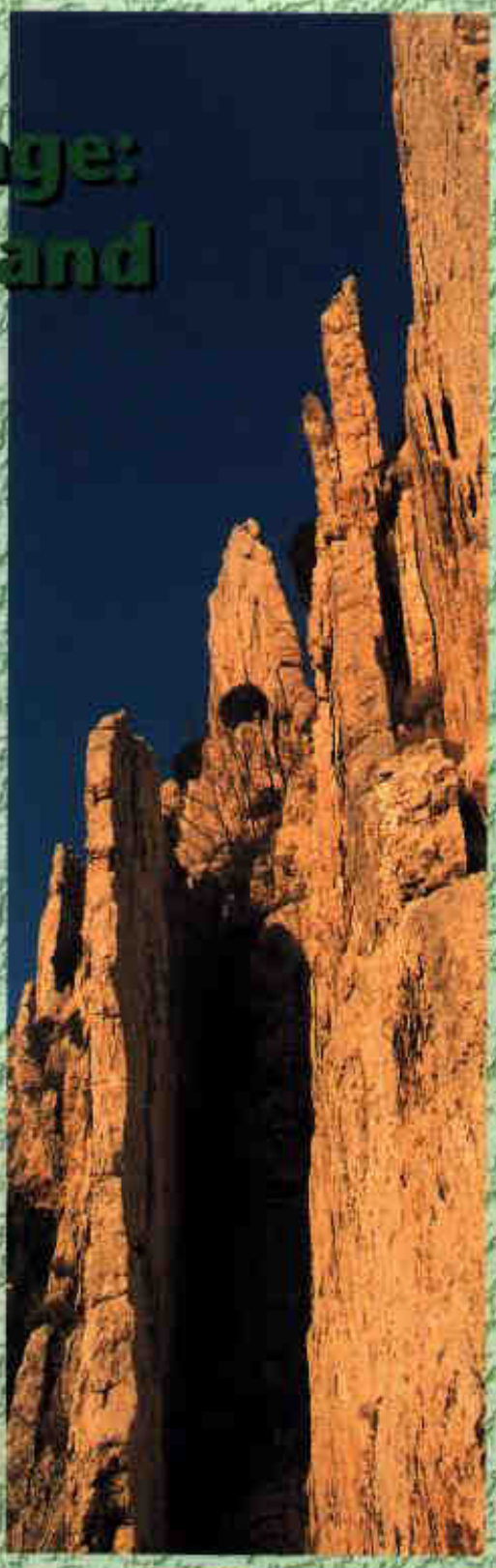
Geological Heritage: Its Conservation and Management



Editors:
D. Barettino
W. A. P. Wimbledon
E. Gallego

Sociedad Geológica de España (Comisión de Patrimonio Geológico)
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EUROPEAN 'GEOTOURISM' - GEOLOGICAL INTERPRETATION and GEOCONSERVATION PROMOTION for TOURISTS

Thomas A. Hose
Faculty of Leisure and Tourism, Buckinghamshire Chilterns University College,
Wellesbourne Campus, Kingshill Road, High Wycombe, HP13 5BB, UK (Email: those01@buckscol.ac.uk).

ON THE ROCKS IN EUROPE

A NEGLECTED HERITAGE

It is opportune at the close of the millennium to review geological interpretative provision within the continent at the forefront, and consequently with a long history, of geological discovery and innovation; the names of Europe's past geologists and its sites still prominently figure in today's literature. It is also timely to review techniques, and consider avoidable pitfalls, in the presentation of these sites, since: *"The public's opinion can be an effective support in the political arena, especially on the local level. However, the problem is that the general public like the politicians, etc. knows almost nothing about earth sciences. . . the geological education at schools is in most cases far from sufficient . . . Popularization . . . can be a great help to bring people in contact with earth-scientific aspects."*(Gonggrijp,1997,p.2946-2947). "Geologia" (the root of our modern "geology") was first used by Richard de Bury (Bishop of Durham from 1333 to 1345) in his ***Philobiblon*** and first widely published in Naples in Sessa's ***Geologia del Dottore*** of 1687. Europe's legacy of archaeological, historical and industrial sites and artefacts is widely recognised, valued, conserved and promoted as a tourism asset. In contrast, both ancient and recent industrial and mining landscapes have been virtually obliterated from the tourist gaze, by amenity landscaping ostensibly to safeguard the environment. They are sanitised into photogenic backdrops. Despite geology's contribution to the development and sustainment of past industrial and present post-modern Europe there is little public awareness of the richness, cultural significance and threats to that heritage; exemplars from the history of geology illustrate both the diversity of the resource base and its tourism potential.

A PUBLISHED HERITAGE

The beginnings of modern geology can be traced to the late sixteenth century; for example, the first British regional geology account is Owen's ***On the course of strata of coal and lime in Pembrokeshire*** of 1595. Seventeenth century observations included those of Steno and Scilla who recognised Malta's "tongue stones" as fossil sharks' teeth. Steno's 1646 visit to Malta helped him develop the

