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EDITORIAL

Each individual problem encountered in attempting to conserve Chesil Beach has been separately reported in these pages as soon as the threat to the scientific interest materialised (13, p 11; 14, p 24; 16, p 26; 19, p 26). This issue of *Earth Science Conservation*, however, contains an overview of the present status of the whole beach, outlines all the various forms of damage it has already experienced, and describes the known range of threats to which this unique shingle structure is currently subject. The author, Dr A. P. Carr, is doubly qualified for, not only has he carried out intensive research on Chesil for many years, but he has also advised the Nature Conservancy Council and a number of other bodies whose spheres of responsibility include the care and management of this stretch of coast.

The help given to the Nature Conservancy Council by voluntary advisors, such as Dr Carr, is indispensible and NCC would wish to express its gratitude to all the hundreds of earth scientists, professional and amateur, who have given freely of their time and expertise in the furtherance of conservation. As reported in the previous number (19, pp 12 - 14), many of the provisions of the Wildlife and Countryside Act are now in force and the geological staff of NCC, like their colleagues throughout the organisation, have had to devote much of their energies to implementing the new legislation. Despite this priority task, however, there has been no let up in demands for fulfillment of the more traditional functions; the results achieved in 1982 are described below.

INTRODUCTION

Chesil Beach has been variously described as 'probably the most extensive and extraordinary accumulation of shingle in the world, and as 'unique'. The beach has gained international recognition and Paul Komar, in a recent American textbook covering the whole field of beach processes and sedimentation, refers to it on no less than seven out of 411 pages.

Chesil is essentially a simple, linear, shingle storm beach which links the so-called Isle of Portland with land much further west. The feature terminates abruptly at the Portland end (Fig 1) but its western limit is imprecise depending partly upon the criteria used to define it and may have changed over time. Its boundary has been variously drawn at the western end of the Fleet lagoon, between Abbotsbury and West Bexington, at West Bexington, at Burton Cliff, and at the jetties of Bridport Harbour (= West Bay). In this article this last, furthest, limit of some 28 km will be taken in accordance with local usage.

Although the pebble and cobble feature is joined to the mainland at Abbotsbury and Chiswell (= Chesilton), over the intervening 13 km it is backed by the shallow, tidal Fleet. Opposite the Fleet, Chesil Beach is between 150 and 200 m in width, but is narrower both adjacent to the cliffs in the west and at its extreme eastern end. At the western end the beach crest is intermittent but becomes continuous from midway between West Bexington and Abbotsbury to as far as Chesilton. The general picture is of a progressively increasing ridge height from west to east with the maximum some 14 m above mean sea level. The pebble size above low water mark also coarsens eastwards with the most rapid rate of change at the Portland end. Mean long-axis diameter at Chiswell is of the order of 5 cm, falling to 3.5 cm near the car park opposite Portland Harbour and rather under 2.5 cm by the Langton Herring area. Offshore the beach drops at a broadly similar gradient to that of the seaward face above low water mark before shelving gradually to about 0.18 m offshore of Wyke Regis and -11 m at a similar distance off West Bexington. There appears to be little appropriate material now available to nourish the beach from offshore so that in some respects Chesil Beach is a 'fossil' feature.

The geological evidence indicates that although some 98 per cent of the pebble and cobble material is chert and flint which could have been derived from a number of primary (and secondary) sources, the diagnostic rocks, eg Triassic quartzites, are likely to have had a southwestern provenance.

Borehole samples suggest that flint and chert pebbles become more angular with depth. However, at these lower horizons, samples are largely derived from more local, less resistant, geological strata. Both these aspects imply that attrition is of some importance as a cause of loss of volume of the beach, at least in the long-term. The boreholes also indicate that the massive pebble and cobble deposits are concentrated in the sub-aerial part of Chesil Beach: below low water level shingle occurs only as limited, discontinuous, horizons. It is difficult to calculate the total mass of shingle but it is probably of the order of 50 million tonnes.

Figure 1: Chesil Beach: site map. To show principal man-made stresses. Note the concentration at the ends of the structure especially towards the SE.
While median wave heights are not unduly large, maximum storm wave heights can be substantial (of the order of 8 m) and, coupled with relatively long wave periods, are capable of generating considerable energy as the 1978-79 winter, which caused substantial flooding and physical damage, demonstrated.

SCIENTIFIC IMPORTANCE

Apart from its value as a bastion against sea flooding and coastal erosion, the beach's importance lies in its educational value and research potential, as well as its amenity and tourist interest. Although pre-eminently of geomorphological and sedimentological significance, Chesil Beach was accorded Grade 1 status on geological grounds in the 1977 Nature Conservation Review. This assessment was based on the 'historical', ornithological and entomological characteristics of the area. Approximately one-sixth of the British breeding population of little terns (Sterna albifrons) nest along the beach while it is the only known British locality of the wingless cricket, Mogoplistes squamiger. The 'solid' geological importance is mainly confined to the peripheral areas of the Isle of Portland and the landward shore of the Fleet where, apart from excellent exposures of Jurassic rocks, there are important fossil beds, notably of the oyster Liostraea hebridica var. elongata near Langton Herring, the boueti Bed near Herbury Point, and the highly fossiliferous section at Tidmoor Point.

The geomorphological and sedimentological interest and educational value is centred mainly on three aspects: the magnitude and uniqueness of the feature, the systematic longshore size-grading of the pebbles and cobbles together with the geological composition of that material, and the existence of long-term records of natural changes, eg in the position and height of the crest of the beach. Of particular importance in this context is the fact that the 'developments' have been concentrated on the margins of, or at the extremities of, the feature. This has meant that the intervening area has been largely undisturbed and has facilitated its use as a full-scale, open air laboratory.

MAN-MADE PRESSURES

Figure 1 gives an indication of the various activities which either have taken, are taking place, or which have been proposed for the Chesil Beach area and its immediate hinterland. Apart from these major impacts, which will be discussed later, there are some others which are on a lesser scale or are more transitory in nature. Amongst the former are the legacy of wartime beach defences and the presence of fisherman's huts, while the latter include disturbance due directly to boreholes and the necessary access to borehole sites. Since there have been at least 9 site investigations in the post-war period such disturbance can have had quite extensive effects eg on surface topography.

Longstanding developments: It has been suggested that gravel has been removed from the West Bay area of Bridport for over 700 years. Construction of the harbour there began in the 1740's and slowly evolved thereafter. Perhaps the most significant change was when, following the recommendations of Sir John Coode in 1866, the permeable timber breastwork of the jetties was concreted in. While this reduced the problems of shoals at the harbour entrance, it effectively stopped the free interchange of beach material from one side of the harbour to the other and introduced a new series of problems.

Many of the economic pressures at the eastern end of Chesil Beach began to grow after the construction of a bridge in 1839 across the channel from the exit of the Fleet into what became Portland Harbour. For example, part of the rear of Chesil Beach was removed for the foundations of the naval base's oil tank depot about 1904, the harbour having been constructed in the mid-nineteenth century. A comparison between Coode's section of 1852 and one in 1968/9 taken near the car park opposite Portland Harbour suggests that a vertical section of approximately 70 m² (more than 30 m by over 2 m in height) has been removed. It is not clear as to the length of the beach affected but a highly conservative estimate of 0.5 km would involve 35,000 m³ (about 50,000 tonnes) of shingle. Based on the known area of the tank farm the amount extracted was probably twice, and perhaps as much as four times, that figure.

We do not know how much shingle had been abstracted before the mid-nineteen thirties, but its removal was obviously causing concern. Prior, writing in 1919, said "... if the removals of shingle have been insignificant in comparison with the whole bulk of the bank, they have been sufficient to exhaust the material of the beach at both ends". Carr has suggested that between about 1935 and 1977 a further 2 per cent of the pebbles and cobbles had been extracted. A smaller amount of wastage is also likely due to attrition. From 'time immemorial', but more particularly between 1948 and 1972 when it was regularised, relatively small amounts of material were removed by 'pebble-picking' along the beach at the south eastern end. Although quantities did not exceed 350 tonnes per year in the 1948-72 period, the effect was particularly insidious scientifically because only particular sizes and shapes were selected. The practice was stopped following a Public Inquiry on grounds both of sea defence and scientific interest although the agents of the Crown Estate Commissioners, who manage that part of the beach, had been in favour of its continuance on grounds of revenue and employment.

Present-day pressures: The caravan sites shown in Fig 1 are widely dispersed and are, in the main, set back from the beach yet their visual impact is most clearly seen from offshore. Figure 1 indicates 3 car parks - there are others, notably at West Bay. That at West Bexington, and the one opposite Portland Harbour, serve a necessary function but tend to be visually obtrusive.

The remaining activities are more site specific and will be described from west to east. The harbour at West Bay is small but still active. It is not clear how any marina proposal for the area might affect this. The shoreline to the west of the harbour jetties is one of relatively high energy and a denuded beach. The recently completed 2 km sea defence scheme there was preceded by other substantial works mostly of an emergency nature. Both these operations were co-ordinated by the Wessex Water Authority and attracted substantial financial support from central government. On the eastern side of the impermeable jetties there is considerable accretion (but this does not prove that longshore transport is to the west along this stretch of Chesil Beach). Material from here continues to be extracted for commercial purposes. During most of the 1970's aggregate removal at the site ran at a rate of about 8,000 tonnes per year. Removal from the foreshore was argued on navigational, employment and financial grounds, the local authority benefiting from royalties on the amount extracted. The other active site of aggregate extraction is at Cogden Beach, a location further east. Between 1967 and 1977 removal at Cogden is estimated to have been about 4,000 tonnes per year. Between West Bay and Cogden is a third location, Burton Bradstock beach, but gravel-winning from this site ceased in 1973. All these western locations were the subject of Public
Inquiries in 1955 and 1966 as to whether removal of shingle should continue. One of the arguments accepted by the Inspector in 1955 was to the effect that it had not been shown that new supplies of material were absent or unable to reach the coast from offshore. The second inquiry merely endorsed the status quo. Present planning permission lapse in 1983 but since in the case of West Bay the local authority can grant itself an extension a further public inquiry will be dependent upon the County Council 'calling in' the approval.

From West Bexington to midway along the Fleet there is little pressure on the beach and the centuries-old Swannery on the landward side of the Fleet, together with the reedcutting at its western end, could be regarded as a positive contribution. Estate management along the western end of the Fleet has resulted in minimal damage to the environment and, indeed, provided some substantial benefits, but further east air photographs clearly show the results of illegal use of tractors along Chesil Beach (to the west of a line drawn opposite Tidmoor Point ('3' on map).

The numbers '1' to '4' in Fig 1 indicate the proposed sites of power stations; the first two would have been oil-fired while '3' and '4' (Herbury Point) were intended to be nuclear. The Tidmoor Point scheme would have been the most environmentally damaging but, because of the permeable nature of Chesil Beach, proved impracticable. The intention was to obtain cooling water via an enlarged channel from the entrance to the Fleet at Small Mouth (near '1' on map) and to dam the Fleet lagoon near Tidmoor Point. The warm outflow was to have been removed via a tunnel under Chesil Beach and dispersed offshore. The most recent proposal for a power station at Herbury ('4') would have had major amenity objections as well as some, primarily biological, scientific ones. The Central Electricity Generating Board subsequently expressed a preference for a third nuclear station at Hinkley Point, Somerset, or for one near Winfrith Heath, Dorset, rather than the Herbury site. Nonetheless the experience from 1957 onwards suggests that the whole idea is unlikely to 'go away' permanently.

The Army bridging camp at Wyke Regis represents the most westerly of a whole series of man-generated pressures which extend to the Isle of Portland with its Ministry of Defence establishments, its prison and borstal, and the various quarries. The camp buildings provide a conspicuous landmark on the mainland side of the Fleet narrows. Opposite them are the best examples of seepage hollows, locally known as 'cans', to be found along the whole of Chesil Beach although they have undergone some damage, mainly through vehicular activity. After the 1978-79 winter it was suggested that these might usefully be infilled on coast protection grounds. Just east of the bridging camp, but completely out of sight, is the recently completed sewage outfall which runs under the Fleet and the beach to a site some 1.3 km offshore where diffusers are situated on the seabed. The biological effects of this system have been called into question.

