5. Moderate collecting should be allowed in 8 site-types (Ice, IIcdef, IIIcdef, VId and VIIf). Moderation can be achieved by banning all commercial collecting and by limitating tool-size. In such sites I recommend all tools to be banned, except a hammer (maximum weight 1,5 kg) and a chisel (maximum lenght 30 cm).
6. Many sites are not in need of any limitation to sampling and collecting. From the point of view of paleontology and mineralogy, collecting should even be encouraged in site-types IIf and IVf, in order to salvage as many specimens as possible from destruction.
7. It is obvious that the use of heavy mechanical equipment or explosives, without a permit, should be banned on all sites, even those not otherwise protected.

Local authorities have sometimes tried to protect geosites through non-discriminating restrictional measures. Sometimes, such regulations are not even inspired by geoconservational considerations, but by an irrational feeling of irritation, caused by the conduct of isolated collectors, or even worse, by the lobbying of local clubs or even influential private collectors, in an attempt to acquire a private "hunting-ground" ! More often than not, this has merely resulted in the degradation of the sites, supposed to be preserved, through neglect and natural decay. It is clear that such blind measures do not serve the sake of earth science. A system of permits should be developed, to allow the occasional sampling of protected sites, when duly accounted for. Some organisation should be responsible for issuing such permits.

The introduction of a "collector's pass" can be considered. Bona fide organisations of amateur-geologists (-paleontologists and -mineralogists) can play a role in selecting candidates for such a pass. They can also accompany novices during an introductory probation. The adoption of a common code of conduct by the majority of amateur-organisations in Belgium, is presently under discussion. Conservational considerations should be included in such a code. Observance of the code can be enforced by sanctioning violations, e.g. through withholding of permits or passes, in very serious cases even by blacklisting the offender.

4. CONCLUSION

I tried to demonstrate the blanket-protection of all geo-objects is not a good conservational policy. A compromise should be sought between the needs of site- and specimen-conservation. This can be achieved through a differentiated approach of the collecting-phenomenon. Vulnerability and needs of protection differ strongly from one site to another. The site-typology presented here may prove helpful in determining the most efficient conservational policy in each individual case.

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EARTH SCIENCE CONSERVATION IN GREAT BRITAIN

by

Keith DUFF[1]

1. INTRODUCTION

In spite of the increasingly sophisticated "Black Boxes" which are becoming widespread in geological studies, geology remains essentially a field science, and is likely to stay that way. Because of this, and due very much to the increased pressure of development and "environmental improvement", the conservation of geological and geomorphological sites is growing in importance. The fundamental aim of earth science conservation is to ensure that the key sites for research, education and training remain available in the future, and this has been recognised by Government since the 1940s. To act as a national agency for nature conservation, including geology and geomorphology, the Nature Conservancy was established by Royal Charter in 1949, and has grown in size and effectiveness since then. In 1973 it became the Nature Conservancy Council (NCC), and is now financed by the Department of Environment. In April 1991 the NCC will be split into 3 separate agencies, covering England, Scotland and Wales separately, but with the same powers to safeguard sites. The history of geological conservation in Britain goes back much further, with the first recorded activities of this sort having taken place nearly 100 years ago in Glasgow, with the conservation of the group of *in situ* fossilised Carboniferous trees known as the "Fossil Grove" inside an ornate building in Victoria Park.

2. OBJECTIVES OF EARTH SCIENCE CONSERVATION

The key objectives (Table 1) are to maintain rock exposures, and the integrity of finite or uniques deposits or landforms, for research, training or heritage reasons. The justification (Table 2) for this is the conservation of a part of our natural, and manmade, heritage for future generations of researchers, students, pupils and amateur earth scientists. There is also an economic element, since the modern industrial society in which we live is dependent upon the continued supply of raw materials located and investigated by geologists ; many of the sites protected by the NCC are vital for training the geologists of the next generation. This feeds into all of the critical industries - minerals, oil and gas, groundwater, civil engineering, and waste disposal. The most important feature of earth science conservation is that the sites it protects are intended to be used by geologists of all kinds, both professional and amateur ; it is not intended that the protected sites should be preserved as "museum pieces" which can only be used by the priviliged few.

