetual
curate of Penzance. He was a man with literary interests, but had no geological knowledge, and never gave a paper to the society. He is unlikely to have been able to give advice to members about appropriate purchases.

Information about the geological objectives of members might also be found in the addresses given by the Presidents of the RGSC at Anniversary Meetings of the society. There were however few records of speeches made by the first President, Davies Gilbert, who served from 1814 until his death at the end of 1839. They were never included in the society's Annual Reports, nor is the first Minute Book of the society of very much assistance. The minutes of the first Anniversary Meeting in 1814 did contain what appears to be a full record of Gilbert's speech, made after he was re-elected as President; however, he made no references in this to the contributions which the society might be expected to make in geology.71 Between 1815 and 1817, while Paris continued as secretary, only passing references were made in the Minutes to Gilbert's addresses to members. In 1817, for example, the only reported remark made by him was in connection with Paris's resignation.72

The records of Anniversary Meetings between 1818 and 1820, when Dr John Forbes was secretary, did include summaries of Gilbert's opening addresses. Only in 1818 however, was he recorded as suggesting possible lines of research to members.73
[The President] proposed as a subject well worthy of the Society's attention, a more intimate knowledge of our Lodes and cross courses - and more particularly the geological structure of our own County.

No minutes remain of the Anniversary Meeting held in 1821, although the meeting was reported in the two Truro newspapers. There were minutes for the meetings of 1822 and 1824 (secretary, H S Boase), but these were the last records of Anniversary Meetings in this book. The society's Minute Book No. 2 was begun as late as 1856.

The two newspapers published in Truro, the West Briton and the Royal Cornwall Gazette, annually included reports of the Anniversary Meetings of the RGSC. In most cases, these reports closely resembled the published Annual Reports, the only major differences being short prefaces, consisting of lists of some of the more distinguished members and visitors at the meetings. The first newspaper reports to be very much more comprehensive than those of the Annual Reports or the Minute Book were to be found in 1839. In that year a weekly paper was started in Penzance, the Penzance Gazette. In the edition for the 9th October of that year there was a long account of the RGSC Anniversary, very much fuller than most of those carried by the Truro papers in previous years. The Royal Cornwall Gazette for the 11th October also included a full account, and one in the West Briton was very similar. It may be that competition from the Penzance Gazette was a motivation, for in the reports of the dinner held after the meeting, details of the various toasts were given and these included one to "The Gentlemen of the Press". This toast was replied to by "Mr Latimer" of the West Briton and "Mr Chorley"
of the Royal Cornwall Gazette; evidence that the event was thought worthy of attendance by reporters.75

In all three of these reports there were full details of an address by Davies Gilbert. His speech, as recorded in the Royal Cornwall Gazette, occupied nearly nine column inches, and this suggests that earlier speeches may have been as long, especially as Gilbert referred in this one to his advanced age and failing health; it was in fact his last. However despite this detail, there were no clues to his own geological ideas. He did refer to some of the work done by the Rev Adam Sedgwick and RI Murchison in Wales, and to their investigations of some of the local sedimentary strata in Devon. He also complimented Sir Charles Lemon on the efforts made by him and other Cornish Members of Parliament in "taking off the duty on tin".76 Gilbert was not primarily a geologist, even though he had become a member of the London Geological Society in 1808;77 his main scientific interests were mathematical.78 He contributed only one paper to the RGSC, 'On elvan courses', in 1819, but this was not printed in the Transactions and no details of it remain.79 His main service to the society was to provide a President who had status.

In 1840 Sir Charles Lemon was chosen as the new President of the RGSC. Like Gilbert, his chief interests lay elsewhere than in geology, for he was a founding member of the Statistical Society, and made several contributions to that institution, and also to the Statistical Section at meetings of the British Association for the Advancement of Science.80
Despite his other interests, Lemon made significant efforts to guide the RGSC in its work. Reports of his advice to the society were much more complete, for after 1840, Annual Reports became much longer, and in most years included the texts of the President's speeches. In 1842, he recommended that members could pay attention to the newly named Devonian rocks, which were believed also to occur in Cornwall.81 In the same year, Lemon informed members that he had written to the Rev William Buckland, seeking his assistance in recommending projects worthy of study, and he had replied suggesting that signs "in favour of the new theory of glaciers" might be found in Cornwall.82 In 1843, Lemon suggested that members could give careful attention to the "altered or metamorphic condition of a large portion of our killas".83 In 1844, he described the functions of the society as "at least twofold", the second function being to learn from the activities of the Geological Society of London:84

Perhaps [the RGSC's] first duty may be to collect and disseminate such scientific matter as the county itself may produce; but it is hardly a less important object that we should maintain a close correspondence with our metropolitan parent:...we should diligently observe the progress of the great machine which they regulate, and bear home for our own use the records of those truths which they have elaborated..

In 1846, Lemon was able to persuade Sir Roderick Murchison to attend the Annual Meeting. When introducing this visitor, he referred to members of the RGSC as "only the auxiliaries of science" (a longer quotation from this introduction is included on page 92). Lemon also said of the society's role:85

...It is our province to gather facts for our great masters to arrange and digest, and when we have exercised due diligence in this humble department of science, we have a right to say we have done our duty.

It is not altogether clear from this reference whether Lemon
was using the term "auxiliaries" simply in the context of Baconian fact-gathering, or whether he was implying that the RGSC members had now to accept that their role in geological research was of lesser importance than that of the London society.

The 'Reports' of the society's Council, published annually, also provide some ideas about the priorities of the society. It becomes immediately apparent that the museum or "Cabinet" was seen to be important, for it was frequently regretted that the collection was deficient in certain types of specimens. For example in 1818 it was reported that: 86

...the Cabinet set apart for the reception of indigenous ores, which ought to be particularly rich and splendid, continues to be defective, and is eclipsed by many other collections, as well public as private; a circumstance uniformly exciting the surprise of strangers...