"principle of supersition". Scilla also recognised in Sicily the extent of former seas, as evidenced by the petrified remains of sea creatures he found well inland. Hooke, in 1668, suggested that fossil turtles found near London indicated a past warmer climate. Hobbs in ***The Earth Generated and Anatomized***, of about 1715, suggested that Genesis's days were much longer than present ones; he also noted that tilted strata were originally deposited horizontally. Concomitantly, Strachey recognised, but did not fully explain (that was left to Hutton), the unconformable nature of some geological boundaries. Lister, in 1684, presented to the Royal Society: "*. . . an ingenious proposal for a new sort of maps of countries, together with tables of sands and clays, such as are chiefly found in the north parts of England.*" and William "Strata" Smith met that challenge in 1815 with ***A delineation of the strata of England and Wales, with part of Scotland***. Buch produced his geological map of Germany in 1824 and also made detailed observations on the structure and formation of the Auvergne region of France. Economic geology was advanced in Germany with Werner's installation as 'professor' of mining at Freiburg; he introduced the first practical natural science instruction courses and geologic field excursion programmes. ***Kurze Klassifikation*** of 1787, a systematic study of rocks and minerals, is his enduring legacy. From observations at the Scheibenberg he propounded the 'neptunism' theory. Hutton, however, propounded the 'vulcanism' theory from a similar Scottish locality (Arthur's Seat, Edinburgh), and in his ***Theory of the Earth, with proofs and illustrations*** of 1795 fuelled half a century of heated debate. Europe was where much of the work on the relative dating of strata and the naming of geological systems was undertaken. Murchison and Sedgwick, working in Britain, completed much of the work; they founded in 1835 the Silurian and Cambrian (the Ordovician separating them was proposed by Lapworth in 1879), respectively, and jointly founded the Devonian in 1839. Murchison's 1845 ***The Geology of Russia and the Ural Mountains*** led to the recognition of the Permian. Conybeare and Phillips established the Carboniferous in 1822. In mainland Europe, Humboldt named in 1795 the Jurassic in Switzerland and d'Halloy the Cretaceous in France in 1822. The first purely scientific account of fossils was Woodward's ***A Catalogue of the additional English native fossils in the collection of J. Woodward M.D.*** of 1728; his collection, with some of Scilla's fossils, is in the Sedgwick Museum at Cambridge, where he endowed Britain's first university geology chair. Plot illustrated in his 1677 ***Natural History of Oxfordshire***, but did not recognise, Europe's first dinosaur bone. Some 150 years later, after it was lost, *Megalosaurus* became the first named dinosaur. This was overshadowed by Mantell's discoveries, from 1821, of *Iguanodon*; now displayed in The Natural History Museum, London. His 1825 Royal Society paper introduced the "Age of Reptiles", now commonly applied to the Jurassic. Cuvier in France was the first to scientifically analyse skeletal remains; recognising the "succession of life", he developed the catastrophism theory. The existence of giant, fearsome, prehistoric creatures was established by the first quarter of the eighteenth century and they featured in De la Beche's famous 1830 reconstruction of ancient life, ***Duria antiquior***. One of Europe's first attempts to accurately depict, although still Genesis-based, the geological past was Scheuchzer's ***Sacred Physics*** of 1731. Gesner's ***De Rerum Fossilium, Lapidum et Gemmeramum maxime figuris et similitudinibus liber*** of 1565 was the world's first illustrated geology book. Martin's 1809 ***Outline of an Attempt to Establish a Knowledge of Extraneous Fossils on Scientific Principles*** was probably the world's first introductory palaeontological textbook.

Arguably the most significant and influential geological textbook of all, at least in the nineteenth century, was Lyell's ***Principles of Geology*** (1830-1833); in print in various forms for some fifty years.

SELLING GEOLOGY

ALL TOO SCHOLARLY

Additionally, many of Europe's museums, libraries and universities house historically important geological specimens, papers and publications. The would-be geological interpreter clearly has a wealth of historic and site-based resources. Well-prepared and presented informational and interpretative materials at geological sites are good for generating public interest, enthusiasm, support and funds. But, with professional peer credibility focused on scholarly research and publications, and not populist materials, little of the wonderment of discovery and history is communicated to the public at most sites. Public indifference - except about dinosaurs, volcanoes and earthquakes - on geological matters, possibly due to the perceived unfamiliarity and complexity of its materials, ideas and terminology, compounds the situation. Such elements are in common with botany and might be due to societal changes caused by rapid technological advances: *" . . . driven by . . . a desire for greater speed . . . speeded up communication . . . produced people with nimbler brains, but reduced attention span. Botanists too must share some of the blame for the impression that plants are boring . . . They delight in obscure scientific terms . . ."*(Ennos,1998). The usual selections of scientifically important, but obscure sites (Hose,1997,Fig.1) for interpretative schemes also mask geology's intrinsic interest and broader societal benefits. Many displays emphasise discrete elements such as rocks, minerals and fossils instead of the holistic approach to past events and environments. They are really 3D textbooks, rich in jargon, obscure facts and remote events. They demand knowledge, understanding, skills and timeframes unavailable to most users. This might be due to an unfamiliarity with the nature of "site-specific geologic interpretation", which can be defined as: *"the revealing of meaning and value of a site by translating geology's technical and scientific language, data and concepts into meaningful commonplace facts, terms and ideas, based upon the experiences, knowledge and understanding of non-specialist persons"*. Personnel with little or no educational and interpretative training often construct displays on limited budgets. Attempts to update them employ the techniques and technologies associated with the mass media; these lack the authenticity of actual specimens and there is no evidence that they are more communicatively competent than traditional approaches.

BETWEEN A FOLLY AND A CENTRE

One of the first British informal geological attractions was Oatlands Park folly (near Weybridge) built between 1760 and 1778 (and demolished in 1948!) and adorned by mainly ammonite fossils, and encrusted with recent shells and real and artificial cave features such as stalagmites. Britain can also lay claim to having the world's first, albeit with laudable educational aims, geologic theme park of 1854; this had three-dimensional re-constructions of prehistoric animals and plants atop accurately