Because of the considerable flow of traffic between Weymouth and Portland, and the marked deterioration of the bridge built in 1839, there is now an urgent need for a replacement. The proposed scheme involves the construction of a new bridge in a dry dock adjacent to the present bridge. On completion the existing channel at Small Mouth would be blocked and a new one made to the southeast in alignment with the new bridge arch. Since the channel has been displaced laterally in the past to a comparable extent, the scheme is unlikely to have major geomorphological implications but both local fishermen and biological scientists have expressed concern, resulting in a Public Inquiry, whose decision is awaited.
All the utilities run along the ‘causeway’ between Wyke Regis and Portland. The most conspicuous of these is the water main laid in 1942, most of the course of which can still be readily detected, although buried. Running in the reverse direction from Portland to the mainland is the 700 mm diameter pipe of the main drainage scheme: this pipeline has recently been installed and for part of its length runs parallel to an open trench known as the interceptor or ‘monsoon’ ditch. The latter was excavated in 1980 in the hope of relieving flooding under storm conditions by speeding run-off into Portland Harbour. Because of the unconsolidated nature of the material all trench digging involves substantial excavation: all side slopes are of the order of 1:3.

The causeway road to Portland is flanked on its northeastern side by the oil tank farm and the naval air base, primarily used by helicopters. This site was largely reclaimed from a sandy area known as The Mere. The small village of Chiswell is situated at the base of the Isle of Portland. It merges with a larger settlement called Fortuneswell which is immediately inland and above it. It is Chiswell that has both recently and historically been subject to flooding. However, whereas in the past fishermen’s cottages were specifically designed with this possibility in mind, recent building has been more conventional. As a result it has become necessary to challenge the effect of natural events rather than to adapt to them.

There is argument as to whether the reclamation nearby has increased the incidence of flooding in Chiswell. The current sea defence proposals are intended to reduce, but not eliminate, flooding and also to minimise interruptions in communications between the ‘island’ and the mainland.

Of all the various activities and artefacts, the sea defence scheme is likely to make by far the greatest impact on Chesil Beach. It consists of four elements, the total cost of which was estimated at £4.5 M at 1980 prices. The components include modifying the existing sea wall, built between 1958 and 1965. The wall suffered from design faults and is too low to prevent overtopping in storms. Other items include raising the Weymouth-Portland road (A354) above likely flood level and the improvement of drainage both behind the sea wall and as far as the northern limit of the tank farm. At the time of writing (November 1982) work on the sea wall and improved drainage is due to start shortly.

The best known element of the sea defence scheme is the plan to raise the beach crest by about 1 m to 1.5 m and install rigid gabions and flexible mattresses for a length of between 500 m and 1600 m. A trial length of 150 m from the end of the existing Chiswell sea wall was completed in 1981. The plan involves placing beach fill into a series of wire cages in the belief that the mattresses will eventually mould themselves to the natural beach profiles. Fill for both gabions and mattresses presented a problem particularly since much of the scientific interest of the beach lies in the natural longshore sizegrading and in the diagnostic composition of the pebbles and cobbles of the indigenous material. Thus any addition of material, especially ‘foreign’ material, would appear to be undesirable. The trial length is mainly filled with chert and flint from the beach. However, this was selected by size, the smaller pebbles being rejected back onto the foreshore. Not only is there a likelihood of this material being lost to the site or even the system, but the screening effectively damages the longshore grading in a manner not dissimilar to that of the ‘pebble-picking’ of earlier years.

If it is accepted that new material is necessary and inevitable - necessary on volume considerations due to shortfall of shingle, and inevitable because planning approval was granted by the Department of the Environment for ‘foreign’ fill in part of the 150 metres-
long trial length of gabions - then local Jurassic limestone from Portland or Lower Purbeck horizons may well be the best option scientifically. Nevertheless there are technical and financial objections to the choice while, surprisingly, quantities may not be adequate for an extended scheme. If cages are broken open the limestone which escapes would eventually be worn down. Limestone quarry waste from the Isle of Portland is virtually unrepresented in the natural beach population by 3-4 km northwest of Chiswell. (This is a reflection of both attrition and net longshore transport.) One of the problems with this part of the sea defence scheme, apart from aesthetic considerations, is the likelihood of further disturbance due to frequent maintenance. The gabions have an estimated design life of 15 years with annual maintenance costs estimated at £22,000 at 1980 prices. The trials at present underway are to see how effective the gabions and mattresses are and how realistic these maintenance assumptions appear to be. Other options more acceptable to the scientific community might also have been considered, for example the raising and armouring of the A354 access road coupled with the possible abandonment of Chiswell village, but the present decision reflects political and strategic pressures, at least in part. The designation of Chiswell and part of Fortuneswell as a General Improvement Area ensures that a whole range of physical alterations, for example to the street scene, attract central government financial aid of up to 90 per cent. If local flooding at Chiswell were the only consideration it would be difficult to justify large scale expenditure.

CONCLUSIONS

This article has catalogued a range of stresses, both naturally and anthropologically generated. Most of the problems reflect the assignment of priorities other than those which the scientific community would wish or, because they view the problem from afar, believe paramount. In spite of its size Chesil Beach may well be at a comparatively late stage in its evolution so that some help is required to retain it as a viable entity irrespective of whether it is considered in economic, sociological, engineering or educational terms. The fact that Chesil Beach has been in more or less its present form for so long may delude people into believing it will remain so.

But most difficulties are general rather than site-specific. Both at Chesil and elsewhere the range and multiplicity of pressures is, at least in part, increased by the economic and technological progress of the country as a whole. The type of 'threat' may change but problems are unlikely to disappear. Chesil, in common with other features of national and international repute, needs the maximum practical protection available.

No references have been given throughout this article but the source of most data can be found in one or other of the following:

2. SALTHILL QUARRY SSSI, CLITHEROE, LANCASHIRE

'GEOLOGY GOES TO TOWN'

The results of a major new initiative in practical geological urban conservation were opened to the public in Clitheroe, Lancashire, in October, when the Mayor of Ribble Valley, Mrs Myra Clegg inaugurated a geological trail which demonstrates the scientific value of a disused limestone quarry on the outskirts of the town. The opening was attended by members of the Council and guests representing a variety of national, regional and local interests. The successful opening of the trail crowns a joint effort by the Ribble Valley Borough Council, the Lancashire & Greater Manchester Joint Reclamation Team and the Nature Conservancy Council, who have worked in close harmony to produce what is undoubtedly the most advanced single site project combining geological conservation and industrial development yet seen in Britain.

About ten years ago Ribble Valley Borough Council, the owners of Salthill Quarry, planned to reclaim the quarry for industrial purposes to meet the growing needs of the town. However, Salthill Quarry has long been of great interest to geologists for the unrivalled sections it provides through a series of 'reef' deposits of Lower Carboniferous age. For this reason the quarry has been notified as a Site of Special Scientific Interest since 1970 and the Nature Conservancy Council and the Ribble Valley Borough Council have, accordingly, sought ways in which conservation of the quarry walls could be combined with industrial development of the quarry floor. Both bodies agreed that the site offered potential for a self-guiding geological trail which could be used to demonstrate (both to geologists and non-geologists) the environmental conditions which existed in the Clitheroe area some 300 million years ago; both bodies agreed that such a trail should be an integral part of the reclamation plans.

The reclamation work at Salthill was carried out by the Borough Council through the Joint Reclamation Team, a group of engineers employed by the counties of Lancashire and Greater Manchester and led by their Principal Engineer, Mr Joe Melling. They have displayed considerable sensitivity to the task in hand and the quarry is now a model example of multi-purpose land use in which scientific education and research have been blended with industrial re-development.

Robin Grayson, a lecturer in geology at Wigan College of Further Education, has contributed to the project since its outset. He has now written the guidebook for the trail, based largely on his extensive research work in the area. The guidebook is aimed primarily at A level geology students and assumes a basic level of competence in the science. It describes eight rock outcrops and two viewpoints which help put the rocks seen on the trail into their regional geological context. One of the major educational virtues of Salthill Quarry is that the major features of interest are on a large scale and can be readily appreciated when viewed from a distance. The limebank structures and significant changes in rock type are conveniently picked out by colour changes and a convincing story regarding the geological development of the Clitheroe area can be related using the backdrop of the quarry walls as a teaching aid. Salthill is also unusual in that it is one of the few disused quarries in the country where fossil collecting can be locally encouraged without significantly affecting the scientific interest of the site. For example, Point Three on the geological trail is underlain by a thick "gravel" which consists of a mass of fossil...
remains, which if used with restraint, could remain a source of specimens for many generations of geological students. As the trail is intended to attract large numbers of students and other visitors to the quarry, the Nature Conservancy Council were of the opinion that a management agreement with Ribble Valley Borough Council under Section 15 of the Countryside Act would be desirable. The agreement provides for access for advanced or research students, who wish to study some of the less stable parts of the quarry. An insurance policy has been taken out to cover such workers and a permit system has been introduced to regulate the usage of the more sensitive parts of the quarry.

For the non-specialist visitor to Salthill a broadsheet which describes the interest of the quarry in non-technical language has been produced. Copies of this information sheet are now available from the Tourist Information Office and Council Offices at Clitheroe.

From the outset it has been clear that all participants in this project have been determined that it will reach a successful conclusion. It is therefore very pleasing to report that their efforts have now borne fruit, and that the integrated use of Salthill Quarry as an industrial site and a geological study area has been achieved. In particular, the way in which it has been possible to produce a clearly defined geological trail, explained in the form of both a published guidebook and a simplified broadsheet, and linked with the protection of restricted access rock exposures for use by research geologists, has provided a suite of facilities quite unique in Britain. However, the achievements have not stopped there; they are being further supplemented by the development of a geological museum within the Clitheroe Castle Museum, in which Salthill Quarry will feature prominently. But even more praiseworthy is the fact that the owner of the quarry, Ribble Valley Borough Council, has designed and developed an industrial site in combination with the geological features, and has done this in a manner which has given them full protection. All this constitutes an achievement of which the site owners must surely be proud, and is certainly one which can expect to receive the support of teachers and students of geology throughout the country. It is to be hoped that other site owners and local authorities elsewhere in Britain will follow Ribble Valley Borough Council's pioneering approach.

3. ACCESS TO SCORDALE NEAR APPLEBY-IN-WESTMORLAND

Dr. G.A.L. Johnson, University of Durham.

The Hilton Beck near Appleby is celebrated among geologists for the almost continuous section of Permian-Trias strata. From the Triassic St Bees Sandstone, adjacent to the Outer Pennine Fault, the sequence is exposed in downward succession to the Permian Penrith Sandstone. Across the Outer Pennine Fault, Ordovician Dunton Shales are visible in the stream with only a few yards separating them from in situ red Triassic Sandstones. The position of the fault can readily be demonstrated though the actual fault plane cannot be seen. Further upstream, drift masks the Lower Palaeozoic bedrock of the Cross Fell inlier except for rare exposures of Skiddaw Slates.

At the line of the Pennine Escarpment the stream changes name to Scordale Beck and it flows within the narrow U-shaped valley of Scordale. Extensive landslips dominate the north-west valley side but the south-east side is less disturbed and shows good successions in the Lower Carboniferous Melmerby Scar Limestone and overlying beds with the Whin Sill. The succession is also exposed in Scordale Beck above the Hilton Mines.

4. THE GEOLOGICAL CONSERVATION REVIEW

Work has now been started on the vast majority of the "blocks" which together make up the Geological Conservation Review; for a significant proportion, site selection is now complete and a draft text is to hand. Despite every effort, however, there remains a hardcore of problem blocks where no start has been made through difficulties in finding scientists with the necessary expertise who are willing to undertake the task.