In 1820 an appeal for donations to buy specimens was made, 87 and in 1826 "those members who have private collections" were asked to donate samples of rocks. 88 In the same year, the Council asked members to agree to the expenditure of some of the society's income for the purchase of specimens. 89 The most important reason for this emphasis on the collection of rocks and ores must be pride in the society's museum, for the geological purposes of the collection were never specified. On one occasion more practical arguments were used to justify the existence of the Museum, perhaps rather optimistically, for there is no evidence to suggest that miners would have been welcome to visit it: 90

...the Oeconomical Department of the [mineral and rock] collection is calculated to afford [the miner] much valuable information. It will teach him the characters and appearances of the different mineral substances employed in the
various arts and manufactures of the Kingdom and enable him to recognise them whenever they may occur in his own districts, and thus open to him endless sources of profitable labour:

Various efforts were made to encourage miners to contribute to the museum, but most were unsuccessful (see also Section 3.3.4).

During the years 1814-17, while Paris was secretary, most of the Annual Reports contained references to the safety tamping bar, which was being promoted by the society (see Section 7.1). The projected geological map of Cornwall was stressed, particularly during the period of Forbes' tenure of the post (see Section 5.3). In 1823 it was recommended by the Council that the tin stream works should be investigated, and this exhortation was repeated in 1829 (see Section 6.2). The Reports referred mainly to the events of the past year, however, and did not consistently set out a programme of study for members. They do not therefore serve as very useful records of the objectives proposed by the society.

The 'Prefaces' to volumes of the Transactions of the RGSC, and some of the papers in the early volumes, might also be used to obtain ideas about the society's geological objectives (see Table 6 (pp. 262-3). Only Volumes I and II contained 'Prefaces'. The version in the first volume was almost certainly written by Paris, for he was the editor, and the style of the prose is similar to that used by him in his papers, etc. Much of the content was rhetorical, since Paris, having left Penzance, was no longer in a position to influence the activities of the society. Nevertheless he did stress throughout what he
regarded as the dual functions of the RGSC (see also pp. 87), and he echoed the objectives on which the Geological Society of London had based much of its early work, the collection of facts:

...the benefits which such an Institution is capable of imparting to our local interests, by defining and multiplying the objects of economical industry, are not less numerous and substantial than those which it will necessarily confer upon Science, by collecting, arranging, and generalising instructive facts.

The Preface to Volume II was written as a report by the RGSC Council. The editor of this volume was Joseph Carne, but it is not known whether he was also the author of the introduction. Apart from references to the projected geological map of Cornwall, there were no other suggestions about the future progress of the work of the society.

Two of the papers included in Volume I have been classified in Table 6 as "advice to the RGSC". The first, by Sir Humphry Davy, 'Hints on the geology of Cornwall', made various suggestions about the features of Cornish geology to which members could give particular attention. Davy advised that there was a pressing need to look at mineral veins, not just because of their economic importance, but also because they gave clues to the chronology of the formation of the granite masses and the killas (see also Section 6). His own ideas about the origin of granite, as given in this paper, show that he was inclined to favour his own chemical interpretation of the causes of internal heat:

To suppose the primary rocks in general to have been produced by the slow cooling of a mass formed by the combustion of the metallic bases of the earths, appears to me the most reasonable hypothesis.

The second paper in Volume I classified as advice, 'A sketch
of the Mining Academies of Freyberg and Schemnitz' by John Henry Vivian, was intended to help the RGSC with its plans for the establishment of a professorship of geology (see Section 4.2.2).

There were also two papers in Volume II by John Hawkins which gave advice to the society. The first, 'On the nomenclature of the Cornish rocks', was read to the RGSC in October 1818. In this paper Hawkins made it clear from where he had derived his geological preferences. He wrote:

I trust that I shall not incur a charge of presumption, if, in this stage of our existence as a scientific body, I point out the necessity of a correct nomenclature. ...it is natural that we should look...to our predecessors in this career, particularly the Germans.

...here I cannot forbear to express the sense which I feel, of the obligations which I owe...to the father of this school [at Freiberg], the celebrated Werner.

His purpose in submitting this paper was to make suggestions about how the members of the Penzance society could enhance their science by ensuring that expressions used to describe rocks in Cornwall were compatible with those used elsewhere. He was concerned in particular about the use of the term "greywacke", which he thought was applied incorrectly by some geologists. This was important because the word was used by Wernerians to describe the age of the rock, rather than just its mode of formation, for greywacke was characteristic of the Transition rocks of Werner. These differed from the primitive clay-slates, in having some simple fossils. Thus it was essential that a clear distinction should have been made between the primitive clay-slates and the true greywackes.
Other topics which Hawkins recommended to the RGSC were studies of the different varieties of granites and their relations with the slates, the primitive sediments of Cornwall, and the mineral veins of the county. In all these papers his adherence to Wernerian ideas was prominent. For example, in 'On some advantages...', he wrote:

The strata which are so familiar to our observation in this remote corner of Europe, derive a particular interest from their ubiquity: they present the earliest results that we know, of the passage of matter from a fluid to a solid state;...

The first paper by John Hawkins in Volume IV, 'Some general observations on the structure and composition of the Cornish peninsula', was also mainly advice to the RGSC. Unlike the majority of his papers which were based on his knowledge of the county formed more than twenty years previously, this one was the result of observations he had made in 1828, when visiting Cornwall to deal with the affairs of his brother, recently deceased. His most important message on this occasion was that the geology of Cornwall required detailed field study, something that could be best achieved by the members of the RGSC who lived in the county, and had constant access to their material.