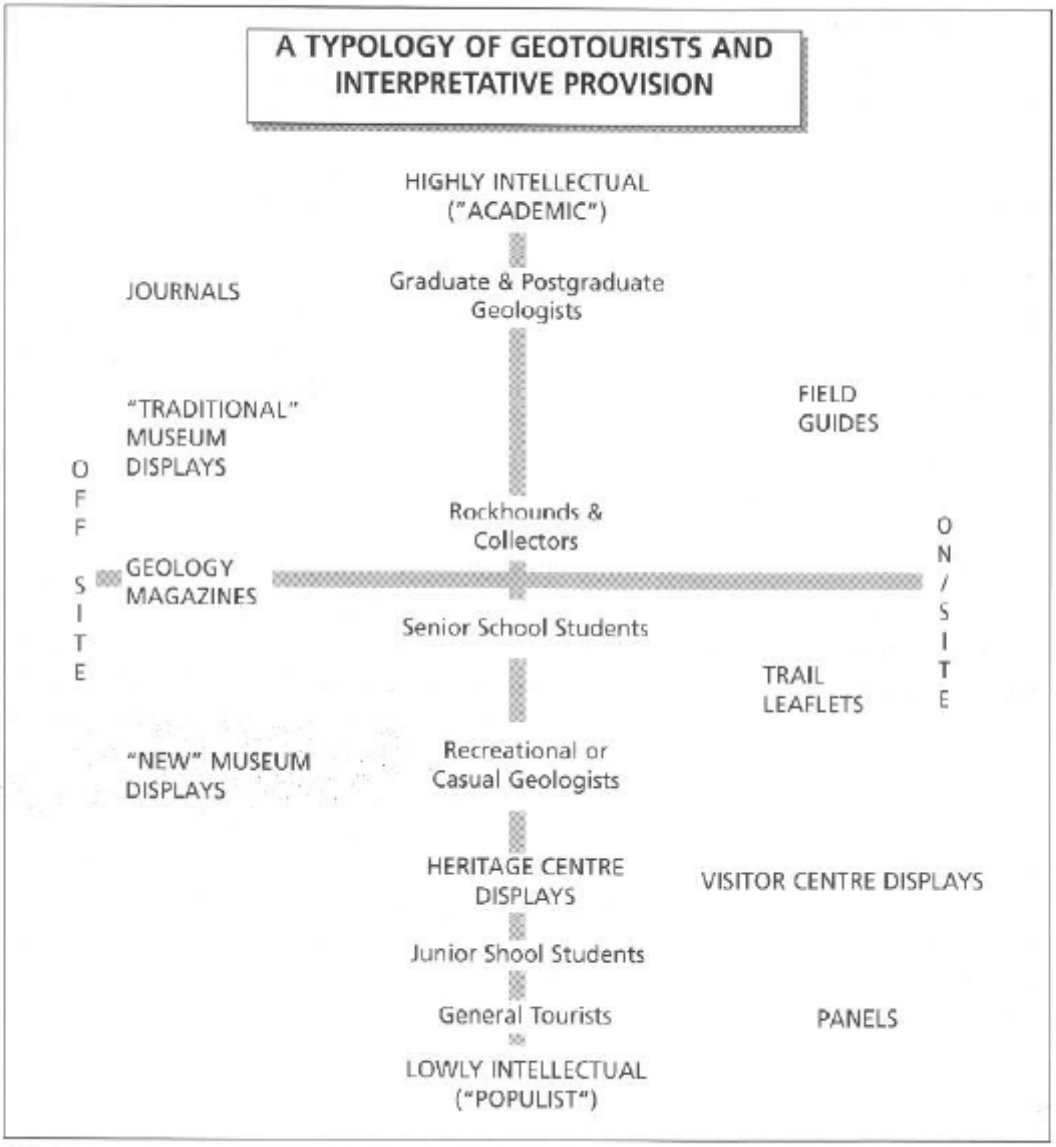


FIG. 1.

rendered stratigraphic sequences at the Crystal Palace, London. The first British public geological museum, of 1841, was that of the Geological Survey; it displayed useful minerals, stones and manufactured items such as metal castings. By the 1930s, after several removals, the exhibitions settled into 3D representations of the Survey's published Regional Guides and accounts of economic geology. The world's first, and surviving, urban geology trail, of 1881, at a Rochdale, Lancashire cemetery consists of thirty small rock pillars, set up with the intent of moral and spiritual uplift since the first is inscribed: *"In the beginning God created the Heaven and the Earth. The series of pillars commencing here with Lava and in ascending order, terminating with Boulder Stones, elucidates the arrangement of the strata of the Earth's crust in the order they were formed by the Creator. Of old hast thou lain the foundations of the earth."* The preservation and presentation of fossils *in situ* began in the late nineteenth century when two 'fossil forests' were preserved. The first is at Middlewood Hospital, Sheffield where a local geologist arranged in 1873 for protective sheds and public viewing by prior arrangement. The second, from 1887, is in Victoria Park, Glasgow and is probably the world's oldest geological visitor centre.

TRAILING ALONG VERSUS EXPERIENCES

After these promising initial developments little further innovation was achieved until the 1960s. Somewhat overtaken by North America, Europe continues to push the global geological community into the conservation, presentation and promotion of geology. The Mortimer Forest Geology Trail, Ludlow, completed in 1977, was the first purposely-established educational trail. A tourist centred trail, with much British design input, was opened in 1994 at Gerolstein, Germany. The provision from the 1980s of collecting facilities, such as at Writhlington near Bristol, from relocated spoil and other waste material is a user-friendly geoconservation measure which directly benefits the experience of the recreational geologist. Another aspect of interpretative provision, perhaps promotion focussed, is the affixing of informational commemorative plaques to either buildings or some geosite feature; for example at Ludford Corner, Ludlow on the founding of the Silurian. The oldest British geological memorial is that to "Strata" Smith, of 1891, at Churchill, Oxfordshire. From the late 1980s geology-focussed heritage and visitor centres opened in Britain such as the National Stone Centre and the Charmouth Heritage Coast Centre. Within Europe, for instance, there is the Puy Du Dome visitor centre, France and the Garrotxa Volcanic Park 'museum', Spain. Such centres provide a range of services such as exhibitions, talks and guided geologic walks. Meanwhile, a revolution has occurred in museum exhibitions. The keynote British event was the Geological Museum's 1973 multimedia *The Story of the Earth* - the first permanent exhibition to explore plate tectonics. It was followed by other attractive, but not so innovative, exhibitions such as *British Fossils* that adopted a traditional specimen-rich approach. These approaches culminated in the mid-1990s replacement exhibitions such as *The Power Within* (geology based) and *Restless Earth* (geomorphology based). A 1999 spectacular multimedia, and some would argue lacking the authenticity of specimens, exhibition is the Dynamic Earth centre, Edinburgh - supposedly celebrating Hutton's great text. There are similar examples of widespread multimedia usage in the USA; for example, the Devil's Canyon Science and Learning Centre, Fruita, Colorado. However, to a large extent these are overshadowed in Colorado and elsewhere by presented *in-situ* vertebrate fossils at spectacular sites such as Dinosaur National Monument Visitor Centre where their preparation can be witnessed. Again, a number of trails have been developed in classic dinosaur hunting territory, such as Rabbit Valley and Riggs Hill (site of the first *Brachiosaurus*, one of the world's largest dinosaurs) where panels and plaques direct the tourist to find spots. Economic geology sites are also interpreted; for example the Raven A1oil field at Rangely. During the 1990s British effort has been expended on the production of interpretative panels; the first of these, sponsored by English Nature, were at Hunstanton, Norfolk and Scarborough, Yorkshire in 1993. A unique 1992 presentational approach is the European Community of Stone, at Frome, Somerset; a henge of monumental stones representative of the geology of the then twelve member states and one of the few pan-European, EC funded, geological interpretative projects. In North America, and well before Europe, the potential of the mass media to promote and popularise geology was recognised in the 1950s. Probably the first of these, and radio-based, was WGBH(Boston)'s 1954 broadcast of an elementary geology course, with associated classroom teaching. The BBC eventually used a similar format in 1988. Geology has had greater coverage on North American and European television. The first British programmes were the one-off BBC productions *The Restless Earth* (1972)

and *The Weather Machine* (1974). The trend has continued up to the present with *Earth Story* (1998) and *Walking with Dinosaurs* (1999). All had accompanying populist books. There has been some crossover between television, video and digital media. Most recently the internet has been associated with such programmes and has also been used to distribute itineraries and 'virtual' field trips. However, an apposite caution is that whilst: *"Television programmes, museums, teachers in classrooms and videos at home all have a part to play, but experiencing something for real, in its natural place, with your own eyes, ears, nose and touch, has a lasting impact and a clarity which cannot be reproduced. More and more people have the opportunity to experience the countryside for real, more and more people want to experience real places."* (Barrow,1993,p.271).