The present position of the group of blocks relating to Quaternary stratigraphy and geomorphology may be taken as typical. Assessment and selection of key sites are
PLATE 5.
The Mayor of Ribble Valley, accompanied by councillors and officers of the Borough Council, representatives of Lancashire County Council, the Joint Reclamation Team and of NCC and invited guests, officially declares the Salt Hill Geology Teaching Trail open.

PLATE 6.
Robin Grayson, the author of NCC's guide to the Salt Hill Trail and himself a member of Lancashire County Council, conducts the first party along the newly-opened trail.

PLATE 7.
At this point in the trail, visitors are separated from the rock face by balustrade fencing; access for research workers is provided by the gate seen in the background. In front of the gate lie rock slabs from which visitors can safely collect specimens.

PLATE 8.
The balustrades at the top of the quarry not only prevent accidents but safeguard the scientific interest of the striated glacial pavement. The old quarry floor, in the background is to be developed as an industrial estate.
progressing, both in-house and through the employment of outside experts. For practical reasons the work has been subdivided into a number of regional and systematic blocks, some of which are now substantially complete including those representing British Pleistocene mammals, Quaternary features in South Eastern England, the Thames Valley, East Anglia, part of the Midlands and Scotland (except parts of the Hebrides and Northern Isles), all cave and karst geomorphology, coastal forms in Scotland and all mass movement features. In some cases full site documentation is now complete, covering site descriptions, literature reviews, assessments of significance and bibliographies. Selection of sites is currently in progress for Quaternary features in South Western England, Cumbria, North Eastern England, and coastal features in England. Work in Wales was temporarily in abeyance but commenced again in January. Site selection is also to start soon in Eastern England and in Somerset. The major gaps in coverage are currently in the West Midlands, the Welsh Borders and parts of the West Country. Any offers of assistance from people with knowledge of these areas would be greatly welcomed.

The situation of the geological blocks is closely similar. In particular help is needed from workers with expertise relating to the Dinantian-Namurian of Scotland, the Culm and Carboniferous Limestone of South Wales and South Western England, the Llandoilo and Llandovery Series, the Mineralogy of Wales and of the Northern Pennines, the Hercynian igneous rocks, the Old Red Sandstone volcanics and some parts of the Caledonian Igneous Province. Again offers of assistance from readers with appropriate knowledge would be much welcomed; those interested should write to the Geological Conservation Review Unit, Pearl House, Bartholomew Street, Newbury, Berkshire.

BATHONIAN

The review of the Bathonian Stage began in October 1982. Modern, detailed research has been carried out in recent years by a number of people, spread over much of the Bathonian outcrop, although comparatively little of this work has been published. Wherever possible, this recent work has been used in the completion of a list of candidate sites, but in some areas the Geological Conservation Review must rely heavily on older literature, which has to be reinterpreted in the light of recent advances in the lithostratigraphic nomenclature, correlation and facies interpretation.

Historically the Bathonian is particularly important for its connections with William Smith, “Father of English Geology”. Several of the lithostratigraphic names used for strata of Bathonian age were coined by Smith in the 18th Century (e.g. Combrash, Forest Marble, Great Oolite and Fuller’s Earth Rock). John Morris, John Lycett, S.S. Buckman, Lindsell Richardson and W.J. Arkell are among the many distinguished geologists who have worked on the rocks and fossils of this age.

There are four areas of Bathonian outcrop in Britain - Brora, on the east of Scotland, the Hebrides, Yorkshire and the main outcrop from the Dorset Coast northwards through the Cotswolds and the Midlands to the River Humber. The major lithostratigraphic units of Bathonian age in each area are, respectively, the Brora Coal Formation, the Great Estuarine Group, the Scalby Formation and the Great Oolite Group.

The British Bathonian, as a whole, exhibits a gamut of environments from offshore, open-marine shelf to shallow, marginal-marine shelf, through paralic embayments and brackish or hypersaline lagoons to paludal, lacustrine, possibly deltaic and coastal plain environments. Faunally, this diverse plexus of generally restricted facies is represented in the fossil-record by rich bivalve and gastropod faunas, together with numerous brachiopods, echinoderms, corals and bryozoans. Ammonites are rare, or absent in many facies. This paucity makes accurate biostratigraphic correlation within the Bathonian very difficult, and has meant that event stratigraphy, brachiopods, gastropods, ostracods and foraminifera have all been used for ‘correlative’ purposes, with varying degrees of success. The ammonite-based biostratigraphic correlation recently published in the Geological Society’s Jurassic Correlation Chart forms a valuable guiding framework for some of the other methods of correlation.

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The White Limestone of Oxfordshire, the Rutland Formation further east and the Great Estuarine Group of the Hebrides have all been the subject of important detailed palaeoecological analyses. Such studies have shed much light on the faunal associations, the sediment-fauna relationships and the stress-tolerances of invertebrate taxa found in marginal marine and brackish-water environments of Bathonian age.

In Yorkshire the sedimentology of the Scalby Formation has also recently been studied in detail. The Moor Grit Member has been interpreted as the deposits of a major braided river channel system, and the overlying Long Nab Member as a network of largely unconfluent channel sandstones cut into finer-grained backswamp and floodplain sediments.

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progressing, both in-house and through the employment of outside experts. For practical reasons the work has been subdivided into a number of regional and systematic blocks, some of which are now substantially complete including those representing British Pleistocene mammals, Quaternary features in South Eastern England, the Thames Valley, East Anglia, part of the Midlands and Scotland (except parts of the Hebrides and Northern Isles), all cave and karst geomorphology, coastal forms in Scotland and all mass movement features. In some cases full site documentation is now complete, covering site descriptions, literature reviews, assessments of significance and bibliographies. Selection of sites is currently in progress for Quaternary features in South Western England, Cumbria, North Eastern England, and coastal features in England. Work in Wales was temporarily in abeyance but commenced again in January. Site selection is also to start soon in Eastern England and in Somerset. The major gaps in coverage are currently in the West Midlands, the Welsh Borders and parts of the West Country. Any offers of assistance from people with knowledge of these areas would be greatly welcomed.

The situation of the geological blocks is closely similar. In particular help is needed from workers with expertise relating to the Dinantian-Namurian of Scotland, the Cull and Carboniferous Limestone of South Wales and South Western England, the Llandeilo and Llandovery Series, the Mineralogy of Wales and of the Northern Pennines, the Hercynian igneous rocks, the Old Red Sandstone volcanics and some parts of the Caledonian Igneous Province. Again offers of assistance from readers with appropriate knowledge would be much welcomed; those interested should write to the Geological Conservation Review Unit, Pearl House, Bartholomew Street, Newbury, Berkshire.

**BATHONIAN**

The review of the Bathonian Stage began in October 1982. Modern, detailed research has been carried out in recent years by a number of people, spread over much of the Bathonian outcrop, although comparatively little of this work has been published. Wherever possible, this recent work has been used in the completion of a list of candidate sites, but in some areas the Geological Conservation Review must rely heavily on older literature, which has to be reinterpreted in the light of recent advances in the lithostratigraphic nomenclature, correlation and facies interpretation.

Historically the Bathonian is particularly important for its connections with William Smith, "Father of English Geology". Several of the lithostratigraphic names used for strata of Bathonian age were coined by Smith in the 18th Century (e.g. Cornbrash, Forest Marble, Great Oolite and Fuller's Earth Rock). John Morris, John Lycett, S.S. Buckman, Linsdell Richardson and W.J. Arkell are among the many distinguished geologists who have worked on the rocks and fossils of this age.

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WESTPHALIAN AND STEPHANIAN

Work on this block started in January 1983 and covers the two series known traditionally in this country as the 'Coal Measures'. They contain one of the nation's most important economic reserves, presently yielding some 125 million tonnes of coal per annum, and have received much attention from geologists. Unfortunately, however, this has largely taken the form of investigations in mines and temporary exposures, and these cannot provide the permanent reference sections which alone can provide long-term stability for research. However, there are extensive natural exposures of these rocks in Britain, and it is intended that the Geological Conservation Review will select the most important, so as to provide a network of sites demonstrating the Westphalian-Stephanian geology throughout the country.

Other than in Devon, the British deposits of this age are almost exclusively non-marine, representing extensive flood-plain/delta complexes. South of the Highland Boundary Fault, they covered most of Britain except for the upland area of the Wales-Brabant Island, which stretched across central Wales and the Midlands. The flood-plains were often blanketed by dense, swamp vegetation, especially arborescent lycopods, and it is the remains of these which form the coal seams. Also found in these rocks are the remains of non-marine vertebrates and invertebrates. Particularly in the lower Westphalian, there are thin, discrete bands of marine shale representing short-lived incursions of the sea over the flood-plains. These marine bands extend over much of Northern Europe and have proved invaluable for stratigraphical correlation. One of the prime aims of the Geological Conservation Review work on this block, therefore, is to locate a series of permanent reference sections for these marine bands. This is of more than just parochial interest. The IUGS Subcommission on Carboniferous Stratigraphy has decided to locate the international stratotypes for at least some of the Westphalian stages in either South Wales or Northern England, and the boundaries between the stages are taken at these marine bands. The British sections will, therefore, play a central role in the world-wide correlation of Westphalian deposits. In the upper Westphalian and Stephanian, correlation has been based more on biostratigraphical criteria, particularly the plant macrofossils. The sites which the Geological Conservation Review will be investigating in these higher strata will therefore include rich fossil-bearing horizons. Particularly important will be the search for a site, probably in South Wales, which can be used as an international stratotype for the base of the Westphalian D Stage. This will be chosen at the lowest horizon to yield the plant Neuropteris ovata Hoffmann.

Work on the block is starting in the southern province of Britain, which includes the South Wales, Forest of Dean and Bristol-Somerset coalfields. These are some of the classic areas for Westphalian-Stephanian geology in Britain. South Wales is important as being the only complete Westphalian sequence in Europe in a non-marine facies, whilst the Forest of Dean provides the best exposed sections in Britain through the Westphalian-Stephanian boundary. The Bristol-Somerset Coalfield is unfortunately not as well exposed as the other two, but is well known for its well-preserved fossil floras and faunas. The Pennine and Scottish provinces, representing the deposits north of the Wales-Brabant Island, will be dealt with later.

PROPOSED COAST PROTECTION WORKS AT BISHOPSTONE CLIFFS, HERNE BAY, KENT.

The cliffs and foreshore east of Herne Bay provide a classic section through Palaeocene and Eocene rocks of the London Basin, much used by educational parties. They were first described in detail by Prestwich in the 1850's and have recently been intensively studied by the Tertiary Research Group; they are the subject of current research in several fields, including vertebrate palaeontology, palaeobotany and micro-palaeontology.

Since the section from Bishopstone to Reculver was designated an SSSI in 1951, the only parts of the section to be threatened by coast protection schemes have been the eastern extremity at Reculver and the western extremity at Hillborough Cliff. However, in 1982, NCC were consulted by Canterbury City Council over a proposal to construct coast defences along a 350 metre length eastwards from Bishopstone Glen. The Bishopstone Stone consists of two separate elements - firstly, a 25 metre wide graded block apron would be placed over the existing beach to protect the cliff toe from marine erosion and, secondly, the London Clay section at the top of the cliff would be stabilised by a retaining wall and the installation of drains. The main cliff-face would not be directly affected by these works, apart from clearance of debris presently obscuring the lower part of the cliff. The blocks forming the apron would not be fixed but are expected to remain in place because of their weight and their close interlocking with other blocks. Unlike a

FULWELL QUARRIES SSSI - A POSSIBLE LOCAL NATURE RESERVE

The exposures of Magnesian Limestone in the disused Fulwell Quarries, Tyne and Wear, have long been famous for the remarkable structures they contain - these include cannonball concretions and radiating, reticulate, coralline, honeycomb and organ pipe recrystallisation structures. Over the years this site has been visited by thousands of geologists, including many from overseas, so that it is no exaggeration to describe it as world-famous. Recently, however, new proposals for infilling the quarry complex have given rise to concern for the future of its features of interest. Moreover, recreational overuse of the site has caused considerable deterioration of some exposures. Consequently, intensive negotiations have recently taken place between the Nature Conservancy Council, the Durham County Conservation Trust and the local planning authority, Sunderland Borough Council, in an effort to devise a development scheme which would enable the extensive derelict area in and around the quarry complex to be restored for the benefit of the local community whilst safeguarding the outstanding geological features. One promising proposal now under consideration is to develop the area surrounding the quarries as a municipal golf course, and to designate the quarry itself as a Local Nature Reserve. This would seem to be entirely compatible with conservation of the features of scientific interest and could solve some of the present problems of misuse of the site. It is hoped that these negotiations will be brought to a successful conclusion in the near future.
concrete revetment, the apron is designed to absorb wave energy, rather than to reflect it. The stabilisation works on the cliff-top have been devised to prevent the London Clay slopes degrading to a natural angle of repose since this could undermine houses along Manor Road.