The discussion above shows that no clear statements about the way in which the RGSC should proceed were given until after Sir Charles Lemon had assumed the office of President. There must therefore be some doubt about the expressed desire of the society to make useful contributions to geology. Nevertheless, some of the offerings of the society had value, and some individual members made significant contributions towards the science. The next section will assess these in more detail.
The major influences on the early research programme of the society appear to have been Paris and John Hawkins. Paris's apparent support for research which was to directed towards the needs of the mining industry will be examined in more detail in the Conclusion. The representatives from the industry appear to have done little to direct the pattern of studies, except at the very beginning of the society's history (see also the discussion in the Conclusion).

8.2 The geological achievements of the RGSC

Some of the ideas that determined much of the work done by the Geological Society of London in its earlier years have already been discussed, and it has been argued that Cornwall was not the ideal area in which these ideas could be tested and extended. Neither detailed stratigraphy of the sediments, nor examination of the palaeontology of the county, were thought to be appropriate for consideration by RGSC members, at least in the initial years of the society's existence. On the other hand, the production of a geological map of the county was a prime objective of the institution, and very possibly one which was determined on in imitation of the London society. Mapping was not however the sole prerogative of the English geological societies, for the art was more advanced on the continent. 103
There were other unresolved questions in geology to which the Cornish members could have paid attention which were more appropriate to the area: the origin of granite and the granite veins was one of the more common problems which had been investigated by visiting men of science, but without a satisfactory resolution. Evidence for the Deluge could also have been examined in the more recent sediments of the county. There were also problems local to the area which were of special interest, in particular the origin and means of locating mineral ores, and the representation of economic deposits on a geological map. It does appear therefore that there was a programme of work which could have been presented to the RGSC. However, it has been shown that the society did not clearly set out any programme for its members; ideas about the pattern of work that could have been done emerged only gradually as the society matured.

How capable were the members of completing those objectives? One of the first objectives was the completion of a geological map of Cornwall. As has been shown in Section 5, considerable attention was paid to this project, which culminated in the publication, in 1832, of the map by H S Boase, in Volume IV of the society's Transactions. It has been suggested that this was not an entirely satisfactory production, and it was soon superseded by the Geological Survey maps of the county. No attempt was made by Boase to include the county's mineral deposits, although this was a deliberate exclusion, for Henwood's survey of the mines was also supposedly near completion (see Section 6). After 1832 there were no more attempts by the society to become involved in large scale mapping projects,
and this must have been due to anticipation of the De la Beche map, which was about to make the efforts of the RGSC redundant. (In the 1840's, the society did publish some smaller geological maps of selected areas in Cornwall, for example the 'Map of Meneage' by Richard Thomas, included in the sixth volume of Transactions.\textsuperscript{104} The investigation and recording of mines by Henwood, eventually published in 1843, was limited in its value, for it was restricted to conditions then current, and made no attempts to draw hypotheses from the information gathered, nor was the study taken further by any other member.

Studies of the origin of granites continued to make progress in areas other than Cornwall, and it was as a result of investigations of volcanoes and other igneous rocks in Europe and elsewhere in the world, that their igneous origin was eventually confirmed. The contribution from the RGSC to these studies was minimal, even though members had been among the first to pioneer studies of the earth's heat, through their investigations of temperatures within mines (see Section 6.2). The study of metamorphic rocks does not seem to have been a major area of work for members of the RGSC until very much later in its history, mainly because the effects of heat were not recognised (see Section 5). Some investigations were made of the diluvial deposits, which were of interest, but of no particular significance (see Section 6.2, and below pp.328-31). Work on mineral veins, and on stream tin, was a more particularly Cornish province. After the publication of the paper
on Cornish veins by Joseph Carne, in the second volume of Transactions, members appear to have been satisfied that veins had now been classified, so no more studies were needed. Few other papers commenting on or extending his paper were read at RGSC meetings. This was not the attitude taken outside Cornwall, for delegates to the British Association, and some members of the Geological Society of London especially the Rev Adam Sedgwick, continued to inspect veins, and to develop and refine their classifications. In the 1830's, studies of the origin of the Cornish mineral veins were carried out, but mainly by one individual, R W Fox, and much of his work was pursued outside the RGSC (see Section 6).

In the 1830's, at a time when the geological history of Devon had come under the spotlight at the Geological Society of London and at meetings of the BAAS, the RGSC was hardly involved at all in what became known as the "great Devonian controversy". The killas of Cornwall were similar to the sediments in Devon that were being intensively studied by the gentlemanly specialists of the London society, so that the RGSC might have been expected to have made a contribution. However the unconventional views of H S Boase about stratigraphy, and those of Henwood about structural geology (see Sections 5 and 6), would have meant that these two secretaries would have had little of use to offer in the way of information about the geology of Cornwall to any of the parties in the controversy. There is no evidence in the society's records that any interest was taken in the affair until it was raised in 1839 by Davies Gilbert, and again in 1842 by Sir Charles Lemon (see above); by that time most of the areas
under consideration had already been investigated by others. 106

Another question relevant to the society's proposed programme of original research was the availability of appropriate skills. There is no doubt about whether amateur geologists and mineralogists of the 19th century were capable of original work; some of the members of the Geological Society of London, for example De la Beche and Murchison, carried out some of the most valuable investigations of this period. In the RGSC men such as Carne, Hawkins and R W Fox demonstrated that some at least of the Cornish members were very skilled. Carne and Fox were mainly self taught, though each acknowledged the help given to them by others, especially mining men; 107 Hawkins claimed that he had relied on the work of William Borlase in his early investigations of Cornish geology, 108 but later had the advantage of learning from Werner and other continental geologists and mining engineers.