PANEL BEATINGS

In examining trailside interpretative provision for tourists and like recreationalists it is informative to focus upon site panels, as these are the most suitable medium for unplanned casual usage. They can draw attention to a site and also focus usage within it. They are available throughout the day and all year to users and, for them, they are free! On-site panels and associated trails have the potential to actively involve users in the learning process and: *"Site information signs have the additional value of beneficially raising the public profile of the implementing sponsor by demonstrating a commitment to environmental and heritage issues"* (Page,1994,p.433). All geological trails and their media incorporate either 'Traditional' Geological Trailside Themes such as: a) Lithological - *description of rock units and types*; b) Stratigraphical - *the sequence of rocks and the implications*; c) Structural - *tectonic features and their implications*; d) Palaeontological or Mineralogical - *to admire, examine or collect* and/or 'User-Friendly' Geological Trailside Themes such as: a) The Unusual or Unique - *the oldest rock or fossil*; b) Internal forces - *faulting and folding*; c) Land-shaping Processes - *action of the sea, rivers, ice or volcanoes*; d) Environmental - *what life, the land and climate were like in the remote past*; e) Economic - *finding and exploiting mineral resources* and f) Historical - *the lives and work of geologists*. The former group is favoured by academic geologists and educationalists, the latter group by tourists and like recreationalists. The holistic is preferable to the dedicated geological approach. It is worth noting that those who 'consume' panels generally have different mindsets, past experiences, knowledge and understandings to those who prepare them.

HOOKED ON GRAPHICS

Published best-practice, observation studies and the author's research suggest that interpretative panels with high attracting and holding power, and apparently communicatively competent in terms of informational exchange, are characterised by being graphics-rich and text-poor, with much 'white space'. The ideal ratio of these elements is approximately 2:1:1. Graphics should not duplicate what the user can see, unless they either add explanation or engage them in focussed observation - revealing that which they would normally not notice. Photo-realistic graphics can beneficially affect their attracting power, but are difficult for people to recall and

identify their elements. Simple, one or two colour, graphics are more memorable. The selection of type to establish a text hierarchy is also significant in attracting or deterring potential users. The author's "rule of three" should be applied in the production of easily-read panels. There should be no more than three different typefaces, typeface embellishments or typeface sizes. Further, this can also be applied to text layout and content, in which there should be no more than three main blocks of text, body text hierarchies, or concepts, ideas and facts linking themes within a unifying storyline. Further, the style and vocabulary should be suitable for a reading and comprehension age of 13 years or less; this can be relatively easily gauged with one of the standard educational reading and comprehension tests in widespread use.

For communicative competence and cost-effectiveness, graphic elements (such as photographs and drawings) should not be used gratuitously: a few bold graphic elements are better than crowded graphics with numerous elements. Some common comparative scale should be given with drawings. Location maps and site plans require especial care, because at least two-thirds of the population have inadequate map skills; mere enlarged copies of topographic maps are unsuitable - much better are 'bird's eye' views. Graphics that have a strong seasonal bias should be avoided - the depiction of deciduous vegetation is an especial problem - since they might confuse the out-of-season user. The text content should provoke users' interest or curiosity by relating to their lives and experiences; it should also reveal a site's story as part of an overall theme, present information at an appropriate level and finally fire users' imaginations by imparting something of geology's fascination to them. The overall colour scheme should harmonise with the location and be appropriate for the specific environmental setting; for example, lighter colours and greater contrast should be used within gloomy settings. Panel shape is also an important design aesthetic and attracting power consideration. Oblong panels, in the ratio of 5:3 and 5:4, are more visually appealing than square or panoramic ones. Research has examined the relationship between panel graphical elements, holding and attracting powers and communicative competence. 'Holding power' is a measure of how long people view a panel and can be expressed as a range or a mean. However, it is not a measure of communicative success; viewers might spend much time at a panel because they are either confused or trying to read a difficult text and storyline; although most casual, rather than educational, viewers are not that persistent! Further:

$$\text{Attracting Power} = \frac{\text{Potential Number of Persons Viewing Panel}}{\text{Actual Number of Persons Viewing Panel}}$$

The ideal is to increase the expectation of reward and decrease the anticipated effort to obtain that reward through the use of competent typography:

$$\text{Likelihood of Selection} = \frac{\text{Expectation of Reward}}{\text{Effort Required}}$$

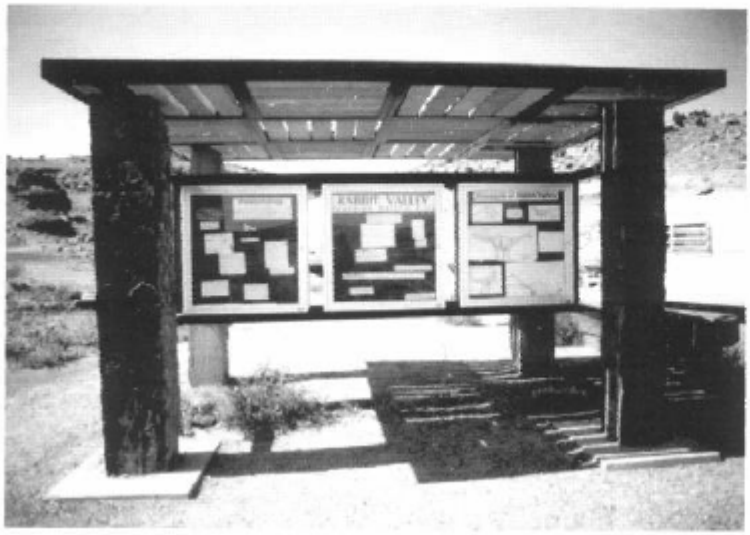
Expectation of reward can be promoted through the use of uncluttered or bold designs with limited text. Panel siting and location are also crucial to their effectiveness. They should be in well-illuminated areas and users should not be

expected to make unnatural detours; they should be at a comfortable viewing height and distance and they should neither obstruct paths nor create circulation bottlenecks. They should be in locations with existing high numbers of visitors. The author's research has shown that otherwise well-designed panels are ineffective because they are at locations with limited visitor throughput. Panels should be of a size, construction, materials and siting appropriate to the host environment and the likely number of users. Several small panels with little content are better than a single large one with much content; this enables several user groups to progress sequentially from one information set to another. When visitors pass a panel either without pausing to examine it or merely giving it a cursory glance, it suggests bad design, poor location and siting, and probably also too much competition from adjacent environmental elements.