Before responding to these proposals, Section staff consulted with Tertiary specialists working on the Bishopstone cliffs and with engineering geologists experienced in the stability of soft-rock cliffs. From these consultations it was concluded that the scheme proposed for Bishopstone Cliffs only poses a direct threat to the London Clay sections - although these are of some interest, their loss would be insufficient to justify outright opposition. The main cliff-face would not be directly affected by the proposed works and would remain accessible for geological study, at least for some time. However, if the worked prevented or greatly reduced marine erosion, the cliff-face, composed of loosely consolidated sands, would gradually become buried by accumulations of talus. In addition it was feared that storms might move blocks from the apron down the foreshore to where they could damage the important intertidal outcrops of Tertiary sediments. Accordingly, the NCC sought a meeting with representatives of the City Council Engineer's Department to discuss the conservation problems posed by the design of the scheme. At these discussions, it became clear that the City Council were likely to support a proposal for artificial maintenance of the cliff exposure through removing any accumulations of fallen debris by mechanical means. Assurances were also given that blocks in the foreshore apron would not move out of place onto the rock platform and that if they did they would be quickly removed and replaced. The cliff-top stabilisation works on the London Clay were shown to be the absolute minimum required to prevent undermining of the houses along Manor Road. No large-scale grading was intended, as was carried out further to the west between Herne Bay and Hilborough Cliff, but the retaining wall and drains would be installed with the minimum of disturbance and the London Clay left to degrade naturally to its stable height. The Engineer's Department also agreed to modify their scheme to incorporate a number of proposals which had been made by NCC staff, and to forward the modified plans for further assessment. Further safeguards can be incorporated as conditions attached to any planning permission the City Council would grant once the plans were finalised. At present the modified plans are awaited; if these incorporate the modifications requested and if the Planning Department agree to impose conditions specified by NCC on the planning permission, it is likely that NCC will have no further objection to the scheme.

In essence, the foreshore apron will reduce, though not prevent, cliff-foot erosion but will not directly affect the outcrops on the rock platform since it will be built on top of the existing beach. Over a period of years, it is expected that beach material will accumulate between the blocks of the apron and will eventually cover the structure. The cliff-face itself will not be directly affected by this apron but will remain fully exposed apart from the bottom metre or so where the apron is built; this part of the section is presently obscured by debris. The City Council agree that, since the apron will prevent or greatly reduce marine scour of the cliff-root, any debris accumulating after construction of the defences will be artificially removed. Thus the cliff-exposures are likely to remain and may in fact be kept in better condition than at present. It is likely that some of the London Clay at the cliff-top will be removed during stabilisation but a cap of clay will be retained adjacent to the cliff-top to prevent excessive amounts of water penetrating into the sands of the Oldhaven Beds. Thus the lowest parts of the London Clay and its contact with the Oldhaven Beds should remain visible.

This scheme is of very considerable interest in that it appears to offer a feasible compromise between the requirements of geological conservation and those of coast protection. It affects only about one-sixth of the total length of the SSSI where there is cliff-top development, the remainder of the site is backed by undeveloped land which, on present policies (see Earth Science Conservation 17, p. 16), should certainly not be threatened by any coast defence scheme in the foreseeable future. Should the modifications and conditions requested by NCC be incorporated, there is a strong chance that the scheme will light a way to a general solution of the widespread conservation problems caused by the erosion of soft-rock cliffs. In these circumstances, if the proposed scheme is installed, its effects will require careful monitoring so that they may aid assessment of proposals for similar coast defence schemes elsewhere in Britain. Further developments will be reported in future issues of this journal.

DUCKMANTON RAILWAY CUTTING, DERBYSHIRE

Duckmanton Railway Cutting (see Information Circular 11, p.9 and 14, p.18) is a famous and well-used geological locality which provides rare and important exposures of Coal Measures strata. The site was purchased by the Derbyshire Naturalists' Trust in 1976 from British Rail and a Trail Guide to the exposures was published in 1978 with grant-aid from NCC. At that time some of the exposures in the cutting were cleared and enlarged and some new ones were created. However, over the succeeding years weathering and human erosion, particularly of the coal seams, caused the outcrops to degrade, in some cases to an unacceptably poor condition. Progressive deterioration had been observed by the Trust's Voluntary Warden for the site, Mr Terry Judge, and led him to conclude that periodic hand maintenance of the exposures was not enough to reverse, or even prevent, the decline. The coal seam exposures presented a particular problem since they were repeatedly worked by the local people for free fuel. In several cases this had created a substantial and hazardous overhang above the seams. Accordingly, in late 1981, the Derbyshire Naturalists' Trust applied to NCC for grant aid to excavate three new large exposures in the cutting and to surround each by a gated enclosure, so as to provide new exposures of high quality in the Coal Measures to which access could be restricted to bona fide geological visitors. After detailed discussions, NCC agreed to provide grant-aid for two of the excavations and enclosures and this work has now been successfully undertaken. Access to these excellent new sections is by prior arrangement with the Derbyshire Naturalists' Trust - applications should be sent to Mrs P. Brassley, Derbyshire Naturalists' Trust, Estate Office, Twyżford, Barrow-on-Trent, Derby DE7 1HJ.

During 1982 a serious new threat to this site arose from an unexpected quarter. When the DNT purchased the site, British Rail retained ownership of the road bridge, which crosses the cutting. This bridge which carries a link to the M1, has been subjected to excessively high loads in recent years and, as a result, by 1982, was no longer safe for two-way traffic, obliging British Rail to seek urgent remedy. British Rail had anticipated this problem when selling the site and had included a condition of sale retaining the right to demolish the bridge and replace it with an earth embankment. Accordingly, during 1982, an application was submitted to the North East Derbyshire District Council for permission to replace the bridge with an embankment. NCC were consulted about this...
proposal and found from careful examination of the plans that the proposed embankment would bury the single most important locality within the site, the exposure of the Clay Cross (vanderbeckei) Marine Band, the proposed boundary stratotype for the base of the Westphalian B Stage of the Carboniferous. Consequently NCC and the DNT registered strong opposition to the plan and pressed British Rail for modifications which would protect the vital exposure. Lengthy negotiations followed during which excavation work was carried out by NCC and DNT to prove the extent of the outcrop of the Marine Band. No acceptable compromise, however, could be reached and British Rail’s planning application went forward for formal consideration by the District Council faced with strong opposition from the NCC, the DNT and a number of eminent geologists. It is pleasing to report that the District Council took full account of the case for geological conservation and refused the application, despite considerable pressure for an immediate replacement of the bridge. Subsequently, British Rail re-opened negotiations with the DNT and it is hoped that a new plan will result in which proper provision is made for the protection of the outstanding geological interest of the cutting.

TOLCIS QUARRY, DEVON

Tolcis Quarry was originally notified as an SSSI in 1964 for the magnificent section its faces provide through the Triassic/Jurassic boundary in White Lias/Blue Lias facies. The exposures were highly fossiliferous and yielded an important assemblage of microfossils, rarely preserved in the classic coast sections of the same strata. In 1969, NCC were consulted by Devon County Council over a proposal to use Tolcis Quarry as a refuse tip. After negotiation, a compromise scheme was agreed which allowed partial infilling of the site while leaving a large section of quarry face still accessible. In 1974, however, a further approach to NCC proposed a second extension of the tip area to cover a large proportion of the remaining quarry face. After lengthy negotiations, a scheme was agreed whereby the most important section of face would be left exposed and protected by gabions and drains, while a considerable enlargement of the refuse tip was allowed. This compromise is still in force and a substantial area of quarry face remains uncovered. However, the soft Lias clays have become overgrown in places and it is hoped to clear the outcrop in the near future.

Over the past year, a renewed threat to the geological interest has emerged. The East Devon District Council are pressing NCC to deschedule the site as a first step to infilling the conservation area completely and, in reply, NCC have made it clear that the District Council’s suggestion is wholly unacceptable. Nevertheless, the District Council have continued to put pressure on NCC and have also sought the support of Devon County Council. Fortunately the County Council have taken due regard of the SSSI status of the site and have repeatedly rejected the District Council’s proposal. It is hoped that this proposal will be dropped in the near future so that tipping operations under the 1974 compromise can be finished and the site restored to a usable condition. Once this has been done and a clearance operation has taken place, this site should once again be a valuable facility for geological teaching and research.
HORSEHAY QUARRIES, OXFORDSHIRE

Two working sand pits near Duns Tew in Oxfordshire provide the best available exposures of the Swerford Sands, an unusual facies of the Chipping Norton Formation in north-east Oxfordshire. Recently NCC were consulted by Oxfordshire County Council over two proposals to infill both sand pits within the SSSI. In their original form, the planning applications made no provision for conservation of geological sections and NCC geologists visited both pits with regional colleagues to examine the condition of their faces and to review the geological features presently visible. As a result NCC advised the County Council that the applications were unacceptable. Subsequently one planning application was refused on various grounds, including geological conservation, whereas the other was withdrawn only to be resubmitted in a slightly modified form. The site owners, Smith and Sons of Blechingdon, have now expressed their willingness to discuss the conservation requirements of the site with NCC and it is hoped that a long-term agreement will be reached. NCC have previously held successful negotiations (See Earth Science Conservation 16, p 29) with Smith and Sons over a compromise tipping scheme for Arcley Fields Farm Quarry, a Jurassic White Limestone SSSI, also in Oxfordshire. In the case of Smith's pit at Duns Tew, NCC have been informed that sand extraction will in any case continue for a further fifteen to twenty years - during this period at least there should thus be good, fresh exposure continually available.

RUBERY CUTTING AND LEACH GREEN QUARRIES, WEST MIDLANDS

This important geological site, on the outskirts of Birmingham, provides good exposures of Cambrian Lickey Quartzite overlain unconformably by Llandover Rubery Sandstone. Many features of interest can be observed and the University of Birmingham regularly take parties of students to the site. Over a period of years, however, the road cutting sections, which once exposed Rubery Shales above the Rubery Sandstone, became progressively more degraded and overgrown and the path through the quarry was almost blocked with rubbish dumped from the top of the old face. Consequently Dr W.G. Hardie of Birmingham University's Geology Department contacted the Geology and Physiography Section in 1981 to report the poor condition of the site and to propose its rehabilitation. Birmingham City Council own the site and the Section approached the Council to seek their permission for a clearance operation only to find that the condition of the path and quarry face had already provoked complaints from local residents and that the Landscape Task Force of the Birmingham City Council's Planning Department were planning to clear away the debris and tidy up the site generally. The Planning Department were very responsive to the views of NCC and work on the site has proceeded according to a programme which takes the needs of geological conservation fully into account. The clearance is now nearing completion and the site has been vastly improved for geological education and research. NCC are most grateful to the Birmingham City Council for their helpful co-operation in reinstating this valuable locality.