Time in which to pursue geological studies is an important requirement for both professionals and amateurs. Both Carne and Fox were "working men", who nevertheless made use of their restricted opportunities to follow their own interests, although it may be significant that once Carne had left the Cornish Copper Company, for which he had worked as manager until 1819, and had joined the family banking and smelting business, the society received fewer original contributions from him. His major paper on Cornish veins was presented in 1818. Fox was involved with the family businesses in Falmouth, and on at least one occasion had to turn down a request
from the BAAS to undertake practical studies because he was too busy (see Section 6.3). For two of the projects undertaken by RGSC members, the authors provided estimates of the time they had taken over their projects. H S Boase stated that his map and the accompanying memoir had involved two years of almost full time exploration, and Henwood's survey of mines was delayed at least in part by the size of the task he had undertaken (see Section 6.5). Carne, Boase and Fox were all comparatively wealthy men, for all three had involvements in Cornish banks, so they did not lack the money which might have been needed to travel or purchase equipment for their investigations. Others were not so fortunate; both Paris and Forbes had had to rely on their earnings from their profession (see Conclusion), and Henwood had needed to seek sponsors for his survey of mines (see Section 6.5). Paris was able to draw upon the resources of the society, for as has been shown, he used a Voltaic battery bought from its funds for use in his lectures on chemistry, and possibly also for mineral analyses.

Other members of the society might have been able to make greater contributions, had they been able to acquire the skills which were needed. The lack of instructional lectures (see Section 4.2.2) may be one reason for the failure of more men to become involved in the research work of the society, although it is also possible that many of these people would have wished to remain as passive spectators.

It has been shown that the active members of the RGSC were predominantly middle class, and that there was an unwillingness to allow practical men to become full members. They
would have been the best qualified to offer practical skills, such as surveying, and might have been able to give instruction in these skills to those who lacked them, to assist the society in its investigations. Those men who were practically involved in the mining industry in Cornwall, such as mine agents, and who might have been acceptable as members, seldom joined the RGSC (see Section 3). The Geological Society of London has also been criticised for its failure to involve the practical men, notably William Smith. The few mine agents, etc., who did join the RGSC rarely made real contributions to the geological work of the society, although William Chenhalls and John Rule had contributed to the development of the safety instruments which the society was promoting (see Section 7). Many others may have been deterred by the subscription (one guinea). One practical man, Richard Thomas the surveyor, whose map of the central mining district has been discussed in Section 5, seems to have been spurned by the society. Details of his offers to the society have been described, and it seems possible that he may not have been considered a suitable person for membership because of his class. Only after 1840 were his contributions welcome. The society's acceptance of W J Henwood, also apparently a man from a lower class, was an exception. This may have been due to the sponsorship of the Fox family, or perhaps because the Henwood family may originally have been gentry, but had lost their capital in mining ventures.

Morrell suggests that the Yorkshire Geological Society had run out of new data about mines by about 1844, because their knowledge was purely local, and the 1850's were said to
have been a "period of sore trial" for the Manchester Geological Society, for in 1857, only five people were present at its Annual Meeting.\textsuperscript{112} Were these problems also true for the RGSC? In the case of the geological map of Cornwall it does seem to be true that the society thought that it had completed its task by 1832, so had no more work to do in this field. But there were also signs, at a much earlier stage, that the Cornish society was finding it difficult to maintain the activity that it had shown in its first year or two. The discontinuation of monthly meetings after about 1820 (see p.108), may have been due to a lack of material available for presentation, although the reason given publicly was the long distances which members had to travel to get to meetings. As early as 1816 (see p.300-1), there were problems in providing a full programme of papers at meetings, and in the 1820's quarterly meetings became difficult to maintain. Only the Annual Meetings continued as originally planned with a full programme, including the reading of several original papers. Annual meetings were held without interruption, with the exception of 1832, when an epidemic of cholera involved the officers of the society, mainly medical men, in more pressing matters.\textsuperscript{113}

After about 1840 there seems to have been a realisation by some members of the society that contributions from amateurs in certain fields of geology, particularly mapping, were becoming less important. This must have been due in part to the increasing professionalisation in geology. Morrell (1972) describes the professionalisation of science as having a number of common characteristics; these include public re-
cognition of the science by government and the universities.\textsuperscript{114} The advent of the Geological Survey implies that geology was beginning to be recognised by government. The teaching of geology in the universities had been growing in importance since the start of the 19th century, although it was not yet an examinable subject. The presence of De la Beche in Cornwall in the latter years of the 1830's, with a small team of professional assistants, may have brought these developments to the forefront more emphatically than in other parts of the country. Other professional men from the universities, especially the Reverends Adam Sedgwick and William Buckland, had also visited the Cornish Geological Society, and had contributed to meetings. Amateur contributions in a different field, palaeontology, did however become important to Cornish geology after about 1840. Men like Charles Peach, S R Pattison and R Q Couch published detailed accounts of Cornish strata and their fossil content in the RGSC's \textit{Transactions}.\textsuperscript{115}

The role of the Geological Society of London was also of importance in affecting the way in which the RGSC developed its perception of its own function. Although the majority of members of the London institution were not professionals, there were among its most active participants men who had the leisure in which to become specialised in geology: G B Greenough, R I Murchison, and De la Beche (before 1831), were all examples of such gentlemanly specialists. Such men were sometimes intolerant of the contributions that could be made by the provincial amateur who did not have the time or the facilities that they had. Two members of the RGSC who suffered at the hands of the elite of the Geological Society of London,
were H S Boase (see Section 5), and the Rev David Williams.\textsuperscript{116} When Sir R I Murchison visited the RGSC in 1846, it may have been intentional on the part of the President, Sir Charles Lemon, to have stressed the ancillary part that provincials were expected to play in contributing to geological research (see p. 92), for Murchison had been one of the most active critics of some of the amateurs who became involved in studies of the Devonian strata.\textsuperscript{117}

Joseph Carne, in a speech at the annual dinner of the society in 1840, listed his own reasons why he thought the RGSC had been less successful of late; his final criticism of members, their "want of application", was probably the most valid reason on his list: (the curator mentioned in the quotation was W J Henwood.)\textsuperscript{118}

...with respect to the operations of the Society, they had not kept pace with the progress of geology during the last year. Perhaps there might be some reasons for this. In the first place, it was well known that the principal attention of Geologists was now absorbed in Palaeontology...of which this county furnished but few specimens. Another reason might be that it was with the Cornish Geological Society as it was with the Royal Society. At the time of this society's establishment, and for many years after, it was the sole depository for the science of its district, as the Royal Society was for some time for the kingdom. But afterwards, other societies were formed, some of which he must acknowledge were more active than their own. But after all he thought the principal reason would be found in their own want of application. There was a good field before them; but with the exception of their curator, they all seemed to have dwindled into mere amateurs. But under the auspices of their president, he would hope for a renovation.