FENCES TO PERGOLAS

Outdoor panels can be categorised on their "Primary Function". Examples: a) instructional or prohibitive - *"Do not collect!"*; b) informational - *"This rock is 3.8 billion years old"*; c) interpretative - *"This is the oldest rock in North America and was formed before there was any life"*. Although interpretation involves the imparting of some information, it is primarily concerned with evoking a response, by revealing significance, to the user that will encourage a positive attitude to the site. Outdoor panels can also be described or categorised on the basis of their "Basic Typography" (or layout): a) text only; b) graphics only; c) equal text and graphics; d) text-rich/graphics-poor, and e) graphics-rich/text-poor. They can also be described or categorised by their "Means of Support" (or presentation): a) fencing or walling; b) building elevation; c) rock face; d) post; e) banner post; f) table-top; g) lectern; h) footstool; i) plinth; j) stand; k) kiosk and l) pergola. Panels of an instructional type should be sited to defend vulnerable points. Panels, especially those of a general

RIGGS HILL, Colorado, USA: a kiosk-like structure in which the graphics were encased in window box panels, with pinboarding, mounted on sandstone slabs; note the (empty!) metal leaflet dispenser on the left. Clearly, even in this somewhat remote location, vandals have done their worst - none of the graphics were visible at the time of the visit. From this site was excavated the first Brachiosaurus (the largest known) dinosaur and a commemorative plaque records the event.



RABBIT VALLEY, Colorado, USA: a pergola structure with window box panels and pinboarding for temporary displays. It provides shelter and shade at the semi-arid site, which is a major dinosaur excavation and research site with a linear trail.

informational type, should be at nodes where people congregate: such as entrances, vehicle parking fee stations, public conveniences, and even around the walls of cafes. Of course, a common constraint on the location and siting of panels is that significant geological features, as well as viewpoints or access points, are fixed and cannot be changed.

GEOTOURISM and GEOCONSERVATION

GEOTOURISM AND GEOTOURISTS

Given that the content, design and presentation method of geological interpretative media greatly influence usage by tourists and other recreationalists, it is somewhat surprising that until quite recently virtually nothing had been done to gain an understanding of such media and their users. The author's research, framed within the evolving field of "geotourism", has addressed this shortcoming. This is partly focussed on the activities of persons termed "fossickers" in Australasia and "rockhounds" in North America. In Europe the somewhat disparaging label "amateur geologist" is employed; "recreational geologist" might be a better summary term. Meanwhile, "geotourism" and "geotourist" are rapidly passing into common usage, often in obscure confidential reports and proceedings, without widely accepted definitions. In Malaysia, the term "tourism geology" (along with undefined "geotourism") has been used for a new branch of applied geology that would: "*. . . support the growth of ecotourism . . . worldwide. This new approach will place conservation geology at the same level of importance as the widely recognized conservation biology and will push geology to the fore.*"(Komoo,1997,p.2973). Some authors are content to utilise the terms, due to an evident lack of dedicated research, either without or with vague definitions. Consequently "geotourism" becomes merely: *"travelling to experience geological sites"* or *"travelling in order to experience, learn from and enjoy our Earth heritage"* and as such divorced from geoconservation, the primary purpose in the author's original model for establishing such provision. The first widely published definition of 'geotourism' appeared in a professional interpretation magazine as: *"The provision of*

interpretive and service facilities to enable tourists to acquire knowledge and understanding of the geology and geomorphology of a site (including its contribution to the development of the Earth sciences) beyond the level of mere aesthetic appreciation."(Hose,1995,p.17). It evolved from a working definition adopted at the outset of a major research project, that included some English panels, in which the theme of 'site-specific geological interpretation': *"The promotion and explanation to a non-specialist audience of the geologic features and/or significance of a delimited area by either a fixed facility and/or populist publication."*(Hose,1994,p.2) was explored. The research, following the author's fieldwork with school parties especially and his recognition of the dramatic loss of British fieldwork sites, developed as a vehicle to add value and significance to geological features and sites rapidly being lost through ignorance and neglect.

The terms require substantial revision and it might now be best to regard: "geotourism" as the: *"provision of interpretative facilities and services to promote the value and societal benefit of geologic and geomorphologic sites and their materials, and ensure their conservation, for the use of students, tourists and other recreationalists"*. Whilst, "dedicated geotourists" are: *"individuals who purposefully select to visit geological and geomorphological sites and exhibits for the purpose of personal educational or intellectual improvement and enjoyment"*, and, finally, "casual geotourists" are: *"individuals who visit geological and geomorphological sites and exhibits primarily for the purpose of pleasure and some limited intellectual stimulation"*. These definitions re-emphasise the educational usage and essential geoconservation component of such provision. Further, they indicate that geotourism includes an examination and understanding of the physical basis of geological (and geomorphological) sites. It is also clear that it encompasses the life, work, publications, notes and artwork, correspondence, diaries, collections, workplace, residences and even the final resting places of Earth scientists.

At the participant level, it is about "recreational geology". As such, even in northern Europe, it is generally not limited by the seasons; the herbaceous deciduous vegetation layers die back, making it easier to find and see rocks and landforms, in the short Autumn and Winter months. Importantly, these are the times when geotourists are unlikely to negatively impact upon bioconservation. It could markedly extend the tourism season in suitable, especially coastal, areas. Clearly, such a strategy depends for its success upon the identification and conservation of its resource-base, a knowledge and understanding of its user-base and the development and promotion of effective interpretative materials. It could generate public and political support and funding for the upkeep of sites and collections, when many governments' geoconservation measures are either compromised by a shortage of funds or paralysed by a lack of political will.

THE CORE CHALLENGE

Geoconservation in Britain has acquired added credibility with the renaming of the Geological Society of London's Geological Conservation Committee as the GeoConservation Commission - a forum to: *". . . promote the conservation of Earth heritage and to ensure that we pass it on in good order to future generations for*

investigation, education *and* ***enjoyment***". It clearly has some crossover with geotourism. It can be defined as: *ithe dynamic preservation and maintenance of geological and geomorphological sites, together with collections of specimens, materials and documents*" and is somewhat interchangeable with the terms "Earth heritage conservation", "Earth science conservation" and "geological (site) conservation". It implies an evolving flexible approach rather than preservation in some notional fixed state. It is about preventing damage or loss whilst maintaining both intellectual and physical access. Sustainable geotourism is based upon controlled site husbandry and professional collections' management. Much of the value of geological sites lies in the availability of, and access to, specimens and the appearance of fresh rock exposures; they actually benefit from limited disturbance, such as cleaning and plant clearance, but not over-collecting. Geotourists must be encouraged, rather than hammering *in situ* rocks, to collect loose material, sketch and take photographs. The challenge is to promote geotourism without destroying its resource-base. Fortunately, there is no evidence that recreational geologists cause much, if any, damage to sites. The most visible damage to the photogenic exposures of fieldguides is by those professionals ignoring geological codes of practice and inadequately supervising students; wanton rock coring is a particular aesthetic problem.

TO KNOW THEM IS TO . . .

