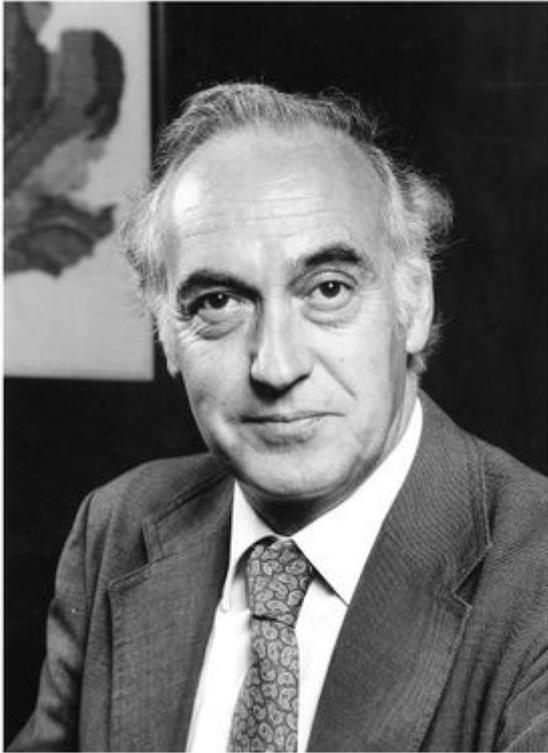


# Visiting Groups — a geological survey in transition

From Earthwise

[Jump to navigation](#) [Jump to search](#)

From: Allen, P M. 2003. [A geological survey in transition](#). British Geological Survey Occasional Publication No. 1. Keyworth:British Geological Survey.



G M Brown, Director from 1979 to 1985.  
1985. He died on 27 March 1997. Plate 2

## Chapter 2 Visiting Groups

The year 1985 should have been one of joyful celebration for the British Geological Survey. The acquisition of its new name in January 1984, to replace the Institute of Geological Sciences, with which few staff had readily identified, had provided a welcome boost to morale in a generally very unsettled period. There was a feeling around that the new name now described what the institution was and, for the first time in the career of many of the staff, it allowed them professionally to be what they wanted to be. Staff were looking forward with enthusiasm to celebrating the Survey's sesquicentennial anniversary and the opening of the Keyworth office as the headquarters of the British Geological Survey by the Hon. Peter Brooke, MP, Parliamentary Under Secretary of State for Education and Science, in October 1985. Sadly, two events were to overshadow the new sense of purpose. These were the publication of the report of the 1982-84 Visiting Group, in November 1984, and the issue of the first NERC Corporate Plan, on 14 February 1985.

The launch of the Corporate Plan, dealt with later (Chapter 3), set off a chain of events that lasted to November 1989 and which gave shape to the modern British Geological Survey, but the modernisation process itself began earlier and was much influenced by the 1982-84 Visiting Group.

Visiting Groups were an instrument of the NERC Council, used to assess the scientific, operational and managerial performance of the NERC's component institutes. They were ad hoc groups, accountable in the first instance to Preparatory Groups, which were subcommittees of Council. Since 1970 these had been responsible for the quality of research in each of the major scientific disciplines covered by the research council. Preparatory (or just Prep) Group A covered the earth sciences. The 1982-84 Visiting Group was the last of its kind to review the BGS. The next internal NERC review of the whole of the BGS was the Science and Management Audit (SMA) of 1991, which operated in a somewhat different style; the most recent, the 1997 SMA. While both of the SMAs found room for improvement in the way the BGS performed, neither of them had the impact of the last Visiting Group.