THE ERCALL QUARRY, THE WREKIN, SHROPSHIRE

For the past two years members of the Shropshire Geological Society have been carrying out detailed surveying in the ErcaII Quarry, Shropshire, with a view to producing a geological trail guide (Earth Science Conservation 19, p. 42). Their work achieved sudden prominence when, during 1982, NCC were consulted over plans for redevelopment of the quarry. The workings are nearing the end of their productive life and the landowner is now seeking a beneficial after-use. Late in the year, a preliminary meeting of the many authorities with statutory responsibilities relating to the ErcaII was convened to consider proposals. These took the form of a "Country Park" development containing a range of entertainment and educational facilities. It seemed likely that the proposed geological trail could well be an integral part of such development; this suggestion was favourably received by the landowner who sought further details of the proposed trail for assessment by his development consultant. As work on devising the trail by the Shropshire Geological Society had almost reached completion, it was possible for a full outline of the proposed trail and its accompanying guidebook to be submitted almost immediately. Shortly afterwards the Section received a comprehensive outline plan for the "Country Park" development which not only made provision for protection of the key quarry faces but also included specific reference to the geological trail. This outline plan is now under consideration by the planning authorities and, if accepted, will be followed by a fully detailed application. Further developments will be reported in future issues of the journal.

DULAS BROOK, BRYNSADWRN BRIDGE, POWYS

The bed and banks of the Dulas Brook at Brynsadwrn Bridge, north of Builth Wells, Powys, formed a key locality for the identification of the Cyrtograptus ellesae Zone of the Silurian, as originally defined by Gertrude Elles. It is thus an important locality for Silurian stratigraphy and has recently been proposed for notification as an SSSI. Shortly after NCC's intention became known, the Transport and Highways Department of the Welsh Office pointed out that the proposed SSSI lay in the path of a proposed road improvement scheme which would involve the construction of a large earth embankment over the exposures and the realignment of the stream. After careful assessment of the plans, NCC staff met representatives of the Welsh Office and the local planning authority-Powys County Council. The geological importance of the site was explained and NCC staff proposed modifications to the road improvement scheme which would allow the most important exposures to survive. No definite decision has yet been announced by the planners and the outcome will be reported in a subsequent number of this journal.

FOSS CROSS QUARRY, GLOUCESTERSHIRE

As reported in previous issues of this journal (Earth Science Conservation 17, p. 22 and 19, p. 40), a large section of rock-face at Foss Cross Quarry has been protected as a conservation area while the remainder of the workings are used for waste disposal. NCC lease the conservation area from the site owners, Gloucestershire County Council, and a permit system for access has been established. Recently the County
Council became concerned about the stability of the rock faces in parts of the conservation area and suggested that some remedial works be undertaken. This suggestion was agreed by NCC and a contractor removed all loose material from the faces and blocked a large and dangerous fissure with a fixed metal grille. At the same time, opportunity was taken to remove debris and refuse which had accumulated in the conservation area. Finally two signposts have been erected to stress necessary safety precautions and to explain access arrangements. The conservation area is now in excellent condition and offers a valuable educational facility with great research potential. Permits for access to the site should be obtained from The Regional Officer, NCC, Attingham Park, Shrewsbury, Shropshire SY4 4TW. Visitors must sign a form of indemnity before entering the site.

SOUTH ELMSALL QUARRY, WEST YORKSHIRE

Like Foss Cross, South Elmsall Quarry is a large disused working, now mostly used as a tip, but containing a small conservation area in which the rock face is preserved for geological study through an agreement negotiated by NCC. One of the 1982 Zechstein Conference field excursions visited the Quarry and found that waste had encroached on to the conservation area and had obscured the important quarry face which exposes the transition from reef facies to flank facies in Magnesian Limestone. Dr Denys Smith of the Institute of Geological Sciences notified NCC of this breach of the agreement and the staff of the Section took the matter up with the West Yorkshire Metropolitan County Council, meeting the officers responsible on site. The burial of part of the conservation area had resulted from a breakdown in the normal consultation procedures and, in accord with the long-standing agreement with NCC, the County Council officers undertook to re-excavate the section. This was successfully completed in November 1982 and the scientific interest has now been restored, thanks to the prompt action of Dr Smith. Had this report been delayed, the quarry might well have been completely filled in with tip and then reverted to its original owner. At this stage it would have been much more difficult, if not impossible, to remedy the damage. As NCC's staff of seven earth scientists cannot monitor all geological and geomorphological SSSI, the effectiveness of conservation must depend on the receipt of information from the geological community as a whole. Information concerning damage to the interest of SSSI's is always welcome by the Geology and Physiography Section, especially if it is transmitted promptly.

MACHAIR ROBACH, NORTH UIST, WESTERN ISLES

Early in 1982, an application was submitted to extract sand from Machair Robach; some time previously the site had been chosen for inclusion in the Geological Conservation Review as a representative beach complex site which shows the effects of extreme dissection of the mature high machair plateau with unparalleled clarity. NCC opposed the application but, despite our representations that the development would be damaging to the scientific interest, the Western Isles Island Council granted planning permission.
permission for extraction. NCC will seek to ensure that adequate restoration conditions are placed on the permission and that the relatively small sand pit which now can be opened does not pave the way for establishing widespread sand extraction.

WHITEADDER RIVER, BORDERS

This section has yielded a diverse assemblage of Dinantian seed-bearing plants, in which fine details of the anatomy are still preserved. The diversity and preservation of these early gymnosperms make it one of the most important Carboniferous plant sites in the world. However, details of the stratigraphy of this section have never been described and the plant-bearing horizons are not accurately localised. Consequently, in August 1982, GCR Unit staff, together with Cedric Shute of the British Museum (Nat. Hist.) made a detailed survey of the main exposures along the river in order to find the principal plant beds. With this new information it is now possible to localise the particularly valuable parts of the section, knowledge of considerable value in conserving this internationally significant site.

CARSTAIRS KAMES, CLYDESDALE

Early in 1982, a planning application was received for large-scale sand and gravel extraction from within this site; in effect the application proposed the removal of more than half of the SSSI. In a wide canvass of opinion throughout the earth science community, NCC received an overwhelming response in favour of contesting the application as vigorously as possible. NCC accordingly submitted a strong objection and, in due course, Clydesdale District Council withheld permission for extraction. In reaching their decision, the District Council were no doubt strongly influenced by the hostility the proposal attracted from earth scientists in Britain and overseas. The applicant has six months from the date of refusal of planning permission in which to appeal against the decision, in which case a Public Inquiry will be held to determine the future of the site.

6. FIELD FACILITIES

The maintenance and improvement of Britain's stock of geological exposures in the interests of conservation is an important part of the Geology and Physiography Section's programme. Some sections are cleared to enable assessment by the Geological Conservation Review Unit or to facilitate research, but numerically the main field of activity is concerned with outcrops of educational value. By providing alternative exposures showing the same interest as a well-known 'classic' locality, for example, sites that are obscured by vegetation or small amounts of downwashed soil or talus can frequently be cleaned with hand tools. Where overburden is more of a problem, mechanical excavators are used. Occasionally, more specialised equipment and techniques are required. For example, quarry blasting was used to produce a clean rock face at Burrator Quarry in Devon (Earth Science Conservation 18, p.9). Again at Burrator Quarry, shot blasting was later used to remove the effects of weathering from the cleaned face in September 1982, some two years later.

Site clearance operations are carried out by hired contractors and are supervised by geologists from NCC. The means of clearance depends largely upon the volume of material to be removed, although other factors, such as site accessibility, have also to be taken into consideration. Sites that are obscured by vegetation or small amounts of downwashed soil or talus can frequently be cleaned with hand tools. Where overburden is more of a problem, mechanical excavators are used. Occasionally, more specialised equipment and techniques are required. For example, quarry blasting was used to produce a clean rock face at Burrator Quarry in Devon (Earth Science Conservation 18, p.9). Again at Burrator Quarry, shot blasting was later used to remove the effects of weathering from the cleaned face in September 1982, some two years later. The Geology and Physiography Section is aware of the need to monitor the condition of the exposures created as part of the site clearance programme. To this end, 105 of the 140 sites cleaned between 1976 and 1981 have recently been examined for signs of natural deterioration, fly-tipping and over-use by field parties. The survey is now complete and the results encouraging. Over-use by geologists does not appear to be a problem with any of the localities visited. Fly-tipping is limited to a very few sites. The main problems arise from the growth of vegetation and the accumulation of talus and downwashed soil, the latter being associated in particular with the weathering of clays, shales and poorly consolidated sediments. The majority of the exposures affected in this way could be readily and adequately restored by hand clearance. Only a very few sites, once cleared, require mechanical re-excavation.

The Section is not in a position to undertake routine maintenance of cleaned sites and seek to encourage schools, colleges, universities and geological societies to become actively involved with the upkeep of "adopted" sites in their own areas. Offers from anyone interested in taking an active part in maintaining, and improving, Britain's stock of geological field facilities would be welcomed by the Geology and Physiography Section at Foxhold House.

EAST MENDIP

The project in the East Mendip area, first outlined in Earth Science Conservation 17, p.24 and later in 19, p.11-12, is now nearing completion and should be finished in the autumn. Some sixty localities in the Frome - Shepton Mallet - Wells area have been identified and documented for inclusion in a projected guide. Of these, sixteen have been improved in 1982 as part of the site clearance programme and include Gunney Slade where clearance of a long disused and heavily overgrown quarry has revealed the landscape unconformity between the Carboniferous Quartzitic Sandstone Group and the overlying Triassic Dolomitic Conglomerate; Chilcompton Railway Cutting where a mechanical excavator stripped overburden to expose a section documented over a century ago by Woodward in which Dolomitic Conglomerate is faulted against folded Lower Lias Limestones and clays; and the 'Milton Lane Section' in Wells where hird...
PLATE 11. CHILCOMPTON RAILWAY CUTTING.

Over the years the walls of this disused cutting had become buried by many tons of talus; as part of NCC's East Mendip project this has now been removed by contractors so that this section, long lost to science, is now fully restored.

PLATE 12

Not all site clearance requires earth-moving machinery! Here volunteers maintain recently cleared exposures in first class condition with simple hand tools.

contractors with hand tools re-exposed a continuous sequence, first described in detail by Richardson in 1911, from the Keuper Marls, through the Rhaetic and White Lias, to the jamesoni Zone Lower Lias.

LIME CRAIG QUARRY, ABERFOYLE

The Geology and Physiography Section, between July and November 1982, assisted the Department of Geology, University of Glasgow, with their studies of the Highland Border Complex at Lime Craig Quarry, Aberfoyle, Central Scotland, through improving exposures by the use of earth moving equipment. The work took place in three phases. The first phase involved the turning over of quarry spoil to expose loose blocks of limestone. Selected blocks, after having been subjected to gentle etching, yielded a sparse fauna of silicified trilobites, brachiopods, gastropods, ostracods, pelmatozoan columnals and other organic material. The fauna is of Lower Arenig age with North American affinities which makes this part of the Highland Border complex younger than the adjacent Dalradian rocks. This contradicts recent assumptions that the Highland Border rocks belong to the Dalradian (mostly Cambrian) succession. The second and third phases involved the excavation of five new sections which exposed rocks of the Southern Highland Group (Dalradian) of Lower-Middle Cambrian age, pre-Arenig serpentinites and serpentinised limestones, limestones and conglomerates of the Lower Arenig Dounans Formation, sandstones, conglomerates and shales of the Lower Old Red Sandstone and a Carboniferous quartz-dolerite dyke. Further information can be obtained from Dr Gordon Curry, Department of Geology, University of Glasgow.

It is intended that a future phase of work at Lime Craig Quarry will establish it as a prime geological teaching locality, this role being in addition to its function as an internationally significant research site. Those wishing to visit the locality should first contact the Aberfoyle Office of the Forestry Commission (Telephone 0877 238 383). The Commission's help and co-operation throughout this project is gratefully acknowledged.