An initial geotourist typology (Hose,1999) based upon primary site usage linked to interpretative provision has been further developed (Fig.1). "General tourists" are attracted to sites by display panels and associated trails and wander from one attractive element to another until they become intellectually overloaded or bored. They, similar to "junior school students", also like to examine displays. "Recreational or casual geologists" like nothing better than to admire the view and collect from the surrounding rocks, whilst "rock-hounds and collectors" turn over spoil heaps. "Senior school students" and "graduate and postgraduate students" similarly like collecting from spoil heaps and visiting quarries; they often make much use of academic fieldguides and journal articles to track down suitable sites. Generally, most educational groups have adequate provision; for many interpretative schemes it is erroneously assumed, or over-estimated, that they will be the market. However, it is likely that in the future tourists and day-visitors, especially as generators of funds and goodwill, will be a major part of the market of geotourism provision. Knowledge of whom visits, and why, geologic attractions should facilitate better-focussed provision. What do me know of adult visitors usually:

- most are casual arrivals - many visits are unplanned or 'accidental';
- most lack basic geologic fieldwork and outdoor recreation competence - they cannot 'read' maps;
- most are over 30 years of age and arrive with partners or small family groups in which the children are under 14 years - satisfying their perceived educational needs is the motivation for the adults' visitation;
- most are of average reading ability - at least half have a reading age of under 13 years;

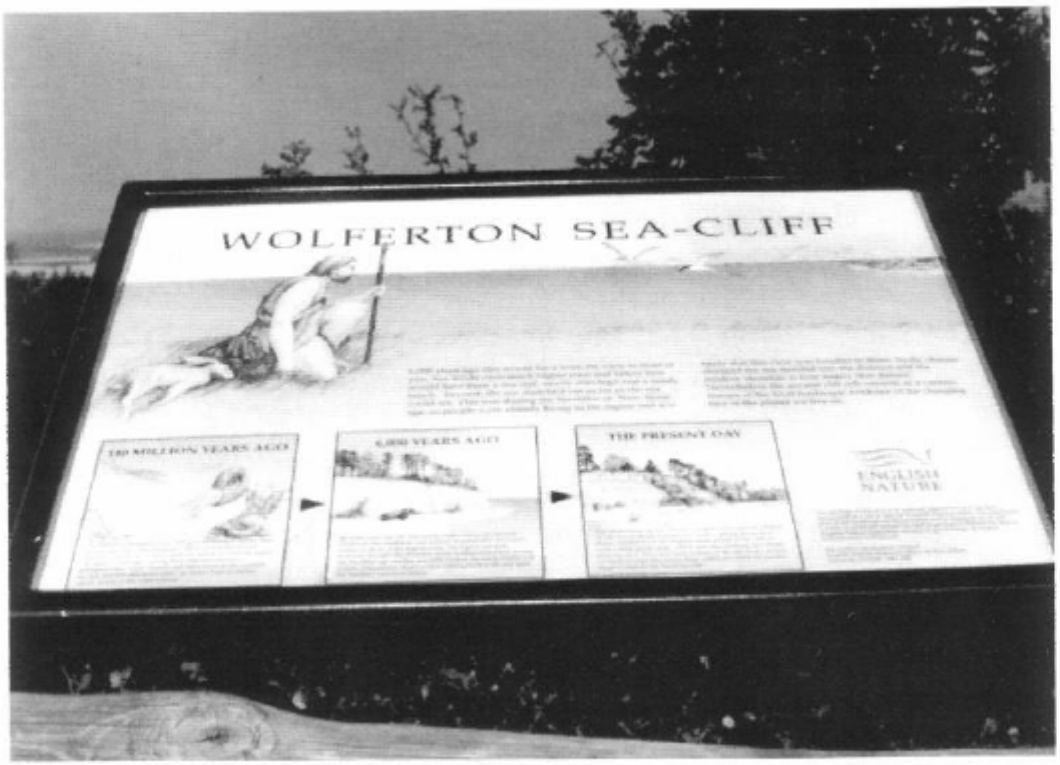
- most are of average educational attainment - most have had the minimal of schooling;
- most lack understanding of geoconservation issues - one-quarter have a limited understanding;
- most are inadequately equipped, especially in their footwear, for outdoor activities;
- most stay within about 400 metres of their vehicles - personal and vehicle security is an issue;
- most view panels for about a minute - three-quarters ignore or pay scant attention to them!
- most view geological interpretative panels least when they are in competition with other subject matter;
- most express some, often much, appreciation of interpretation - 'hands-on' facilities are especially liked;
- most enjoy guided walks and accompanied field excursions - for the 'opportunity to ask an expert'.

They are willing to pay an entry fee to geological attractions - but much less than for a theme park -. Their purchases are usually limited to inexpensive souvenir items such as postcards, pencils and the like, rather than books. Useful as these observations are in developing overall interpretative briefs, they merely scratch the surface of understanding the communicative interaction of site visitors with interpretative media. There is still little real knowledge and understanding of the effects of interpretative media design on cognition, informational exchange, emotive response and behavioural modification. Much of what is considered as best practice in interpretative design has yet to be empirically tested or proven!

GEOLOGICAL INTERPRETATIVE PROVISION CONSIDERED

BESIDE THE SEASIDE

Examples of communicatively competent, in terms of informational exchange, geologic panels highlight what can be achieved through adherence to best practice. At Wolferton, Norfolk (U.K.) a lectern panel literally describes the viewpoint of Neolithic people and employs everyday language: *"6000 years ago this would have been the view in front of you. Sea-levels were much higher then and below here would have been a sea cliff, nearly 20m high and a sandy beach - beyond the sea stretched out as far as the eye could see. This was during the Neolithic or 'New Stone' age, as people were already living in the region, and it is likely that this view was familiar to them. As the climate changed, the sea receded into the distance and the modern shoreline is now nearly 2km distant. Nevertheless, the ancient cliff still remains as a curious feature of the local landscape, evidence of the changing face of the planet we live on."* But, it is in a little visited location and its cost-effectiveness and usefulness must be questionable. At Charmouth, Dorset a new (1998) graphics-rich plinth panel employs roundels, which reduce the need for text, to outline fossil collecting. The communicative competence of many other panels is questionable and



WOLFERTON, Norfolk, UK: a graphics rich fibreglass laminate panel in a wooden lectern mount outlining the pre-historic viewpoint from above an old sea cliff. It is a little visited location.

alternative schemes are advisable. The text-rich plinth panel at Portesham Quarry, Dorset is at a neglected location where: *"The limestones range from Portland Stone at the base of the quarry through to beds of the Lulworth Formation (Lower Purbeck). They date from the Upper Jurassic Period and are approximately 145 million years old. The limestones form a prominent east-west ridge with the older Kimmeridge Clays*

CHARMOUTH, Dorset, UK: a panel in which the text has been reduced and graphic roundels focus on specific points of interest. It is at one of England's most prolific and important fossil locations.