Britain is unusual because of the very wide range of geology that occurs within such a relatively small area. All of the Periods of the geological column are well-represented, from the Precambrian to the Holocene (except the Miocene), and most are very well exposed in coastal cliffs, large quarries or in mountainous areas. In addition, much of the early development of the science of geology took place in Britain, with the result that many major stratotypes are located in Britain, and many of the Periods are named from Britain (such as the Cambrian, Ordovician, Silurian and Devonian). There are also many sites remaining which were fundamental in the recognition of concepts such as unconformity.

3. CONSERVATION LEGISLATION

Laws to protect geological sites (Table 3) first came into being in 1949, with the National Parks and Access to the Countryside Act. This gave the Nature Conservancy the power to identify and designate National Nature Reserves (NNR) and Sites of Special Scientific Interest (SSSI). NNRs are areas of land owned or managed by the NCC, and are designated mainly to protect biological features ; they are not a major mechanism at present for safeguarding geological sites. SSSIs (Table 4) are areas of land not owned or managed by the NCC, but which are still of high nature

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KEY OBJECTIVES OF EARTH SCIENCE CONSERVATION
* Maintaining rock **exposures** in quarries, cuttings, cliffs and outcrops
and
* maintaining **integrity** of finite or unique deposits and landforms
based on
* Research, educational or recreational value

Table 1. Key objectives of Earth science conservation.

conservation interest. However, the National Parks and Access to the Countryside Act did not give strong enough protection to SSSIs, and to overcome this problem a further law - the Wildlife and Countryside Act - was brought into force in 1981. This requires NCC to inform all owners and occupiers of every SSSI about the extent and importance of the site, and also to give them a list of all those activities which could damage the scientific interest of the site. Any owner or occupier who then wants to carry out any of these activities must consult with the NCC, and there will be a period of discussion over the proposals. NCC has the power to make management agreements with the landowner to compensate him for the profits he would have made from his development if he agrees not to go ahead, and also agrees to manage the land so as to protect the conservation features. This does not apply in the case of proposals under the physical planning system, only to changes in landuse which do not require planning permission. As a last resort, NCC can seek a special Nature Conservation Order from the Secretary of State for the Environment if the owner still intends to go ahead ; this has the effect of preventing the development. The ultimate sanction is compulsory purchase, but this is very rarely used.

The NCC is also required to tell the Local Planning Authority about every SSSI in their area, and the Authority must, by law, consult NCC over any physical planning application to change the use of the land. They are required to take account of the comments made by NCC, but do not have to follow the advice we have given ; NCC has no power of appeal if the planners do not take our advice. These powers override those requiring owners to consult NCC over changes in land use.

The SSSI system works reasonably well in protecting geological sites, and most of the consultations we receive are over developments which need planning permission.

Other organisations are also involved in geological conservation in Britain, but usually do not have the legal powers that NCC has. There is a strong wildlife conservation network, largely organised on a County basis, and which owns many nature reserves, some of which contain geological features of interest. There is a range of national bodies, such as the National Trust, which are also involved in protecting geological sites. In Britain we are fortunate to have a large number of very enthusiastic geological societies and institutions who are active in conservation, and who provide manpower, advice, and funds.

4. THREATS TO GEOLOGICAL SITES

Broadly, geological and geomorphological sites can be placed into 2 categories, each with characteristic conservation needs. Exposure sites (Table 5) are those sites whose scientific or educational value lies in providing exposures of a deposit which is extensive or plentiful underground, but which is otherwise accessible only by remote sampling. Examples are coastal cliff sections in the lowland areas of southern and eastern England, quarries, and sections in riverbanks or cliffs. Integrity sites (Table 5) are those sites whose educational and scientific value lies in their containing a finite and limited deposit or landform that is irreplaceable if destroyed. Examples are kames and eskers, karst pavements, and cave earths.