While it was still called the Institute of Geological Sciences, nearly the whole of the BGS had been scrutinised by a series of Visiting Groups between 1974 and 1978. This had been done in five phases, and was brought together in a final report to Council in 1978. The 1982-84 Visiting Group was different in that it was to look at the whole of the BGS, except for the Hydrogeology Unit and the Malcolm Brown was born in Redcar, North Yorkshire on 5 October 1925. After war service as a navigator in the Royal Air Force he went to Durham University to read Geology, then Oxford for his DPhil on the layered and ultrabasic rocks of Rum. After a short spell in Princeton University and the Carnegie Institute in Washington, he returned to lecture in Oxford in 1955. In 1967 he became Professor of Geology at Durham, where he remained until he became Director of the Institute of Geological Sciences. Because of his expertise as a petrologist he was appointed a NASA Principal Investigator of the Apollo Moon Programme and brought a sample of moon rock to the UK for research. He served on NERC Council. He was elected a Fellow of the Royal Society in 1975 and was knighted in 1985. He died on 27 March 1997.

Museum, in a single exercise, taking less than half the time of previous Visiting Groups. It was to be conducted by a core group of Professor Bernard Leake of Glasgow University (chairman), Mr H R Tainsh, a consultant in the petroleum industry, and either the Chairman or Secretary of the NERC. They were aided by a secretary from the NERC HQ staff and up to six other scientists from outside the NERC, chosen for their expertise in the fields being scrutinised.

The Visiting Group began its work in April 1982 and completed its report in April 1984. This period coincided with the implementation of a new management structure (pages 83-87 and [Figure 3](#)), which was done by the BGS Director, Malcolm Brown ([Plate 2](#)), partly in consultation with the Visiting Group. It meant, however, that the management and research programme structure that was being investigated by the Visiting Group were ones that were being replaced, not the new ones. During the time of the investigation the Visiting Group gathered evidence by personal interview, presentations and written submissions from staff. A characteristic of the Visiting Group, not evident nowadays in the SMA, was for the team to visit every individual member of the science staff in their offices to discuss their work. These were private interviews, the records of which were held in confidence and, supposedly, not shown to senior managers. This arrangement gave staff an opportunity to talk freely and frankly about any aspect of their work and management. Members of the Visiting Group also visited the Bureau de Recherches Géologiques et Minières (BRGM) in France, which the chairman believed had carried out a successful mapping programme in collaboration with universities.

They also brought in an external consultant, Dr Digby McLaren, previously the Director-General of the Geological Survey of Canada. Dr McLaren visited the BGS for a week early in April in 1984, right at the end of the Visiting Group's study, and submitted his report in a letter to Professor Leake almost immediately. The Geological Survey of Canada was (and is) a ministerial organisation fully funded directly by government. In contrast, the BGS is a non-departmental government body only partly funded by direct grant. Many of Dr McLaren's comments reflected his preference for the

Canadian way of doing things, but also were more relevant to a country still economically highly dependent on resource exploitation, which the UK, by then, was not. In addition, he did not fully take into account the Government's drive towards the market economy and the impact that this was having on government bodies in the UK. On completion, the report was passed through Prep Group A to NERC Council, where it was approved at its July 1984 meeting. A mechanism for implementation was agreed by Council in September, after which an implementation plan was requested from the Director. A series of meetings was organised in the BGS, starting on 20 November and ending on 12 February 1985, at which Dr John Bowman, Secretary to Council, addressed staff on the report.

In a summary of the report issued to staff in an Office Notice (number 12/84) in November 1984 it was said:

The VG concluded that, although the Survey was sustaining scientific vigour and innovation in some areas, there were major problems which needed to be tackled, particularly in work funded through the Science Budget. They were extremely concerned that many of these problems had been identified by the previous VG (1978) but that little progress had been made in tackling them. They concluded that Council must take a much more positive role in ensuring that changes recommended by the current VG are carried through.

It was also stated that the Council wished to exercise more control over the work carried out with funding from the Science Budget. They proposed that a system of guidance and monitoring be set up that was similar to that exercised by customer departments in the commissioned research programme. This was, in effect, a statement of no confidence in the BGS senior management's ability to manage its own science programme without supervision and, more than anything else associated with this Visiting Group, set the management against it.