Examination of papers published in the volumes of Transactions will afford a more detailed picture of the work done by members, and can also indicate the extent to which they derived inspiration from the Geological Society of London. (It is not
possible to do this for all papers read at meetings of the society, as in many cases only the titles of papers were preserved, and these are not always a reliable indicator of the subject content.) Table 6 (pp.262-3) shows a breakdown of the content of papers published between 1818 and 1832 in the first four volumes of Transactions (see also Appendix 10).

Few of the papers in the first four editions of the Transactions of the RGSC appear to have been directly inspired by the Transactions of the Geological Society of London. There were no papers at all on palaeontology (none are included in the Miscellaneous section). Some of the papers on recent sands and stream tin, in Volumes II, III and IV did include some information about recent organic remains found in steam works and below sand banks, but did not include detailed descriptions of the material found. The first account of fossil material found in the shales of Cornwall was given to the RGSC by Charles Peach in 1837, but was not printed until the publication in 1842 of the first part of Volume VI of the society's Transactions.119There was a greater emphasis in the first four volumes on petrology than on stratigraphy, and papers on mining were much more prominent than in the London society's Transactions.

A preference for collecting and collating facts, shown by a number of authors in the RGSC Transactions, may have been derived from the similar attitude to inductive reasoning promoted by Greenough at the Geological Society of London. The extracts already quoted, by John Forbes (on pp.149-50) and Joseph Carne (p.194), are examples of the reluctance of some
members to theorise. Dr John Davy, Sir Humphry's younger brother, was also doubtful about the ability of either Huttonian or Wernerian theories to explain the granite veins of Cornwall. In a paper in Volume I, 'An account of some granite veins at Porth Just', he wrote "[the arguments] merely tend to show that further enquiry is necessary before the phenomena of granite veins can be satisfactorily explained, or reconciled to any system".  

In Volume I few geological hypotheses were prominent, for many of the papers were on practical themes (see Appendix 10). The three papers by Paris gave little hint of his ideas about geological theory; two were practical, on the safety bar and on the soils of Cornwall. The third was mainly concerned with stratigraphy; this paper by Paris, 'On a recent formation of sandstone, occurring in various parts of the northern coast of Cornwall', was originally prepared at the request of Sir Joseph Banks and Lord De Dunstanville, and dealt with the mode of consolidation of the sands of the raised beaches common in some parts of Cornwall. He made only a brief reference to the origin of the recent sands, saying they were "supposed to have been originally brought from the sea by hurricanes".

There is however another clue to Paris's geological ideas. The ordering and names of the specimens which were to be displayed on the Geological Pillar, presented by Paris to the RGSC in 1817, suggest that he was sympathetic to Wernerian ideas about the classification of rocks (see Figure 11 (p.96)). A des-
cription of a "Geological Temple", included in his book *Philosophy in sport made science in earnest* (1827), also supports this contention.\textsuperscript{124} The details of the pillars of the temple resembled the pillar presented by Paris, and now in the possession of the RGSC. (The "Mr Seymour" named in the text is thought to have been Paris himself.\textsuperscript{125})

[Mr Seymour] had dedicated [the temple] to the genius of Werner, and every pillar and ornament bore testimony to the refined taste of its architect. It consisted of a dome, constructed of innumerable shells and corallines, and surmounted by a marble figure of Atlas, bearing the globe upon his shoulder, upon which the name WERNER was inscribed. The dome was supported by twelve pillars of so singular and beautiful a construction as to merit a particular description; the Corinthian capital of each was of Pentelican marble; the column consisted of a spiral of about six inches in breadth, which wound round a central shaft of not more than two inches in diameter; upon this spiral were placed specimens of various rocks, of such masses as to fill up the outline, and to present to the eye the appearance of a substantial and well-proportioned pillar.

Paris later modified his ideas, as a footnote, "Geological Theories - Fire and Water", used in the 1861 edition of his book, shows.\textsuperscript{126} Paris may have attended lectures by Robert Jameson at Edinburgh, which could explain why he promoted Wernerian ideas, but a biography of Paris in Munk's Roll mentioned only the classes of "Dr Hope and Mr Playfair", and Playfair was a convinced Huttonian.\textsuperscript{127} The influence of Paris' patron, William Maton, may have been significant, as he is described by Porter as "Wernerian trained".\textsuperscript{128}

Volume II contained the first of several papers on the origin of recent sands in Cornwall; 'Observations on the submersion of part of the Mount's Bay; and on the inundation of marine sand on the north coast of Cornwall', by Henry Boase.\textsuperscript{129} The dominant theme in this and most of the subsequent papers was
discussion of local beliefs that the sands were the result of one or more catastrophic events. For example, Boase wrote: 130

...from the freshness and preservation of some of the remains [of woodland detritus beneath the sand], the inundation of sand, as well as water, must have been sudden and simultaneous; and the circumstance of ripe nuts and leaves remaining together, shews that the irruption happened in the autumn, or the beginning of winter.

This paper owed little to the ideas of Cuvier about catastrophism; it owed most to history, and it was from historians, especially Borlase, that Boase had derived his ideas.