Exposure sites are mainly threatened by 2 types of development - waste disposal by landfilling in disused quarries, and the building of coast protection works in front of soft eroding cliffs. Less frequent problems are caused by building works on the floors of disused quarries, and by extensive planting of forests in the uplands. Waste disposal affects many disused quarry SSSIs, especially in lowland England, and is a considerable conservation challenge. Compromise schemes, where only part of the site is filled and the rest is left for conservation, may sound suitable in theory but rarely work in practice. Many important sites have been lost through compromise schemes that went wrong. In recent years NCC has initiated research into this area, to seek effective practical means of safeguarding important geological features in landfill sites. This has been carried out in close liaison with

CONSERVATION OF EARTH SCIENCE SITES IS JUSTIFIED PRIMARILY
* Because we are committed to preserving our heritage for the future
* To allow research for the advancement of science and the success of industry
* To train earth scientists
* To provide an essential teaching facility for schools
* Because sites have aesthetic, amenity, historical, cultural and wildlife values

Table 2. Justification for Earth science conservation.

LEGISLATION ON CONSERVATION IN ENGLAND
* National Parks and Access to the Countryside Act 1949
* Countryside Act 1968
* Nature Conservancy Council Act 1973
* Wildlife and Countryside Act 1981
* Department of the Environment Circular 27/87 on Nature Conservation
* Town and Country Planning act 1990
* Environmental Protection Act 1990

Table 3. Legislation on nature conservation in England.

landfill operators, and we are making progress. Work continues. Coast protection works are equally challenging, and are usually much more politically sensitive since they involve loss of land, and perhaps also property. They are a particular problem for geological conservation on the east and south coasts of England, between Norfolk and Devon. In most cases the protective work includes grading and draining the cliffs, building large concrete structures at the foot of the cliff, and installing groynes in the intertidal zone. All this has the effect of completely obscuring the strata in the cliff and foreshore. Again, NCC has initiated research into alternative methods of coast protection, to try and find ways in which cliff erosion can be reduced without causing serious reduction in the geological interest of the cliff. Results are encouraging and work is continuing.

Integrity sites are more vulnerable than exposure sites since they are, by definition, irreplaceable. The major threat is from quarrying, since the sand and gravel deposits making up glacial depositional features such as kames, eskers, moraines and outwash fans are in great demand for the construction industry. Whilst limited exposures in such features are valuable in seeing the internal structure and composition of the landform, extensive quarrying rapidly destroys the feature itself. Quarrying in limestone areas can also have serious effects on underground cave systems, through removal of the caves themselves, by affecting the pattern of underground water movement, or by causing blast damage to cave formations such as stalactites. In northern England, extensive karst pavements cut on Carboniferous Limestone have been seriously damaged by removal of the karst surface for sale as rockery stone in ornamental gardens.

There are many other pressures on integrity sites. Agricultural improvement of marginal land through the use of large machinery to reshape the land has caused the loss of many small-scale features such as pingos, fossil river channels, swallow holes and kettle holes.

SELECTIONS OF EARTH SCIENCE SSSIs

* Undertaken as a part of the Geological Conservation Review

* Sites selected on a national (whole GB) basis

* Sites represent consensus view of academic and geologists in industry and government

* 2000 earth science SSSIs selected in Great Britain

* Results to be published in 50 detailed volumes

* "Quaternary of Wales" published in 1989

Table 4. Selection of Earth science Sites of Special Interest (SSSIs) in Britain.

Such damage can be avoided through use of the legal safeguards in the Wildlife and Countryside Act. Extensive forestry planting in upland or lowland areas can obscure landform features, so that not only are they much harder to find, but they are also more difficult to relate, as visual links are obscured. Similar damage is also caused to exposure sites through forestry planting.

Geomorphological sites which are important for demonstrating active processes, such as sand dune evolution, river channel processes, and lanslide phenomena, are also at risk from manmade works designed to control the forces of nature.

The collection of geological specimens has sometimes been considered to be a problem in geological conservation, especially in regard to fossil collecting. The problem has generally been overstated, and it is now generally agreed that very few fossil sites can realistically be considered to be at risk from collecting. An exception is the locality on the coast of Scotland which yielded the only known examples of the conodont animal. The argument now appears to be one of philosophy rather than practical conservation. In the case of minerals the situation appears to be different, since by their very nature mineral veins are much more variable and discontinuous than are fossil bands ; it seems that there are very real possibilities of mineral sites being completely removed through collecting. In both these cases NCC is involved in discussions with individuals and groups in an attempt to work out agreed conservation prescriptions for fossil and mineral sites.