forming the low ground to the south once occupied by the old Abbotsbury branch railway. The beds dip into the hillside (northwards) forming the northern limb of the Weymouth anticline. The equivalent beds on the other side of the anticline make up the Isle of Portland." However, the real significance of the quarry is mentioned in a small text box with reproduction line drawing: *"In Aubrey Strachan's 1898 memoir "The geology of the Isle of Purbeck and Weymouth", an illustration of a "tufa enclosing a silicified tree trunk" is shown. A copy of that illustration is shown above. The text describes it as the "calcareous envelope of a prostrate trunk found on the lower Dirt Bed . . . 15 feet (4.6m) long and 3 feet (0.91m) in diameter at its thickest part. The cavity which had originally been occupied by the trunk still retained fragments of silicified wood." This large fossil sheath of algal tufa can still be seen in the western extension of the quarry."* It also employs a photo-realistic graphic, a geological section and an extract of a detailed topographic map, together with an account of the site's industrial archaeology. Sadly, the opportunity to mention that *"You are standing on a spot where giant cycad forests overlooked by distant*

PORTESHAM QUARRY, Dorset, UK: a text-rich fibreglass laminate panel inset within a concrete capping atop a solidly constructed, from limestone blocks, plinth. It is at a little-visited private location.

rumbling volcanoes, browsed by great herds of dinosaurs, grew about 135 million years ago – a real Jurassic Park!" was overwhelmed by material even the dedicated geotourist would find dull! A new (1998) graphics-rich plinth panel at Cleeve Common, Cheltenham is visually overloaded by the inclusion of line drawings of local fossils and a rock section 'unreadable' by most casual users; a fifth of the panel's space is also allocated to the sponsors. From a mid-1990s text-rich plinth panel at Tout Quarry, Isle of Portland comes: *"The rocks that make up Portland are Upper Jurassic in origin, formed from sediments deposited in layers at the bottom of ancient lagoons and seas. The upper layers (The Lower Purbeck Beds) date from approx 125 million years ago when there was a low partially submerged coastline and vast swamp over the South of England. The Lower Layers containing the prized building stone (The Portland Beds) date from approx 135 million years ago and are of marine origin indicating that the area was part of a shallowub-tropical sea."* A text that, with a 17+ year-old's reading age, would not be out of place in a textbook! From a banner panel near Malvern comes: *"600 million years BC. Watch out! The restless Earth brings volcanoes to the Malverns. Molten rock rises up from deep within the Earth in great lava flows and ash clouds, some of it exploding into the sea and onto the islands that were here – just like more recent eruptions at Mt. Pelee in the Caribbean or Mt. Pinatubo in the Phillipines."* Which in itself is fine, even if the examples are obscure to non-specialists, but it continues: *"Lava and granites originally formed as hot molten rock, were thrust up toward the surface by great forces in the Earth. Once there, these rocks formed the high Malvern ridge. For the rest of this story the ridge will always be here, as an underwater reef or a line of hills."* Overall, the text (of which there is far too much) conveys some of the drama of past events and it is supported by appropriate line graphics.

Readability analyses of most panels indicates an age of 17+ years and that there is little or no attempt to involve and engage the user. They are essentially informational with content irrelevant to the recreationalist and too technical even for the dedicated geotourist.

ON TOP OF OLD SMOKEY

From a large, graphically bold banner panel at a roadside parking area in the Auvergne, France comes the somewhat technical: *"Approximately 2 million years ago there appeared magmas that were so viscous they could not flow out of the sides of craters but formed domes; externally they kept their diameter as 'pistons of lava' which made vertical constructions - in the case of La Roche Teuliere in several places and in the case of La Roche Sanadoire one place. They are made of a grey trachyte called 'phonolite' because of the way this rock sounds when struck by a hammer. It is found as tiles and flat stones commonly made from the cooled material as it recovered from the torture . . . produced by the plastic distortion and the friction of magma centres. The prismatic structure . . . is bound to the network of the shrinkage cracks during cooling of the lava (like a pool of mud dries up in the Sun). In general, columns or organ pipes orientate themselves perpendicular to cooling surfaces of the chimney or contacts with colder lava. The rocks . . . belong to the volcanic Ajguiltier Massif of which the period of volcanic activity was spread between 2.2 and 1.9 million years. This volcano was partly covered by a glacier."* Somehow, the drama of

La ROCHE SANADOIRE, Auvergne, France: a large, solidly-constructed banner panel with bold graphics, but rich in textual explanation. However, its orientation places the viewers' backs to the scene! Also, its supports are a dominant architectural feature within the rural landscape

(admittedly underground) volcanic activity is lost in this text! Again, the use of everyday adjectives would have helped. From one of several panels along a trail in the remains of a quarried Auvergne volcano is the quite well written, if unexciting and informational: *"The piling up of the deposits which you can easily notice here helps to briefly reconstitute the history of Puy de Lemptegy. Three of the deposits are linked with three important volcanic periods: (1) a fissural eruption with numerous vents that probably occurred 70000 to 60000 years ago(?) (2) The edification of the scoria's cone . . . some 30000 years ago and, finally, (3) the explosive eruption of . . . 9000 years ago."* but, some of the vocabulary is suspect!

HAMMERUNTERWIESENTHAL, Saxony, Germany: a text-only, roofed post sign in a large limestone quarry on the 'silver road' trail route.

From Hammerunterwiesenthal, Germany, a text-only, trailside post-sign describes, with much irrelevant detail, the large limestone quarry where: *"Kossmat (a geologist from*

Saxony) proved in 1915 that the limestone and the surrounding crystalline rocks (mica schists) were folded and metamorphosed at high temperatures and pressures. The metamorphism greatly altered the original rocks (deep sea sediments). The limestone . . . is crystalline, very dense, solid and in parts mixed with mica. Limestone from Hammerunterwiesenthal can be compared chemically with the limestone in Thuringia and also the Island of Rugen, but it is however, considerably older." It lacks any sense of drama and an indication of the site's rich and interesting structure and minerals. There is little value in the comparative information for visitors.

From a mixed text and graphics, panel at the Scheibenberg: *"The basalt rock is of volcanic origin and rests on gravels and sands which came from an ancient river, which before the uplift of the Erzegebirge filled a broad, flat valley - into which subsequently, in the Tertiary period, masses of lava flowed. The place where these erupted has not been ascertained . . . Out of the cooled and solidified lava were formed about 24 million years ago the basalt pillars, which on the northern side have a thickness of almost 3 metres and a height of 30 to 40 metres. As the six-sided columns are resting only on sand, they are called 'rootless'. The exposures of the 'Organ Pipes' . . . took place through quarrying. . ."* This text covers too many uninteresting points. Considering its status as Germany's most significant geo-historic site its neglect of the human-interest that fuelled fifty years of polarised argument and revealed the fallibility of geologists is lamentable. A picture of Werner and copy of a contemporary illustration could better establish the site's historic associations and also emphasise its cultural significance.