An interesting paper on the same subject was included in Volume III; 'On the singular state of some ancient coins lately found in the sands of Hayle; and, on the evidence deducible from them relative to the period of the earliest deposition of sand on the northern coast of Cornwall', by Joseph Carne. 131 He reported that a number of coins, identified as Roman, had been found in their containing vessel in the unconsolidated sands near Hayle, during excavations for the Hayle Causeway. He was able to deduce, from the position of the coins within the deposit, that the sands had been laid down very much earlier than legend suggested. He also proposed that the field evidence did not support the idea of a sudden inundation: 132

Presuming, therefore, that the coins were buried by the Romans... it will follow that the first accumulation of sand... took place prior to the final departure of the Romans from this country... It will also follow that the accumulation of sand... could not... have wholly taken place in the twelfth century, nor could it, as tradition asserts, have been accomplished in only two nights... the accumulation has, in all probability, been wholly gradual.

Dr H S Boase, the eldest son of Henry Boase, also discussed
the origin of the recent sands and the submarine forests found beneath them in some parts of Cornwall, in a paper titled 'On the sand-banks of the northern shores of Mount's-Bay'. He agreed with Carne that traditional accounts were unsatisfactory, and suggested that changes in sea level might have been the cause:

...with respect to [the occurrence of woods] under the sea, it may be argued, that they have not changed their situation, but that the level of the sea is now higher than when they flourished... That the level of the ocean has been subject to very great variations is admitted by most geologists: and if it occurred in this instance, it would offer a satisfactory solution of the position of submarine forests.

Volume IV contained four papers on the origin and occurrence of stream tin (also see Section 6.2). Discussions about the role of catastrophes, in particular the Deluge, were continued in the analyses of the formation of these deposits. Joseph Carne, in both his papers on this subject, accepted that there had been a "general deluge", and that this had been the main cause of the placement of the fluvial tin. WJ Henwood differed in his interpretation, suggesting that the main deposits of stream tin had been formed before the Deluge, and doubted that they had been eroded from the lodes. J W Colenso, a mineral agent with the Duchy of Cornwall, also contributed a paper on stream tin. He made no references to the Deluge, but he did observe that the good state of preservation of the organic remains in the deposit at Happy Union Mine at Pentewan was most probably due to the very fine grain of the silt in which they were preserved; this was so fine that it would "scarcely admit air or water to pass through it". None of these papers made specific references
to the Biblical Deluge, although in some the word, "Deluge", was spelt with a capital "D", implying that it was the Biblical flood that was being described.

Volume III (1827) contained three papers which were not particularly relevant to the Transactions of a geological society. These were: a paper by T F Barham which would have been more appropriate in an antiquarian journal, 'Some account of ancient circles and other remains on Botrea Hill...', another by the same author on the tin trade in Roman times, and one by John Hawkins on the ancient and medieval tin trade. The presence of these papers in Volume III provides further evidence that at this time the officers of the RGSC were finding it difficult to maintain the supply of original geological material (see above).

A number of papers on mineral veins included in the RGSC Transactions have been discussed in some detail in Section 6. Although as described above, John Hawkins usually made clear his partiality to Wernerian views, several authors were dubious about the ability of any school of geological thought to explain the features that they had observed in Cornwall. The quotation from R W Fox's 1832 paper (p. 206) was representative of several others.

Two more members of the RGSC who adhered to Wernerian ideas were Dr H S Boase and W J Henwood, although both added their own individual interpretations. Henwood's ideas about the similar ages of granites, killas and mineral veins have already been discussed in Sections 6.4 and 6.5. Boase, in his
long paper on the geology of Cornwall in Volume IV, wrote: 142
"I cannot refrain from stating my dissent from the doctrine of
the igneous origin of granite".

Did the Cornish Geological Society make any significant con-
tributions in its earlier years to the newly emerging science of
geology? It is not easy to answer this question, for
although none of the early studies carried out by members
could be described as seminal, it does seem possible that the
existence in Penzance of an alternative source of geological
ideas, which were directed towards fields other than those
which were being advocated by many of the members of the
Geological Society of London, must have had some influence on
the progress of early 19th geology. As has been shown, the
society received many visitors from the Universities, and from
the London society. The reasons for their presence must have
been partly due to curiosity about the work that was being
carried out in Cornwall, and some may have directed their own
work to take account of what they had learned there. For
example, one of Sedgwick's first geological excursions after
his appointment as Woodwardian Professor at Cambridge had been
to Cornwall, and he had attended a meeting of the society
while there. 143 It is possible that Sedgwick's later interest
in the origin of mineral veins may have been inspired by what
he had learned at that meeting, for he would have heard Carne
'On the granite veins of Cornwall'; and John Hawkins' paper
'On the intersection of lodes...'. 144 Studies of English
geology which suggest that the only subjects of importance in
the first few decades of the 19th century were stratigraphy and
palaeontology have neglected the role of provincial societies.

7.3 Was there a dominant influence on the early geological work of the RGSC?

Historians of geology sometimes distinguish between historical and causal schools of thought.\textsuperscript{145} Causal theories try to establish general laws linking causes and effects in the earth sciences, and make use of physics and chemistry.\textsuperscript{146} For the historical geologists, the time sequence of events in the history of the earth is important, and they rely more on stratigraphy and palaeontology.\textsuperscript{147} Causal theories were more representative of continental schools of geology in the early 19th century, including many of the followers of Werner, although Werner had also stressed the historical sequence of formations. Historical theories were also typical of the work of members of the Geological Society of London.

If the first thirty years of the Royal Geological Society of Cornwall are examined with these concepts in mind, it seems clear that, in the papers presented, there tended to be more emphasis on geological causes than on the historical sequence of natural events. The series of papers which investigated heat within mines, and those on the origin of mineral veins, and of stream tin, were primarily of the causal type. In the particular case of RW Fox, he used methods borrowed from physics in his studies of the heat of the earth and mineral veins; he also applied ideas from the new chemistry to the latter series of investigations (see Section 6.3). The scarcity of papers dealing with stratigraphy, and the conversely
popular petrological accounts may also have owed something to the influence of the continental causal schools.