5. POSITIVE CONSERVATION

In addition to responding to the types of threat set out above, NCC is also involved in a range of more positive practical conservation measures. These involve the re-excavation of old geological sections which have become obscured by rock and soil, and the creation of entirely new exposures in areas of particular geological significance. Already, over 300 sections have been excavated for this purpose, mainly by using large machinery ; in some cases, purely manual labour has been used. The new exposures created are used both for teaching and research, and also to demonstrate geological features to the general public.

Linked to this work is the publication of a range of geological trails or guidebooks, aimed at students. These are very popular, and we use them as a way of channeling visitors to particular sites which are able to stand heavy levels of use. In this way it is possible to give protection to other, more vulnerable localities, by providing geologists with more attractive alternatives. This is a particularly effective way of protecting small and highly important sites such as stratotypes.

6. THE FUTURE

Within the last 18 months NCC has been pulling together all our accumulated experience of geological conservation, and using this as the basis for developing a strategy for geological conservation in Britain. We have consulted very widely amongst all those with an interest in geological conservation, and using their comments and advice have produced a comprehensive document which looks to the future. This publication - Earth science conservation in Great Britain : A strategy - is now widely available, and copies will be give to all

EXPOSURE AND INTEGRITY SITES

Definitions

Exposure sites : Sites whose scientific or educational value lies in providing exposures of a deposit which is extensive or plentiful underground but which is otherwise accessible only by remote sampling.

Integrity sites : Sites whose educational and scientific value lies in their containing a finite and limited deposit or landform than is irreplaceable if destroyed.

Conservation Objectives

Exposure sites : Preserve exposure, judging changes on their merits in terms of exposure and, where required, enchance sites.

Integrity sites : Minimise man-made changes and preserve integrity of sites.

Table 5. The exposure and integrity sites concept and its conservation applications.

participants at this symposium. It is supported by a comprehensive and detailed manual of practical conservation techniques, and by leaflets aimed at particular interest groups ; copies will be available for participants.

The strategy provides an overview of the need for earth science conservation, the means by which it can be achieved, and the bodies most able to take an active role. It recognises that not all sites which are of interest to geologists can be protected by law, and that many sites of value to local communities must depend on local groups and initiatives for their conservation. The strategy stresses the vital role of these groups andprovides a scheme for increasing their effectiveness and extending their impact. It aims to promote the widest possible participation, and identifies specific areas in which organisations or individuals can provide the most useful contribution. It sets out 6 strategy themes for action over the next 5 years :

1. Maintaining the SSSI network. This is a statutory obligation falling mainly to NCC, owners and occupiers, and planning authorities. NCC will continue to promote research into less damaging alternatives for waste disposal, coast protection, and other development threats. NCC will also continue the publication programme for the Geological Conservation Review, and improve site documentation, site management and site monitoring.

2. Expand the RIGS network. The network of non-statutory earth science sites (Regionally Important Geological/Geomorphological Sites =RIGS) is a main plank of the strategy and will do more than any other measure to increase the number of sites receiving active conservation, and to obtain the widest involvement in earth science conservation. Each RIGS scheme is locally run, by interested individuals rather than by NCC staff, and draws upon the commitment of active amateur and professional geologists in their local area. The aim is to cover as much of Britain as possible over the next 2 years.

3. Develop new conservation techniques. This is essential for the future, and includes identification of priority research needs, commissioning or undertaking research, carrying out field trials of the proposed new techniques, and encouraging the adoption of the new techniques where appropriate.

4. Improve site documentation and conservation of samples. Information on the interest of sites, and specimens collected from them, are part of the scientific resource of a site and come into the area of earth science conservation. Site documentation should be standardised as far as possible, and properly curated to ensure ease of access. To achieve this the National Scheme for Geological Site Documentation should be developed further, RIGS groups should keep detailed records of the sites in their area, and copies of these records should be sent to the Geological Local Records Centres.

5. Increase public awareness. We need to make the general public much more aware of geology and earth science conservation, with the aim of

gaining widespread and longterm support for conservation. There should be major initiatives to make greater use of the media, to provide many more site information boards targetted specifically at the general public, and to include more earth science (including conservation) in school education.