The report itself was damning. While the Visiting Group acknowledged the impact of the Rothschild transfer (see Chapter 4) and recognised the funding difficulties that had followed the completion of the funding transfer in 1976, they seemed especially irked by the apparent lack of response by BGS to the recommendations of the 1978 Visiting Group. No part of the BGS escaped criticism and it was decided by Council that the core group of the Visiting Group should not be disbanded, but should be retained to monitor the implementation of the report's recommendations — another slight on the competence of the BGS senior management. The chairman of Prep Group A, who at that time was Professor J C Briden, was added to the core group. It was to meet every six months, starting in December 1984, to receive a progress paper from the BGS Director.

An important general criticism in the report was that the BGS work programme was too big, covering too wide a field, and work in it was not prioritised. They noted that there were too few support staff and that capital funding was inadequate. It was their view that a rationalisation of the whole BGS programme would liberate funding for both of these areas. The report was critical of the way that managers were burdened with administrative duties and not able to devote time and effort to research and scientific leadership. They recommended a review of career-development procedures and suggested that there was a need for a more formalised programme of training for all staff, as well as an improvement in management training. In their comments about the organisational structure they referred to the need for steps to be taken to improve the mobility of staff between different work areas within the Survey to give them the opportunity to acquire experience in a wider range of research, including overseas. They thought that linkages between different parts the Survey's research programme where similar research was being carried out, though variable, were generally poor enough to justify taking management action to strengthen them, including running seminars to improve the flow of information among staff. They also believed that links with universities could be strengthened and that staff were not publishing enough in the

peer-reviewed journals.

The Visiting Group broke down the current BGS programme into thirteen areas, which in priority order were given as:\*

- \* backlog of land survey maps and publications

- geological and geophysical syntheses of the continental-shelf data
- deep geology studies of the UK crust
- data management
- regional multidisciplinary geological surveys of the UK landmass
- regional geochemistry and metallogenesis
- isotopic and stratigraphical palaeontological studies
- seismology, geomagnetism and other geophysical methods applied to deep Earth structures and processes
- fluid processes in crustal environments; fluid-inclusion studies
- environmental hazards and environmental maps
- geochemical and geophysical methods and techniques
- rock physical properties and engineering applications • organic geochemistry related to energy resources.

Their view was that the primary objective of the BGS was to prepare and keep under revision the geological synthesis of the UK and the surrounding continental shelf by the collection, interpretation and correlation of available data relating to the three-dimensional geology, and expeditiously to publish the results by means of maps and reports. Thus, priority in the programme should be given to those elements that supported this. Effectively, these were the first eight in the list above. They commented that the last five should be supported primarily by commissioned research. If commissioned research income fell below 75% of the total for any one of them, consideration should be given to curtailing or discontinuing it.

The criticisms relating to the conduct of the mapping programme were, perhaps, the harshest. The report claimed that there was a lack of concentrated drive, poor management and too much perfectionism in it. These, they considered, could not be dealt with by a simple injection of funds to clear the backlog of maps and publications that they had identified and to speed up the rate of mapping. They could only be addressed by fundamental changes in work practices and an appreciation by staff of the needs of the modern industrial and scientific communities. It is significant that the Visiting Group praised the way that the BGS handled its commissioned research programme, commenting that in it there was evidence that staff could deliver high-quality maps and reports to time, which they contrasted markedly with the conduct of the Science-Budgetfunded geological mapping programme.

Their detailed comments covered all aspects of the mapping programme. They were tacitly critical of the way that mapping projects were carried out, usually with only two or three field staff in the project team, compared with the recently created Regional Geological Surveys (RGSs) (see Chapter 9), which consisted of up to ten multidisciplinary staff. These had been set up by the Director as a model for the future mode of operation of the Land Survey, the part of the Survey that carried out the geological mapping programme. The Visiting Group enthusiastically endorsed this approach.