CYNWYD FOREST, CLWYD

In early December, a mechanical excavator was used to uncover a new section through Ordovician rocks yielding the richest and most diverse fauna of Rawtheyan (Ashgill) age so far discovered in Wales. With the kind co-operation of the Forestry Commission, officers of the Geological Conservation Review Unit undertook a detailed examination of the locality. The deposit yields brachiopods, gastropods, bryozoans, graptolites, cystoids, conulariids and trilobites, including a number of taxa previously unrecorded from Wales, in an exquisite state of preservation. In recent years the site has suffered from the depredations of over-zealous "amateur collectors", some of them intent on commercial gain. It has hitherto been impossible to ascertain the provenance of the valuable fossil material at the site. Excavation has now made it possible for the first time to relate fossil occurrences to stratigraphy and sedimentology. The fauna found here enables close correlation with the type-development of the Ashgill Series in the Cautley area of Cumbria.
UNIQUE FIND OF FOSSIL SHARKS IN TEMPORARY EXCAVATIONS NEAR GLASGOW.


During the summer of 1982, a major temporary excavation into basal Namurian shales was conducted by the Hunterian Museum, University of Glasgow with the material assistance of the Geological Conservation Review Unit and local NCC staff. The site, which lies in a housing estate at Bearsden, north-west of Glasgow, has now been landscaped and is to be marked by a permanent information plaque erected by Bearsden and Milngavie District Council. The object of this painstaking ‘quarrying’ operation was the systematic collection and conservation of in situ examples of marine sharks and the complementary fish fauna. The palaeoecological value of the deposit was enhanced by the finding of five genera of crustaceans and, in addition, an articulated shelly fauna. Samples of all classes were collected and the horizon of each recorded. Fluctuating salinity is reflected by changes in the fossil assemblages, present at different levels in the 6 m section. There is no previous British record of Namurian fishes in any semblance of completeness; thus their affinities, habitats and modes of life are little known. The finds at Bearsden have astounded specialists all over the world, for fish found there rate amongst the best in the world for their diversity and superior preservation. Palaeozoic shark systematics has been advanced by the first discovery of a complete bradyodont, an obscure class of shark, known until now almost exclusively from teeth. Among the Bearsden specimens, anacanthus sharks are well represented for the first time in Europe and new finds include a new species of Symmormium, which grew up to 2 m, and a species of the genus Stethacanthus, probably the finest example of a Palaeozoic shark yet found anywhere in the world. Other mature sharks, only a few centimetres in length, also occur and include a new species of Dinazea and a tiny mollusc-eating bradyodont. Of the more than twenty different fishes preserved at Bearsden, about half are palaeoniscids (early ray-finned fish), the majority being new species, and one being a representative of a new family. The crustaceans too are of considerable importance. Most are new species and all reveal superb morphological detail; their cuticle preservation is superior to that of the highly acclaimed Mazon Creek fauna of North America. In addition, allochthonous plant material occurs, including the only known uncrushed sample of Lepidophloios. The best of the remarkable material retrieved from Bearsden is presently being conserved at the Hunterian Museum where, in due course, it will go on permanent display.

NEWNHAM QUARRY, DURSLEY, GLOUCESTERSHIRE

As reported in Information Circular 11, (p.6), a Public Inquiry was held in 1976 into an appeal against a refusal of planning permission to tip at this site; permission for tipping was later granted on condition that an area for geological study in the south-west corner should remain free of tipped material. Unfortunately the tip operators failed to heed this requirement and infilled the south-western corner of the site. This came to the attention of NCC in 1979 and was reported to Stroud District Council, the local planning authority. The District Council found it necessary to take enforcement action against the tip operators before the south-western corner was re-excavated in 1982. Inspection of the re-excavated area by NCC staff indicated that further work was required to make the site fit for geological study. With the approval of the site owner, Mr R.S.J. Hill, work commenced in late 1982 and a manual clearance operation to be undertaken in early 1983 will complete the restoration. Most of the old quarry area is now infilled and will be returned to agricultural use in due course. Consequently Mr Hill has stipulated that intending visitors should obtain access to the conservation area from the lane behind the quarry, on the south side, which passes within a few metres of the quarry. Astile will be provided in the fence around the conservation area to give access and it is intended that notices will be installed to explain the interest of the site and safety precautions. Geologists wishing to visit the newly excavated quarry faces should write for permission to Mr R.S.J. Hill, 49 The Quarry, Dursley, Gloucestershire.

CARMARTHEN JELLYFISH

A previous number of Earth Science Conservation 15, p. 19 carried news of a new and confidential fossil locality in South Wales and of its scientific exploration. During December 1982, NCC, in collaboration with Dr J.C.W. Cope of University College, Swansea, undertook further excavations at the site. Already famous in a British context as the source of late Precambrian “soft-bodied” fossils, the locality has recently yielded very rare echinoderm specimens. December’s dig was designed to allow a systematic search for further specimens of these rare fossils. As the jelly-fish of Carmarthenshire and South Australia are conventionally accepted as being of very late Precambrian age, this extends the range of the phylum Echinodermata back beyond the presently established Cambrian examples and makes the Carmarthen specimens the world's earliest. Further news of these finds will appear in later numbers of Earth Science Conservation.

LOCH BORRALAN

The Loch Borralan complex, an assemblage of igneous rocks, whose mineralogy is unique in the British Isles and matched at less than a dozen localities worldwide, has recently been included in the GCR. Key parts of the complex are mantled by a thin layer of peat and this lack of exposure has long hindered the work of geologists anxious to study this poorly exposed, but highly controversial, rock mass. As part of its nationwide programme for rehabilitating rock exposures, the Geology and Physiography Section arranged for the Bad na h-Achlaise section to be improved so that some of these problems of interpretation could be resolved. The merits of the project were rapidly attested as a number of remarkable finds were soon made. Since Peach and Horne’s day, the Cambrian quartzites at this locality were thought to lie immediately above the Ben More Thrust, but the recent excavations revealed that pyroxene-bearing nepheline syenites comprising the western margin of the complex are intruded into the quartzites. The simplest interpretation of this relationship is that emplacement of the Loch Borralan...
complex took place before the main movement on the Ben More Thrust occurred. Dr. Ian Parsons from Aberdeen University, who has a long standing interest in the alkaline intrusions of the Assynt area, initially suggested that the work be carried out and is now investigating the new discoveries. An account of the venture has already appeared in the New Scientist and is the subject of a paper to be carried in the next issue of the Scottish Journal of Geology. Much of the ground underlain by the Loch Borralan complex is owned by the Forestry Commission and they intend to plant much of the area over the next few years. However, the Forestry Commission have shown a willingness to ensure that none of the critical localities or their access paths are planted. The co-operation of the Commission, both in allowing the NCC project and in taking heed of the needs of geological conservation, is gratefully acknowledged.

THE LYE STREAM, SHROPSHIRE

In Earth Science Conservation 19 (p.34), it was reported that, following excavation at this classic locality, a major study was being made of the newly exposed Lower Old Red Sandstone section. Work has continued during the past twelve months, and several new discoveries made. Probably most significant is the discovery of arthrodiras in the lower part of the section. This is the oldest reported occurrence from anywhere in the world of this group of fish, which were later to become important members of the Middle Devonian fresh-water faunas. Another exciting discovery is of the arthropod Kampecarinus, which is probably one of the oldest known myriopods. Even amongst the better known species, important new developments have resulted from this work. For instance, Mr Peter Tarrant has been able to make the first comprehensive reconstruction of the head-shield of the important zone fossil Traquairaspis symondsi, previous attempts having been hampered by more fragmentary material. All of the fossils found are being located with great accuracy and related to the individual channels in the sequence. From this, it is hoped to draw some conclusions about the original life assemblages. In September, the Ludlow Research Group visited the section as part of their excursion to the Welsh Borders. The meeting was arranged in order to examine possible stratotypes for the topmost stage of the Silurian System. The Lye Stream represents the best inland section for highest part of the Silurian in the area and clearly shows the boundary with the Devonian as developed in the Old Red Sandstone facies.

SHIPTON, OXFORDSHIRE

The historic Emslow Bridge and Bletchingdon Quarries were the sites of famous reptile finds in the 19th Century. Studies of local Middle Jurassic sections in this century have, however, centred on invertebrate faunas and stratigraphy. Part of the Geological Conservation Review study of fossil vertebrate localities has included a survey of the White Limestone - Forest Marble (Bathonian) reptiles at Emslow Bridge. In December, as part of this study, sections were excavated through the critical rock interval at Shipton Cement Works in that part of the quarry closest to the sections figured in the 19th and early 20th Centuries, particularly the *fimbrirato-waltoni* Beds. In addition to reptiles, the Bathonian strata of Oxfordshire have proved to be rich sources of fossil mammals - all Middle Jurassic mammals so far described are from Britain - and Shipton was regarded as a worthwhile prospect for the finding of further material. Accordingly, in parallel with the search for reptiles, a team of specialists under the leadership of Prof. Kenneth Kermack (University College, London) was invited to investigate promising clay horizons. Results of these investigations and the search for other macro- and micro­vertebrates will appear in later issues of this journal. NCC would like to thank Blue Circle Industries for allowing this investigation to take place.

TEMPLE GRAFTON, WARWICKSHIRE

The Lias localities of Warwickshire and adjoining counties have been famous for their fossil insects since the pioneering work of the Rev. P.B. Brodie. Many names, well known from museum collections, such as Binton, Strensham and Grafton can now no longer be located, largely due to subsequent infilling and degradation of the original pits. In March 1982, as part of the G C R Unit's review of palaeoentomological localities, one of Brodies' original collecting localities at Temple Grafton was re-excavated to provide a section through the lowest units of the Blue Lias, including the "Insect Beds". The excavations made possible new collections from this locality for the first time this century and the material obtained is now being studied by Dr P. Whalley and Mr E. Jarzembowski of the British Museum (Natural History) Entomology Department.

PUDDLEBROOK QUARRY, GLOUCESTERSHIRE

Puddlebrook Quarry is the only locality known to yield the famous Drybrook Sand­stone flora of Dinantian age, but for many years a rock-fall which obscured the plant bed has prevented collection. In September 1982, the site was excavated to re-expose the plant bed and to clean the section so that more detailed sedimentological observations could be made. The fresh plant material collected during these excavations is now being studied by Dr. Keith Allen of the University of Bristol and his research student, as part of a comprehensive review of the Dinantian floras of England and Wales.

MALVERN GEOLOGICAL TRAIL

Since publication of Earth Science Conservation 19 (pp 32-3), Gullet Quarry - one of the main localities on the Malvern Geological Teaching Trail - has been fenced in order that the upper bench of the quarry can be visited in comparative safety. Although the five main localities comprising the trail can be visited at present, the accompanying guide, which is being prepared by Dr. Bullard, will not be published until next year.

FYFIELD DOWN NNR, WILTSHIRE

In October 1982, NCC carried out a hand excavation of an inspection pit demonstrating a soil profile in the floor of Clatford Bottom as the exposures had become severely degraded. The pit forms part of the FYFIELD Down Geomorphological Trail set
Though once exposing a 4-metre section of Blisworth Limestone, the old faces of this quarry had long since lost their value to geological education and research.

An hour or so’s work by a JCB and the unique scientific interest of this locality is well on its way to serving geological science once more.

Since completion of a site cleaning project in February 1982, Thrapston Station Quarry now provides the only permanent section of the Cornbrash and Blisworth Clay in the East Midlands. Using a combination of machine and hand labour, a section from the Blisworth Limestone through the Blisworth Clay and Cornbrash into the Kellaway Beds has been established and will be of value both to teaching and research, especially as the site is well-placed to receive visitors from universities and schools in the Midlands. The site owner does not require to be approached over each individual visit to the site, but requests that visitors avoid the adjacent arable land and maintain the quarry in a tidy condition.

7. PUBLIC INQUIRIES

CAIRNGORM PUBLIC INQUIRY

Earth Science Conservation 19 (pp 18-19) carried a report on the Public Inquiry which had been held in Kingussie to consider an application by the Cairngorm Chairlift Company for planning permission to extend downhill skiing facilities within the northern corries of Cairngorm. The Secretary of State for Scotland’s decision was announced in December 1982.