However, the influence of the Geological Society of London is also apparent in many of the same papers, for Fox, Carne and others stressed that fact gathering was important and necessary, in order to improve and strengthen the hypotheses that were being presented. The ideas of the diluvialists, such as Buckland, appear to have met with unqualified acceptance by most RGSC members.

Another factor of importance, the perceived nature of the rocks in Cornwall, must also have influenced the direction taken by several of the Cornish geologists. If historical geology is mainly concerned with establishing the order in which rock formations were laid down, then Cornwall was not a promising region for this type of investigation, for the sequences of sediments typical of much of England were not so clearly marked in the south west. The question of the evolution of granite, whether it was precipitated from a primeval ocean, or had its origins in subterranean heat, also created difficulties, for until this controversy had been resolved, it was conceptually difficult to recognise the metamorphic alteration of those sediments most nearly adjacent to the granite. It may also be the case that the failure to discover fossil material in Cornish sediments before about 1835 could have been due partly to a belief that none were present to be found.
Paris's role in the early years of the society also needs examination, for he appears to have been a convinced proponent of utilitarian ideas (see also Conclusion). Volume I of the RGSC Transactions included several practical papers, not such an obvious a feature of the succeeding volumes, and Paris was most influential in its compilation, both as editor, and as secretary of the society at the time when most of the papers were read. The inclusion of two papers on mineral processing in Volume I, together with accounts of mines and mining academies on the continent, and a description of Richard Trevithick's adventures in Peru, suggests that the members of the RGSC were prepared to allow that geology, as a discipline, embraced a very wide range of topics. Paris's paper on accidents in mines should perhaps be treated as a special case, for it was most probably included in order to give prestige to the society and to Paris himself (see Section 7.1).

As will be shown in the Conclusion, the practical emphasis of the RGSC tended to diminish in the 1820s, even though some investigations of stream tin would initially suggest the contrary. Although economic motives were a part of the reason for these studies, intellectual curiosity about the origins of these deposits was also strong (see above and Section 6).

It is necessary therefore to conclude that inspiration for the geological pursuits of the RGSC came from a variety of sources, and that no one source was dominant. In addition, in the first twenty five or so years of the society, some members were prepared to pursue independent lines of study, which did not conform to the programmes advocated by the Geological
Society of London. Only after about 1840, as the national influence on English geology of the Geological Society of London became stronger, did the RGSC begin to see its role as ancillary to that of the London society.

NOTES AND REFERENCES

1. Cornwall Geological Society (1814), (1).
2. Royal Geological Society of Cornwall (nd).
3. Quarterly Meeting 17th February 1822, RGSC Minute Book No.1.
4. Laws and Rules of the Royal Geological Society of Cornwall, 1869, (5). The most recent edition of the Constitution and Bye-laws (adopted in December 1989) describes the objectives of the RGSC as: "...for the purpose of encouraging the study of Geology with special reference to the mining interests of the County; to encourage the popular study of Geology and allied sciences as a cultural subject; to afford opportunities for instruction in these sciences; to advance education in those fields by the provision and maintenance of a public museum, and to preserve geological knowledge in its transactions".
8. Minutes of Initial Meeting 11th February 1814, RGSC Minute Book No.1.
9. H B Woodward (1907), (23, 30).
11. Minutes of Initial Meeting 11th February 1814, RGSC Minute Book No.1.
12. Some short-lived chemical clubs were formed before 1814. See Averley (1986).
13. W T Lawrance (1924), (84).
14. List of members of the Cornish Club 1817-1818, CRO T3063.
15. Ibid.
16. DNB.

17. Majendie's address was included in the 'List of Honorary Members 1818', Transactions, Royal Geological Soc., Cornwall, I, 1818, (xi).

18. DNB.


20. John Rowe (1953), (95).


22. DNB.


24. Minutes of initial meeting, 11th February 1814, RGSC Minute Book No.1.

25. Letter from Thomson to Rogers, 18th November 1813, Rogers Family Autograph Collection, 2, CRO RP 17/73.


27. The report of the RGSC meeting of the 9th April 1814 in Annals of Philosophy, 3, pp.88-9, included more detail than that of the RGSC Minute Book No.1.


31. 'Journal of the Mayor of Penzance' [Henry Boase], entry for 4th May 1817, Collectanea Cornubiensia, (1527). A footnote to this entry, by the compilers of Collectanea Cornubiensia, suggested that it was Sir Humphry Davy who was the guest at dinner, but as the visitor was described as "Professor", it is more probable that he was Edmund.


33. West Briton 2nd December 1814.

34. Davies (1983), (6).

35. Vivian (1818A), (73).

36. RGSC Minute Book No.1.

37. J H Vivian 'On the methods pursued for smelting cobalt in Hungary and on those for preparing arsenic in Saxony' p.60-70,
'A sketch of the mining academies of Freyberg and Schemnitz' pp.71-77 and 'On the salt mines of Poland and Germany' pp.154-167, Transactions, Royal Geological Soc., Cornwall, I, 1818.

38. Hawkins (1822C), (148, 153).

39. Letter from John Hawkins to his wife, 26th September 1830, WSRO (H), 8, 1983.

40. 'Extract of a letter to Dr Clarke', August 1814, WSRO (H), 2, Pt.3/481. Some information about Hawkin's travels had been published in Walpole's Memoirs (1818).

41. RGSC Minute Book No.1.

42. Sir Christopher to John Hawkins, 30th September 1818, WSRO (H), 7, 1796.

43. See various entries in Davies Gilbert's Almanacs (CRO).

44. Quarterly Meeting (no date, but by the position must be before the 1st March 1816), RGSC Minute Book No.1. The entry was scored out, but clearly readable.