Their criticism went right to the heart of the Land Survey and caused considerable resentment. Traditionally, the geological mapping staff had regarded palaeontologists, mineralogists, geochemists and geophysicists as service providers to be called upon only when needed. By contrast, in the RGSs all staff were equal members of the project team, taking part together in project planning, interpretation of the results and end-of-year reviews. In some of the RGSs there was also a significant involvement of academics, who were similarly regarded as members of the project team.

The service relationship, which the Visiting Group clearly did not like, did not exist within the RGSs, which even included analytical chemists within the teams. Indeed, one of the Visiting Group's specific recommendations was that such staff should become more involved in interpretation within the team context throughout the BGS work programme. There is no doubt that this was a more expensive way to carry out the mapping programme, but the Visiting Group was convinced that there were clear scientific and operational advantages of this approach. They also believed that it should become part of the project specification to write up the research findings and prepare maps for publication. Surprisingly, even in the early 1980s it was not mandatory for field staff to ensure that all the maps and the memoir were produced for each sheet that was mapped before moving on to new work.

Since the last quarter of the nineteenth century there had been three standard outputs from the mapping programme. The mapping scale at which the field geologists worked was six inches to the mile (later 1:10 000) and maps at this scale were compiled from field data and made available to the public. These same maps were used as a source in the process of compiling maps at the scale of one inch to the mile (later 1:50 000), which were colour printed and sold to the public. Thirdly, each one-inch map was accompanied by a memoir describing the detail on it.

The emphasis within the Land Survey was pre-eminently on mapping. Field staff were expected to do 20 weeks or more mapping a year. In some of the field units if they were not in the field immediately after Easter or if they were back in their offices before the clocks went back in October, individuals had to explain why to their District Geologists. The field staff would invariably compile their

1:10 000 maps during the winter, but there was often too little time for them to begin to work on the memoir and the 1:50 000 map. Added to this, after 1976 the demands of commissioned research took priority over Science Budget work and it is not surprising that a backlog of publications and maps had built up.

The backlog of maps and publications had been identified and criticised by the 1978 Visiting Group. By 1984 the position had not improved. The Visiting Group reported this to Council in July 1983, half-way through the review, and was asked to propose practical measures to deal with the backlog. They identified two classes of backlog material. In one, all the work had been completed, but there were insufficient funds to pay for printing. In the other, for various reasons, staff had been diverted from the tasks of writing and map compilation, leaving the work incomplete. In some cases, the unfinished work had languished for many years and the Visiting Group recognised one group of backlog items that would have to be abandoned because there was no one left in the Survey who could carry them through. In their interim report they identified a recoverable backlog of 37 memoirs, 13 sheet explanations (it was not clear at this stage what they meant by a sheet explanation, because none had been written in the Survey) and 20 1:50 000 maps. A little later, these figures were revised upwards to 52 memoirs and sheet explanations and 21 maps. There was an additional problem. It was expected that each year nine new maps and explanatory texts would be added to the production schedule. If these were not to be added to the backlog, a plan for the current programme was required that was separate from that to clear the backlog.

A separate task, which they thought needed tackling even though they did not give it high priority, was the completion of the conversion to the 1:50 000 scale of all maps that had been published at one inch to one mile. This task was well under way, but they had identified 228 sheets in the UK that still had to be converted.

Though the reasons for the backlog were many and varied, they generally reflected inefficiencies right through the system, from the way the mapping programme was planned and carried out to the production process and protocols for proof checking. Clearing the backlog was never going to be

easy, a point the Visiting Group recognised when it said that fundamental changes in work practices were required in the Land Survey. They also recognised that there was a cost to clearing it, putting it at £1.21 million over the three years 1984–87, and they asked Council for special earmarked funds for this purpose. Of all their recommendations, the Visiting Group stressed that this was the most important.