The report of the Inquiry first considers the scientific, scenic and recreational importance of the site and its immediate surroundings and concludes them to be of outstanding importance. Secondly, consideration is given as to whether the proposed development would jeopardise the qualities on which that importance is based and concludes that the proposed development would have a significantly adverse affect on the application site and would be likely to reduce the value of the adjacent Cairngorm plateau, the proposed road construction in particular encouraging access to sensitive areas. Finally, the report considers whether the benefits of development would outweigh the costs and concludes that, since the very strong objections to the proposal must outweigh the undoubted benefits, the application should be refused. The Secretary of State confirmed that planning permission for the submitted scheme should not be granted. He agreed with the Reporter that the site of the proposed developments is of outstanding scientific, scenic and recreational importance, and accepted the Reporter’s conclusion that the scheme, as submitted, and the road extension in particular, would change the character of the site and diminish the qualities which are the basis of its importance beyond the measure which the benefits would justify.
boulders, occurs on the west side of Lurcher’s Gully. Vegetated forms occur on the east in the Caimgorms or elsewhere in Scotland.

49. Apart perhaps from solifluction sheets in Lurcher’s Gully, the geomorphological features of the application site need not be destroyed by the proposed development, but the landscape character of the area would be changed by the construction of chairlifts, ski tows, buildings, snow fences, roads and car parks.

50. The Nature Conservancy Council is preparing a Geological Conservation Review which will identify the most important geological and geomorphological localities in Britain, the safeguarding of which is essential for research and education in the earth sciences. The whole of the application site will be included in a Grade 1 Geological Conservation Review site.

It is clear from the reporter’s conclusions that he accepted all of the arguments being put forward by the Nature Conservancy Council on geomorphological grounds and that he considered them to be a matter of significance. As a result of the Secretary of State’s decision, the features of biological and geomorphological interest which appear within the site are no longer under threat.

COWTHICK QUARRY SSSI, NORTHAMPTONSHIRE

The bulk of the Nature Conservancy Council evidence to the Inquiry naturally related to biological matters, but a significant amount of the geomorphological evidence was presented by Dr D.E. Sugden of the Department of Geography at the University of Aberdeen and by Dr J.E. Gordon of the Geological Conservation Review Unit. As recorded in the report, Drs Sugden and Gordon established the following facts:

"46. The Cairngorms massif is one of the most outstanding localities in Britain for a spectacular range of landforms. It is the scale and total assemblage of features developed in a relatively compact area which makes the Cairngorms so remarkable.

47. Coire an t-Sneachda and Coire an Lochain are of geomorphological importance on account of their high cliffs, the classic arete which separates them, the massive and unique granite slab on the back wall of Coire an Lochain, the protalus rampart on the eastern side of Coire an t-Sneachda, and the boulder moraines on the floors of both corries. Apart from the granite slab and avalanche site in Coire an Lochain, none of the landforms in the northern corries is unique.

48. A very good example of a slope covered in gelification lobes, i.e. garlands of boulders, occurs on the west side of Lurcher’s Gully. Vegetated forms occur on the east side of the Gully and good examples of stepped solifluction sheets at the top of the Gully.

49. The geomorphological significance of the northern corries lies less in the individual landforms than in their location, the representativeness of the assemblage, ease of access, and scientific and educational importance. Taken with the adjacent plateau and the Glen More Basin, the area provides a key vertical transect through an assemblage of glacial, fluvioglacial and periglacial landforms, erosion surfaces and tors which is not duplicated in the Cairngorms or elsewhere in Scotland.

50. Apart perhaps from solifluction sheets in Lurcher’s Gully, the geomorphological features of the application site need not be destroyed by the proposed development, but the landscape character of the area would be changed by the construction of chairlifts, ski tows, buildings, snow fences, roads and car parks.

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COWTHICK QUARRY SSSI, NORTHAMPTONSHIRE
FOSSIL COLLECTING LICENCES AT CHARMOUTH, DORSET

The West Dorset District Council's proposal to make an Order under Section 18 of the Coast Protection Act 1949, to prohibit the removal (except by licence) of material from the cliffs within the parishes of Charmouth and Stanton St. Gabriel, was discussed in the preceding issue of this journal (Earth Science Conservation 19, p. 19). A public inquiry into the proposed Order was held in Bridport on April 27th and 28th 1982, and much geological evidence was presented. Perhaps not surprisingly, a good deal of controversy arose during the inquiry, principally as a result of the positions adopted. Both NCC and the Geological Society of London gave qualified support to the proposed Order, in so far as they did not oppose it as long as it was accompanied by a licensing system which would protect the needs of bona fide geologists. This was accepted by West Dorset District Council, who agreed to detailed proposals for a licensing scheme which were put forward by the Society.

The earlier background to the case is set out in Earth Science Conservation 19 and need not be repeated. By March 1982 it had become clear that the West Dorset District Council regarded some form of licensing of access to the site as essential, fully recognised the scientific and educational value of the site and did not wish to restrict unnecessarily the activities of bona fide geologists. By this stage it was clear that there were two possible courses of action. One was to seek to hold the status quo for as long as possible at risk of the District Council imposing restrictions framed without geological advice and to face the possibility of random prosecution of geological visitors by landowners. The other possibility was to attempt to arrive at some generally acceptable agreement. The contacts with the District Council suggested that the prospects for agreement were favourable and the need to devise a long-term solution also pointed to a policy of consultation rather than confrontation. During this time, NCC and the Geological Society and the Institution of Geologists (working in concert), drew up details of possible licensing schemes which would not significantly affect the activities of most geological visitors.

At the Inquiry, a joint case for NCC and the Geological Society of London was presented by an NCC geologist. The Society and NCC were agreed that they would not oppose the Order so long as a satisfactory licensing scheme, making full provision for the legitimate educational and research requirements of geologists, and not unnecessarily restrictive or administratively burdensome in character, was introduced. There were slight variations in the licensing proposals suggested by the NCC and the Society but these were not of any real importance. Significant extracts from the joint evidence are set out below:

"The apparent intent of the proposed Order is to establish some form of control over the geological activities taking place within the area. Whilst there is clearly a substantial amount of opposition to the proposal, both the NCC and the Geological Society are of the opinion that since many of the activities which are taking place at Charmouth lie on private land, and are taking place without the owner's consent, it would be irresponsible to condone further unauthorised activities of this nature. Therefore, neither the NCC nor the Society wish to oppose the Order as it stands, but instead wish to recommend a form of licensing which they would be able to accept, if it were incorporated within the operational format of the Order. It would clearly be wrong for geologists to seek to put themselves above the law by demanding free and open access to land without the consent of the landowner, and so the introduction of an easily operated licensing system has obvious advantages.

Both NCC and the Society agree that there should be no restrictions on the collection of loose material from the beach or from scree on the cliffs, providing that no tools (e.g. hammers etc.) are used to break up rock material in the process. This "collecting by hand" should require no licence.

Visitors' licences would be required for all parties and/or individuals visiting Charmouth Beach and would permit collection from the beach, scree and/or cliff. Equipment to be used would be restricted to hammers of not more than 1 kg (2 lb) weight and cold chisels of 0.5 kg (1 lb) weight. Licences would be available at no charge and would be available on per diem basis at any time, from a licence-issuing machine at Charmouth Beach. The leader of the party or individual would be required to collect a licence which would be required to be completed before proceeding to the beach, and then returned to a box on leaving the beach.

Research licences would be required by individual bona fide research workers and would be provided without charge by the District Council on application during working hours. Issue of such a licence, which is recommended for use by any individuals who will make either extended or regular visits to Charmouth Beach, would be made available free for periods of one year. Such licences would permit the use of hammers and cold chisels of any weight, crowbars and ladders for the purposes of collecting rock, fossil and mineral material.

Extraction licences, for which there would be a charge, would be required by any individual or group who wishes to carry out large scale extraction of rock, fossil or mineral from the beach, scree or cliffs, and/or wishes to use hammers or cold chisels of any weight, crowbars, picks, ladders, pneumatic or other mechanical excavating equipment or explosives. Extraction licences would require prior application, and full details of the proposed operation would be required at that time. The District Council reserves the right to monitor any such extraction and/or to require the holder of the licence to co-ordinate their activities with an appropriate scientist or scientific organisation.

In a letter to the Geological Society dated 20th April 1982, the West Dorset District Council confirmed that their Recreation and Amenities Committee were in broad agreement with the licensing system suggested in the Society's letter of 25th March 1982. If the evidence presented at this enquiry leads to the District Council, or the Secretary of State on
The chalk pit. An Ature Conservancy Council witness appeared for the District Council and gave evidence on the impact of the proposals upon the geological interest. Before the

should be considered - the Charmouth case fell into this category.

It is not, and never has been, NCC policy to seek to influence the activities of geologists through promoting the introduction of licensing schemes. Standard policy is to seek agreement with the owners of geological sites to ensure open access for geologists. Only where it is clear that all access to a particular site will otherwise be banned, will any kind of “licensing” agreement be considered - the Charmouth case fell into this category.

In the event, the Secretary of State ruled, in August 1982, that the Order should not be confirmed. In his report, the Inspector concluded that there was insufficient evidence to prove that the efforts of fossil collectors were having a significant impact on rates of cliff erosion, and on this ground recommended refusal of the Order. The Inspector commended the case put forward by NCC and the Geological Society, but considered that it did not warrant the making of the Order in these circumstances.

As a result of the decision, it is now likely that access to this important site will continue to be available. Geologists should, however, bear in mind that the owners of parts of the site may now consider taking action to prevent fossil collection from their land without permission. Should this occur, NCC will take whatever steps it can to solve the problems such action will cause.

**WEST HARNHAM CHALK PIT SSSI, WILTS**

In early 1982, a Public Inquiry at Salisbury heard an appeal against the refusal of Salisbury District Council to permit the development of a residential caravan site within the chalk pit. A Nature Conservancy Council witness appeared for the District Council and gave evidence on the impact of the proposals upon the geological interest. Before the

In June 1982, the Secretary of State for the Environment refused the appeal. Although the proposed caravan site development will not go ahead, the long-term future of the SSSI remains uncertain - there is nothing to stop the owner from making further planning applications. Although access to the site in the past seems to have been informal, it is now recommended that intending visitors should obtain consent from the owner, Mr E. Goodman, 1 Wey Meadows, Weybridge, Surrey.

**COLLYWELL BAY, TYNEMOUTH TO SEATON SLUICE SSSI, NORTHERN LEXCONS**

As reported in Earth Science Conservation 19 (p.24), a DoE Hearing was conducted in May 1982 into proposals by Blyth Valley Borough Council to extend coast protection works across the southern half of Collywell Bay, within the important Tynemouth to Seaton Sluice SSSI. At the hearing NCC were the sole objectors to the scheme and called Dr J.M. Jones of Newcastle University’s Geology Department to give evidence on the scientific interest of the cliff-section under threat. Dr Jones drew particular attention to the importance of a unique exposure of coal seams coked against a Tertiary dyke and described in detail the commercial applications of geological research undertaken here. Letters of support for NCC’s case were presented from staff of local schools and universities, emphasising the educational importance of this site. During early negotiations over this scheme, and during the hearing, the Borough Council put forward proposals for the incorporation in the scheme of geological inspection chambers which in theory might enable geologists to continue to study some of the features of interest. The geologists consulted by NCC, however, were of the unanimous opinion that the proposed chambers would be only a partial substitute for the present cliff-face and would be difficult to use for educational purposes. It would certainly be difficult to maintain rock-faces enclosed in this way and the proposed access arrangements, via a locked manhole and ladder, would probably deter a number of potential visitors. For these reasons the Borough Council’s proposal could not be accepted as was made clear at the hearing.

In his report, the DoE Inspector accepted that this coast-section was important for
geological study, but stated that in his view the safety of the public and protection of the property on the cliff-top must be paramount; he consequently approved the application for grant-aid for the coast defences. The Inspector however proposed that inspection chambers should be incorporated into the design to achieve the best available compromise. Since that decision was announced, the Borough Council have informed NCC that they would not pay the extra cost of including the inspection chambers. NCC have offered to grant-aid the scheme in respect of the inspection chambers but it is not yet clear whether the Borough Council will take up this offer and negotiations still continue.