45. Quarterly Meeting, 17th May 1816, RGSC Minute Book No.1.

46. Copy of letter from Hawkins to W J Henwood, 16th February 1833, WSRO (H), 2, Pt.8/973.

47. John Hawkins to his wife, 12th July 1817, WSRO (H), 8, 1889.

48. Paris to Hawkins, 10th July 1824, WSRO (H), 2, Pt.5/718.


50. Collectanea Cornubiensis (col. 1479).

51. Ibid.


53. Journal of Mr Richard Edmonds, reproduced in part in Collectanea Cornubiensis.

54. Monthly Meeting 1st December 1815, RGSC Minute Book No.1. The "Royal Institution of France" may have been the Institute de France, founded in 1795.

55. Anniversary Meeting, 20th September 1814, RGSC Minute Book No.1.

56. RGSC Minute Book No.1.

57. The name was given as "Wm Greenough MP", but later versions of the list used the correct forenames.

58. H B Woodward (1907), (270).
59. West Briton 25th February 1814.

60. Anniversary Meeting, 20th September 1814, RGSC Minute Book No.1.

61. Quarterly Meeting, 25th November 1814, RGSC Minute Book No.1.

62. Hailstone had studied at Freiberg; Porter (1977), (144). Porter (1977), also describes Maton as "Wernerian trained" (173).

63. Royal Geological Society of Cornwall (1815).

64. Transactions, Royal Geological Soc., Cornwall, I, 1818 pp.xi-xii.

65. Both John Taylor, and one of his sons, Richard, did join the RGSC as ordinary members in the 1830's. Their names appeared for the first time in a list printed in the Annual Report for 1834.


68. RGSC Annual Report 1839.


70. Royal Geological Society of Cornwall, Library Catalogue, (nd). The most recent publication listed in this catalogue was dated 1873 (22). All entries were in the same hand.

71. Anniversary Meeting, 20th September 1814, RGSC 1st Minute Book.

72. Anniversary Meeting, 16th September 1817, RGSC 1st Minute Book.

73. Anniversary Meeting, 6th October 1818, RGSC 1st Minute Book.

74. Royal Cornwall Gazette 11th October 1839.

75. Ibid.

76. Ibid.

77. H B Woodward (1907), (270).

78. A C Todd (1967).

79. RGSC Annual Report 1819.

80. Pearson (1976), (24-5).
81. **RGSC Annual Report 1842** (17).

82. Ibid. (25). Buckland had been persuaded that this was a viable theory by Jean Louis Agassiz in 1838.

83. 'President's Address', **RGSC Annual Report 1843**, (21).

84. 'President's Address', **RGSC Annual Report 1844**, (10).

85. 'President's Address', **RGSC Annual Report 1846**, (9-10).

86. **RGSC Annual Report 1818**.

87. **RGSC Annual Report 1820**.

88. **RGSC Annual Report 1826**.

89. Ibid.

90. **RGSC Annual Report 1815**.


92. H Davy (1818B).

93. Ibid. (49-50).

94. Vivian (1818).

95. Hawkins (1822C).

96. Ibid. (145-7).

97. Ibid. (153-4).

98. Ibid. (158).

99. Hawkins (1822A), (5).

100. Hawkins (1822D), (241).

101. Hawkins (1822A), (6).

102. Hawkins (1832).


106. Ibid.

107. See DNB for Carne, and for Fox: Fox (1836).

108. Hawkins (1832A), (14).
110. DNB.
112. Manchester Geological Society (1908), (viii).
113. Royal Cornwall Gazette 29th September 1832.
114. Morrell (1972), (1).

115. Pattison's first paper for the society was 'On the Carboniferous System in Cornwall', Transactions, Royal Geological Soc., Cornwall, VI, 1846, pp.267-75. Richard Q Couch, a Penzance surgeon, wrote many papers for the society on fossil geology, the first being 'Report on the fossil geology of Cornwall', Transactions, Royal Geological Soc., Cornwall, VI, 1846, pp.219-226.

116. See Rudwick (1985) on the reactions of Murchison to local advice about the stratigraphy of Devon. The Rev D Williams' name first appeared as a corresponding member of the RGSC in 1842. His first paper for the society was presented in the same year: 'On granite veins', Transactions, Royal Geological Soc., Cornwall, VI, 1846, p.64-7.

118. Royal Cornwall Gazette 16th October 1840.
119. Charles W Peach 'An account of the fossil organic remains found on the south-east coast of Cornwall, and in other parts of the county', Transactions, Royal Geological Soc., Cornwall, VI, 1841-5, pp.12-23. From 1841 onwards, papers were published annually with the Annual Reports of the RGSC, and were later bound together in sets covering several years.

120. John Davy (1818), (25).
121. Paris (1818B).
123. Paris (1818B), (4).
125. See the entry for Paris in Bibliotheca Cornubiensis.
126. Paris (1861), (342).
128. See Footnote 62.
129. Henry Boase (1822A).
130. Henry Boase (1822A), (135).
131. Carne (1827B).
132. Carne (1827B), (147-8).
133. H S Boase (1827).
134. H S Boase (1827), (188).
135. Carne (1832A), (47), and Carne (1832B).
136. W J Henwood (1832), (66-8).
137. J W Colenso (1832).
138. Ibid. (34).
140. T F Barham 'Some arguments in support of the opinion that the Iktis of Diodorus Siculus is St Michael's Mount', Transactions, Royal Geological Soc., Cornwall, III, 1827, pp. 86-112.
141. John Hawkins 'On the intercourse which subsisted between Cornwall and the commercial states of antiquity; and on the state of the tin-trade during the Middle Ages', Transactions, Royal Geological Soc., Cornwall, III, 1827, pp. 113-135.
142. H S Boase (1832), (456).
143. West Briton 1st October 1819.
144. RGSC Annual Report 1819.
145. See for example, Laudan (1987).
146. Ibid. (4,15).
147. Ibid. (5).