6. Develop international links. Strengthening existing links and creating new contacts is important, to benefit from the experience of others, provide information about our own experiences, and strengthen the international profile of conservation. This should be done through the European Working Group on Earth science conservation, through the development of links between national bodies and individuals, and through formal conferences.

Through the consultation exercise undertaken by the NCC to develop the strategy, we have achieved overwhelming support for the proposals, and there has been a very high level of willingness to participate in implementing these aims. Over 300 individuals outside NCC have commented on the proposals, and over 80 % indicated their wish to become involved personally with implementing the strategy. Of the 320 individuals and organisations who responded, only 4 did not support the basic aims of the strategy ; with support like this we are very optimistic that major advance can be made.

The strength of the strategy as it now stands is the wide support it has received from disparate organisations. There is commitment for involvement by the NCC, by earth science societies and their members, by universities, polytechnics, colleges, schools and field centres, by museums, museum-based organisations, and the Geological Local Records Centres, by county wildlife trusts, and other local and National conservation organisations, by landowners and site managers, by mineral, waste disposal and civil engineering companies and consultants, and by local councils and other statutory bodies.

The strategy provides a clear way forward for earth science conservation in Britain, and if it can be of any assistance in strengthening site protection elsewhere in Europe it will have achieved one of our key aims.

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ETAT DE LA PROTECTION DU PATRIMOINE GEOLOGIQUE EN FRANCE

par

Guy MARTINI[1]

RESUME

Affirmer la valeur patrimoniale de la géologie, sensibiliser le public à cette mémoire de la Terre, sont à mon avis les outils de base pour une protection du patrimoine géologique.
En France, à présent, un réseau de 8 réserves naturelles géologiques nationales a été mis en place et des réflexions sont conduites pour la prise en compte d'un projet de loi spécifique au patrimoine géologique.

1. INTRODUCTION

Le terme même de "patrimoine géologique" contient en lui-même deux mots chargés d'importance, le mot : "patrimoine" accolé au mot "géologique". Comment peut-on, en effet, assurer la protection de notre outil fondamental de travail si nous ne pouvons pas affirmer et démontrer la valeur patrimoniale de la géologie ?

Faire de la géologie un patrimoine à part entière qui ne va plus seulement concerner les scientifiques mais l'ensemble de nos contemporains, tel devrait être, l'objectif de base nécessaire pour en assurer la protection.

Le patrimoine géologique, ce patrimoine non renouvelable, est la mémoire de notre planète, la mémoire des environnements qui s'y sont succédés, la mémoire des origines de la vie, la mémoire de nos propres origines....

Et ce n'est peut-être pas par hasard si notre société et nous-mêmes commencons à admettre cette notion de patrimoine géologique...

Pour, peut-être, mieux comprendre toute l'importance de l'acceptation publique de cette notion, il nous faudrait très sommairement nous pencher sur l'évolution historique de la notion de patrimoine.

Aux origines, dans notre société occidentale, le patrimoine correspondait à la propriété et aux biens de quelques ordres qu'ils soient qui étaient transmis de père en fils. Cette première définition correspondant donc à la notion la plus limitative de la famille et de sa possession dans le temps. La propriété a été bien évidemment la première chose "protégée" !

Par la suite, avec l'évolution de la société, cette notion de patrimoine s'est étendue à l'ensemble des habitants d'un pays qui constitue, de fait, une sorte de famille nationale. On a commencé à parler de Patrimoine Humain ou de Patrimoine National.

Un des acquis de la révolution française étant bien d'apporter la notion de bien collectif, bien sur au patrimoine historique, architectural, artistique, etc.. On n'a finalement, à ce moment, que peu évolué par rapport au sens premier du patrimoine où la notion restrictive de patrimoine familial s'est, simplement, étendue à l'ensemble de la famille humaine.

Schématiquement et en prenant des raccourcis, il est apparu tandis que cette famille humaine évoluait, que sa propre existence ne pouvait avoir lieu à l'écart de son environnement. On a donc été amené à parler de patrimoine environnemental et donc, fort heureusement, à protéger cet environnement.

Le patrimoine géologique doit suivre cette évolution pour constituer la nouvelle étape de cette lente prise de conscience d'une société et est-il autre chose que,

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