WOODEATON QUARRY, OXFORDSHIRE

Woodeaton Quarry was first designated as a geological SSSI in 1975 and is well-known and well-used for geological education and research. Its faces expose a fine section through the Jurassic White Limestone Formation and, of particular significance, the Hampen Marls. This is the only good exposure of Hampen Marls, apart from the type-locality, and is of great value for analysis of Middle Jurassic depositional environments and palaeogeography. On 19th November 1982, a Local Inquiry was convened to hear an appeal against an enforcement notice served by Oxfordshire County Council on the owner and operator of this site. This enforcement action was taken by the County Council to stop the continued tipping of waste, despite a County Council ruling that such use was not permitted under the terms of an existing, long-standing planning permission. In view of the geological importance of the site, preparations were made for Section staff to appear at the Inquiry to support the County Council. However, shortly before the Inquiry convened, staff of the Section met the site owner and put forward a package of proposals which would conserve the three faces of the highest geological importance within the quarry; at the last moment the owner agreed to these proposals in full. Although, in these circumstances, it was unnecessary to attend the Inquiry, NCC put forward a written submission explaining their case and recording the agreement which, it was suggested, should be incorporated as planning conditions to give long-term security to the site, were the appeal to succeed.

TAW-TORRIDGE ESTUARY, DEVON

As reported in Earth Science Conservation 19 (pp 22 - 4), a Public Inquiry was held in 1981 to consider an appeal by a local gravel operator against refusal of planning permission for extraction within the Taw - Torridge Estuary. NCC were involved as that extraction could have an adverse effect upon the stability of the sand dune shoreline of Braunton Burrows NNR. The decision, announced in October 1982, upheld the appeal and awarded planning permission for extraction within the estuary for a further limited period.

DUNGENESS, KENT - LOCAL COUNTRYSIDE PLAN

As reported in Earth Science Conservation 19 (p. 22), a Public Inquiry was held on 15th December 1981 in Lydd to hear objections to Dungeness Local Countryside Plan. The Inspector reported on 29th January 1982 and the plan was finally adopted on 18th November 1982.
Over the past eight years, the owner of this SSSI, Mr. P.V.R. Sorensen, has been seeking to reopen West Mine as a show-mine. His proposals have been drawn up as a result of detailed discussions with many geologists and mine historians and have received widespread support amongst the geological community. During 1977 and 1978, Mr. Sorensen submitted three planning applications to Macclesfield Borough Council for permission to reopen the mine entrance and to erect a number of buildings; the first application was refused and the two subsequent applications were not determined. Mr. Sorensen appealed and a Public Inquiry was eventually held in Alderley Edge during March and April 1982. Mr. Sorensen proposed to re-excavate and reopen the original entrance to West Mine, which had been infilled during the 1960’s, and to construct buildings housing a public assembly area, a display area, staff rooms, changing rooms and storage. Only part of West Mine would be open to the public, who would be led along a specified route by professional guides, as in a show cave. Geologists wishing to undertake research or specialised educational projects, however, would have access to all parts of the mine.

Alderley Edge is regarded as the most important site in Britain for the study of non-ferrous mineralisation within sediments. Although West Mine is but one of several mines which remain accessible in the Alderley Edge area, it displays many features and mineral associations which cannot be seen elsewhere. The non-ferrous metallic ores occur at three different horizons within the Triassic Sherwood Sandstone Group: each horizon contains different associations of ores and sediments. The non-ferrous ores comprise principally copper minerals with lesser amounts of those of lead, manganese, cobalt, nickel and vanadium. Over thirty-eight mineral species have been recorded with unconfirmed records of several others, and there can be no doubt that the area yields the most diverse and abundant suite of such minerals in a stratiform occurrence known anywhere in Britain. The origins of the mineralisation are still not fully understood, although the subject has already been studied extensively. The genesis of ore-bearing sedimentary rocks is of great importance to mineralogists and economic geologists and is thus the topic of much current research, some of which is currently taking place at Alderley Edge.

The Nature Conservancy Council provided two witnesses at the Inquiry to support the applications. Mr. Sorensen’s proposals would ensure the long-term conservation of the site, would facilitate access, would maintain all parts of the mine in a safe condition and would promote geological education and research. There would also be significant indirect benefits to geological conservation over a much wider area, in that the mine would attract public interest away from other, over-used sites and thus reduce the visitor-induced pressures they experience and would also provide the public with a controlled, educationally-orientated opportunity to discover the relevance of geology and mineralogy to everyday life and to be shown the ethics and practices of geological conservation. The opening of a show-mine in an area well-known for its old mines would also promote safety, just as the opening of show caves in well-known cave areas has led directly to a fall in the accident rate. By this means untrained people can see what a cave is like without placing themselves at risk - the provision of a show mine should similarly lead to fewer people putting their lives at risk by entering old mine workings without proper equipment and knowledge.

In presenting this evidence, the Nature Conservancy Council were supported by many geologists with a research interest in the Alderley Edge area, many of whom are currently undertaking work on the Alderley Edge ores. There was, however, considerable opposition to the proposals from local residents and the local authority, mainly over the perceived increase in visitors to the area which a successful outcome to the appeals would occasion. There was also considerable concern over matters such as increased noise and inconvenience to local residents, together with difficulties in visitors reaching the site. The result of the appeals will be published in a future edition of this journal.
In June 1982, a Public Inquiry was held in Shrewsbury to hear objections and comments from the public. Staff of the Geology and Physiography Section appeared at the Inquiry to give evidence largely supporting that of the County Council. The Inquiry provided an opportunity to place on record the national and international scientific importance of Wenlock Edge as a classic site with enormous potential for geological education and research. The report of the Inspector is awaited and will be summarised in a future issue of Earth Science Conservation.

**CRAIGHEAD QUARRY SSSI, KYLE AND CARRICK**

The future of this internationally important Ordovician locality remains unresolved, in spite of strenuous activity by the Nature Conservancy Council (see Earth Science Conservation 17, p. 18; 18, p. 17 and 19, p. 20). As reported earlier, the Scottish Development Department refused Kyle and Carrick District Council consent to use the quarry for refuse disposal on scientific grounds and advised them to consult with the Conservancy and the Institute of Geological Sciences in an attempt to devise an alternative scheme which would fully protect the areas of the highest interest. These consultations failed as both NCC and IGS found that if the geological interest were to be adequately protected, no tipping could be allowed. Letters to this effect were sent to the Scottish Development Department by both NCC and IGS.

Since the last issue of this journal, the date for the Public Inquiry which will decide the future of Craighead Quarry has been fixed twice, only to be twice postponed at the request of the District Council. The Inquiry will now be called for a date early in March 1983, and the Nature Conservancy Council is putting the finishing touches to its preparations. NCC will oppose the District Council’s proposals in the strongest possible terms and will draw support for its case from eminent geologists from as far away as China and from learned societies and professional bodies including the Institution of Geologists, the Geological Society of London, the Geologists’ Association and the Palaeontographical Society. The case will be co-ordinated with those of other objectors, who include the Scottish Wildlife Trust, the owner of Craighead Quarry and a neighbouring farmer. Full details of the Inquiry will appear in the next issue of this journal.

One aspect which has given rise to some concern is the discovery that the owner of the quarry, who supports the conservation case, is unable to give any indication of levels of usage of the site since no-one has ever asked his consent to visit the locality. It would be most valuable if geologists who have visited Craighead Quarry could advise Dr K.L. Duff at Foxhold House of the frequency of their visits, the number of students per visit (if appropriate) and the particular reasons for the visits, (palaeontological, stratigraphic, sedimentological, etc). Should the District Council’s application to use the site for refuse disposal be refused, the owners of the site have indicated that they would be willing to discuss the possibility of developing the educational value of Craighead Quarry and such information would greatly forward these discussions.

**BARTON CLIFFS SSSI, HAMPSHIRE**

In July 1982, the New Forest District Council applied for planning permission to erect further coast protection works on the "Naish Farm Section" within the Barton-on-Sea Cliffs SSSI. The proposed works would stretch from Chewton Bunny eastwards to the existing Barton defences, along one of the two remaining undefended stretches of cliffs within the SSSI, and would obscure part of the international type section for the Bartonian Stage of the Eocene from bed A2 to about bed J.

The current proposals consist of three stone-filled strongpoints (similar to that already existing at Chewton Bunny) and a rock-filled revetment along the cliff toe, carrying a permanent access track. In addition, the beach in front of the revetment is to be renewed with imported shingle as required. The surface of the access track would lie about three metres above high water mark so that the lowermost three metres of the cliff would be permanently obscured. At this stage, no drainage or grading is proposed for the cliffs above and behind, except where "limited" grading might be necessary in order to protect the access track. The toe-works would be followed by drainage and grading works on the cliffs above the access track, "to be carried out only in areas which required such works, and not necessarily along the whole length". It is unclear whether the ultimate intent is to produce a cliffline which resembles that created by Christchurch Borough Council to the west of Chewton Bunny, although such a scheme must undoubtedly hold great attraction for the engineers.

On receipt of the proposals, NCC consulted widely with geologists known to have an interest in the Barton section and received over sixty responses; the vast majority opposed the proposed works because of their effects on the scientific interest of the site. Subsequently, at a series of meetings with New Forest District Council’s engineers, and with local councillors and residents, NCC geologists explained their position and investigated how the proposed scheme could be amended so that it would cause significantly less damage to the geological interest. These negotiations failed and NCC thus had no option but to register a formal objection to the proposed works.

By submitting the present proposal, the New Forest District Council has overturned its previous policy to allow erosion to continue along this stretch of coast until a stable natural position was reached - a policy recommended by the Council’s engineering consultants in the early 1970’s and maintained until relatively recently. Moreover, the land behind the cliffs which are the subject of the application carries no permanent development, the nearest permanent buildings being some eighty metres behind the cliff edge. As the rate of retreat is only one metre per annum, the scheme would seem to produce little immediate return. Where a chalet development occupies part of the cliff-top, it has already proved necessary to move individual chalets landwards to prevent their loss. The excision of this inconvenience is, however, felt to be little recompense when weighed against the destruction of a large part of the internationally significant Bartonian stratotype. Instead, NCC are of the opinion that both conservation and coast protection would be better served by taking no action at present other than to seek improved and novel methods of coast protection which are compatible with geological conservation (see pp. 19-21 above). In view of the long period which must elapse before permanent property is threatened, there would seem to be every opportunity to adopt this option.
The Nature Conservancy Council’s objection has been supported by Hampshire County Council, since the erection of coast defences would breach two of their structure plan policies, which specify that there shall be a general presumption against development which would adversely affect Sites of Special Scientific Interest. Should the application be approved by the New Forest District Council, there is every indication that the scheme would require grant-aid from the Department of the Environment and application for such aid would automatically lead to further consultations with NCC who would seek a Public Inquiry. Should this happen, NCC will contact all interested geologists to seek their views and support.

8. GEOLOGICAL CONSERVATION EXHIBIT

Full details of this exhibit, which is at present booked until the end of June 1984, appeared in Earth Science Conservation 15, pp 19-21. The current programme of showings is as follows:


Bookings for the period after June 1984 can now be taken, and prospective borrowers should contact Dr K. L. Duff at Foxhold House giving some indication of the dates they would like. The normal loan period is 4 - 6 weeks. A substantial descriptive prospectus and specimen worksheets, which enable school children to derive maximum benefit from the exhibit, are available.

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The following publications are currently available:

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- Staple Edge Geology Teaching Trail (1981) 60p
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- Salthill Quarry Geological Trail (1982) 75p

To be published in April 1983:

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Copies of Conservation and the Earth Sciences (1977) (15gm) and the more recent back numbers of Earth Science Conservation are available, from Foxhold House only, free of charge, on receipt of an appropriately stamped self-addressed envelope with your request. Weights of back numbers are: 19 - 70gm; 14 to 18 - 50gm each; No. 13 - 30gm; No. 12 - 35gm; No. 11 - 25gm.

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