The group's next major criticism related to the way that the Land Survey should operate in the future so as not to build up another backlog. They were concerned about the impact of commissioned research on the Science Budget Programme, seeing this as one significant reason why projects were not completed. They looked forward to the development of a five-year plan for the Science Budget Programme to run alongside one for the Commissioned Research Programme, which, they noted, was being discussed with customer departments. In fact, neither happened. Discussions with Government departments failed because this was a way of working that was no longer in fashion. The trend among all Government departments was away from special or single-tender relationships towards competitive tendering for all its research, and no exceptions were to be made for the BGS. Instead of a five-year plan for commissioned research, the opposite happened. The Commissioned Research Programme became an agglomeration of small contracts each one won as a result, often, of cut-throat competition.

The Visiting Group also noted, using information from 1980, that for about 60% of the land area of Great Britain the 1:10 000 mapping was either seriously deficient or had failed to keep pace with advances in geological thinking. A plan to deal with this was needed, and, during 1984, Plan 2000 was developed by the BGS senior management (see Chapter 11). This was a critically important document. It was based on an evaluation of the quality of mapping on each one of the

1:50 000 sheets that covered Great Britain. It proposed a resurvey programme to replace the deficient maps with ones that would meet modern needs. The programme was to last fifteen years and it was proposed to start it in 1985. Though Plan 2000 was not funded and did not take place, the document was used for planning the major resurvey programme that started in 1990.

Important though it was for the Survey to develop Plan 2000, the Visiting Group seemed to be more concerned that a way should be found to bring in the universities to help with the mapping than for the BGS to improve its own medium and long-term planning. Out of this concern came their recommendation to establish the Joint BGS/Academic UK Geological Mapping Committee (see Chapter 7).

There were several other key recommendations, some having a bearing on the operational procedures within the BGS, others being somewhat academic.

Among the most significant were:

- Following completion of those currently in preparation, memoirs should be abolished and replaced by short explanatory booklets to accompany each map sheet. This was a decisive act, which the Visiting Group felt was necessary in view of what they claimed was a difficulty in writing memoirs that had been evident throughout the whole of the twentieth century.
- A standardised, Survey-wide database management system should be developed.
- The NERC Deep Geology Committee should review the work of the Deep Geology Research Group.
- Liaison between offshore and onshore mapping programmes should be improved.
- More scientific research arising out of the Offshore Commissioned Research Programme should be funded out of the Science Budget. This drew attention to the failure of Government departments to make any contribution to BGS research other than that which they paid for

directly in contracts.

- The aims and objectives of all the research groups in the Geochemistry Directorate needed urgent review, partly in consultation with industry and relevant Government departments, and the number of projects in the Geochemistry Programme reduced considerably.
- Similarly, the Geophysics Programme needed to be reviewed and focused on fewer projects, becoming more integrated within the overall BGS Science Programme. Greater emphasis should be put on interpretation of data, and less on data acquisition.
- An investigation of the funding arrangements for handling enquiries should be carried out, to ascertain whether charges could be levied for them.

The echoes of these and additional minor recommendations were to reverberate around the BGS for years to come.

The full report was not released to BGS senior management until October 1984, when the Council had decided on their implementation strategy. When it came, the Director was given until early December to write a detailed implementation plan, but on 5 November he had to face Prep Group A to defend his current Science Budget Programme, in particular the retention in it of the five programme areas that the Visiting Group declared should be funded by commissioned research only. A special meeting of the BGS Directorate was called for 25 October to plan the approach to be taken in dealing with the implementation.

Malcolm Brown's paper to the core group was presented at a meeting on 12 December, which, coincidentally, was the day that the NERC Corporate Plan for 1985 was received by senior management under conditions of great secrecy. It was a fighting document running to seventeen pages. Malcolm Brown had good cause to be annoyed. As early as June 1981 he had presented a paper to Prep Group A identifying a series of problems that had been precipitated by chronic underfunding of the Land Survey. The balance between strategic and applied research was wrong, too many staff were taken away from strategic programmes for commissioned research, leading to loss in continuity in the programme, and there was inadequate funding to sustain even a basic mapping programme in such a way that meaningful targets could be set and deliverables delivered. Although he had been given £800 000 in 1982/83 by the NERC specifically to start the Regional Geological Surveys (see Chapter 9), the underlying problems could not be addressed and had remained there. He, therefore, did not deny the validity of some of the criticisms, but they were not new to him and they remained as problems, in his view, because of inactivity at NERC HQ when faced with his requests for help. He clearly pointed out where the Visiting Group had misinterpreted evidence and gave a number of cases where actions were already in hand to deal with points raised in recommendations. In a report that was put together over a period of two years it is inevitable that some issues raised early on would be overtaken by events. The introduction of a new matrix management structure was a case in point. It was still only partially implemented and many of the benefits from it, which the Director expected would deal with points of criticism made by the Visiting Group, were not yet in evidence. But Malcolm Brown was insistent that without a higher level of Science Budget no matter what he did he could not guarantee success in addressing any of the Visiting Group's criticisms.

Five actions emerged from the December 1984 meeting of the core group. The first was to revise the draft of the terms of reference for the BGS, which Malcolm Brown had presented to it in his paper. These were the first terms of reference that the BGS had ever had and were an attempt to clarify the function of a national geological survey; it was clear from much of what had been written in the report that this was necessary. These terms of reference were eventually established by NERC Council in July 1985 and released to staff in an office notice (16/85) in October that year. They were based in part on the terms of reference prepared by the 1985 Strategic Plan Working Party which had been submitted to the Director in March that year. His derivative consisted of a concise general

statement followed by a supporting functional description. The concise statement read:

The primary objective of the British Geological Survey is to prepare and keep under revision the geological synthesis of the UK and the surrounding continental shelf by the collection, interpretation and correlation of available data related to the three-dimensional geology, and to publish expeditiously the results by means of maps and reports.

The next action required of the Director was to define the high-priority science research projects and identify the individuals to work on them, so that moves could be made towards reducing the staff complement to a level that was more manageable within the available Science Budget. This had nothing at all to do with the Visiting Group report, but everything to do with the first NERC Corporate Plan, released that day. The other three actions were about support-staff recruitment and ways of dealing with the backlog.

By the May 1985 meeting of the Core Group the Director had initiated a plan to clear the backlog of publications and maps within three years, as required by the Visiting Group. Guidelines for the new sheet explanations that were to replace memoirs had been drawn up, and actions relating to all the other recommendations were in hand. Malcolm Brown also presented his version of the breakdown of the work programme. He had quite clearly been upset by the way both the Visiting Group and Prep Group A had dealt with it. He did not agree with the thirteen-fold division of the work programme presented in the Visiting Group report, nor with the principle of prioritising it, nor with relegating parts of it to the Commissioned Research Programme. His modification was: \* UK land-survey mapping, and elimination of in-house backlogs in maps and publications

- geological and geophysical syntheses of UK continental-shelf data
- deep geology studies of the UK crust (geological, geochemical, geophysical and geotechnical)
- a national geoscience database development and application to the maintenance of an ongoing UK inventory with acquisition, handling, interpretation and dissemination of data
- regional multidisciplinary surveys of selected, problematical areas within the UK landmass (in other words the Regional Geological Surveys)
- regional geochemistry, metallogenesis, and mineral resource studies
- geological, geochemical and geophysical studies required to improve the national geological database, advance the basic science programme, and introduce more modern methods in order to become more effective.

In arguing for this breakdown, Malcolm Brown managed to persuade the Core Group that, except for the backlog of maps and publications, which was highest priority, no priority order was to be inferred from this list.

There are some interesting differences between his list and the one the Visiting Group produced. Whereas the Visiting Group inferred that the whole of the geological mapping programme would be conducted through the regional multidisciplinary surveys, Malcolm Brown restricted this approach to problematical areas. It is difficult to understand why he did this. He had created the Regional Geological Surveys alongside the systematic mapping programme with the aim of influencing the way the Land Survey operated. At first, he had not included the routine production of maps in the remit for the RGSs, but by 1984 he had begun to change his mind about this. Now, when given the green light by the Visiting Group, he chose to keep the RGSs separate from the routine geological mapping programme. Perhaps he was facing reality, knowing that some of the Assistant Directors managing the mapping programme were implacably opposed to the idea.

Among the other changes, he added important detail to the line on database management and brought in a mention of mineral resources, missing from the Visiting Group list. Most significantly,

he obtained freedom to reshape the programme in future years by rolling the last seven of the Visiting Group's list, which included five items that they thought should be funded by commissioned research only, into one, catch-all category.

The Core Group accepted Malcolm Brown's revised listing, though by then, within the BGS, it had effectively been made redundant by the 1985 Strategic Plan. They were satisfied, overall, with the actions that had been set in train to deal with all the other recommendations of the Visiting Group, agreeing at the May meeting that the only significant outstanding action was the one related to the map and memoir backlog.

The Visiting Group had been critical of the BGS for not implementing the recommendations in the 1978 Visiting Group report. In Malcolm Brown's vigorous defence of this charge he had specifically identified funding shortages as the root cause of the failure. Equally, there were resource implications to full implementation of the 1982-84 recommendations. The Visiting Group recognised this. In addition to the request for £1.21 million to clear the backlog, they made a special plea to Council to restore the BGS baseline funding to enable the Geological Mapping Programme to be continued at a level that was more appropriate for the enormous task the Visiting Group itself had identified. This was less than what was required for Plan 2000, which had been drawn up to deal with this task. It was Plan 2000, however, that was presented to Council. They approved it, but made no funding allocation to it. Nor did they enhance the baseline. The plan to clear the backlog of maps and publications in three years, as required by the Visiting Group, was given high priority within the BGS, but this also was not fully resourced. The debate between the Director and NERC HQ was about whether the money for this task could be taken out of the Science Budget allocation each year without wrecking the remaining programme or whether a special additional allocation should be made by NERC HQ. This argument rumbled on and was never resolved. The backlog was not finally cleared until 1997.

Council's wish to exercise more control over the conduct of the BGS Science Budget Programme because of its dissatisfaction with the lack of response to the 1978 Visiting Group's recommendations was not acted upon in the context of the Visiting Group. It was meant to be taken up during the reorganisation of the NERC that followed the 1985 Corporate Plan, but it was not until the creation of the Programme Board in 1989 (Chapters 5 and 6) that this issue was resolved.

The 1982-84 Visiting Group report was such a severe shock to the BGS and Council that it became a serious stimulus for change. Although it was overshadowed by the events surrounding the 1985 Corporate Plan, the impact that the Visiting Group report had on operational procedures in the BGS was not in any way diminished. Most of the recommendations were acted upon, though it took many years for some of them to become fully implemented. More importantly, the need for radical change was pushed into the forefront of the minds of the BGS senior staff; thus enabling the modernisation process to gather momentum and proceed at a pace that was commensurate with what was happening in the outside world.

Retrieved from

[http://earthwise.bgs.ac.uk/index.php?title=Visiting\\_Groups\\_-\\_a\\_geological\\_survey\\_in\\_transition&oldid=42707](http://earthwise.bgs.ac.uk/index.php?title=Visiting_Groups_-_a_geological_survey_in_transition&oldid=42707)

Category:

- [History of the British Geological Survey](#)

# Navigation menu

## Personal tools

- Not logged in
- [Talk](#)
- [Contributions](#)
- [Log in](#)
- [Request account](#)

## Namespaces

- [Page](#)
- [Discussion](#)

## Variants

## Views

- [Read](#)
- [Edit](#)
- [View history](#)
- [PDF Export](#)

## More

## Search

## Navigation

- [Main page](#)
- [Recent changes](#)
- [Random page](#)
- [Help about MediaWiki](#)

## Tools

- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Permanent link](#)
- [Page information](#)

- [Cite this page](#)
- [Browse properties](#)

• This page was last modified on 23 September 2019, at 17:30.

- [Privacy policy](#)
- [About Earthwise](#)
- [Disclaimers](#)