SCHEIBENBERG, Saxony, Germany: a roofed banner-type, text-rich panel; note the 'organ pipes' in the quarried cliff. Probably Germany's most important Geohistoric site, evidence from which led to Werner's development of the 'neptunism' theory to explain the origin of rocks such as basalt

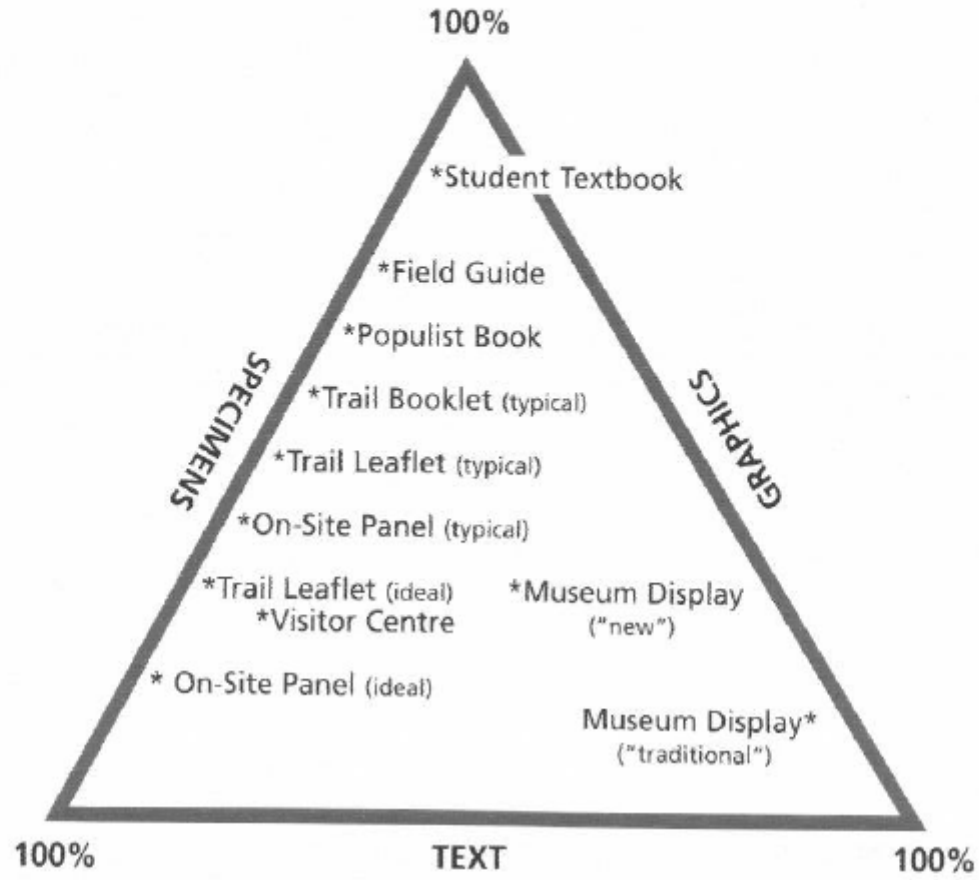


FIG. 2.

AND FINALLY

AN EMBARRASSING LEGACY

It might seem churlish to criticise existing provision, but there is much to be gained for geoconservation if it leads to the widespread adoption of interpretative approaches which are communicatively competent. Research indicates greater attention must be paid to the vocabulary, style and informational content of displays, panels and publications. Their relative specimen, graphical and textual content has been analysed and a general model developed of typical and ideal media (Fig.2). Too many are prepared with either an inadequate appreciation or total ignorance of visitor types, needs and behaviour. Their message is often complex, confused and irrelevant to visitors' experiences. Writers of geological texts must select appropriate storylines, informational and oral language content so that they present geology in an interesting and lively manner to casual users. Unfortunately, panel mountings are so solidly and expensively constructed that replacement in the near future is unlikely. Poorly designed panels are an embarrassing legacy to the whole geological community. They result from the failure to undertake adequate visitor studies, employ geologically knowledgeable populist copywriters and experienced designers, coupled

with the overriding desire of many conservation and sponsoring agencies to rush in and express their territoriality in order to secure credibility and funding in the competitive leisure-time marketplace. Perhaps, too there has been an over-emphasis on dedicated provision such as panels, trails and associated publications. At many locations interpretative provision could better be provided on an informal and non-dedicated basis; for example, at roadside parking areas, in cafes and at refreshment kiosks. Further, it might well be that the provision of permanent and semi-permanent interpretative media is neither the most cost effective nor communicatively competent vehicle for interpretative provision. Guided walks and personal interaction with geologists (even good graduate students) as docents might better develop an interest in Earth heritage amongst tourists and like recreationalists. To achieve communicative success and conservation effectiveness, interpretative provision needs to be widespread and appropriate to host site and culture.

ON THE HOUSE

Present European geotourism provision is spatially and thematically fragmented. It lacks a coherent 'house style', a necessary pre-requisite to acquiring a recognisable identity. Further, due to a mismatch between informational content and users' perceptions, knowledge and understanding, its communicative effectiveness is limited. However, there is much that can be done quickly, even by the relatively inexperienced geological interpreter, to address these shortcomings. Modern WP and DTP software packages usually incorporate quite sophisticated grammar, stylistic, reading and comprehension level tools; of course, they cannot eradicate jargon, obscure examples and ill-conceived storylines! A cost-effective means of preparing on-site interpretative provision is the production of general informational panels on topics such as folding, faulting, fossilisation, historical geology, stratigraphy and vulcanology, usable at a range of sites, supplemented with interpretative site-specific panels. Recent quality advances and cost reductions in digital imaging and printing systems, coupled with simple, inexpensive thermal-laminating systems, could be exploited to enable the rapid turnaround and updating of semi-permanent panels. These panels should conform to a unified colour, illustrative and typographic scheme. Such a coherent and recognisable 'house style' could readily attain pan-European access on electronic templates (distributed on diskette/CD-ROM or via the internet). Readily recognisable geotourism provision requires the acceptance of a pan-European interpretative 'house style' by the many and various national agencies and the establishment of a central co-ordinating body to oversee the preparation of: a) web-based virtual field guides and information sites; b) on-site panels; c) development of a programme of guided site visits in popular tourist areas; d) way-marked trails for walkers, cyclists and motorists; e) new exposures, loose and spoil-tip material for limited 'souvenir' collecting; f) revamped and new museum, library, heritage centre and even café-located displays. A pan-European integrated geotourism and geoconservation strategy really is necessary to protect the remaining legacy of important and interesting sites from sheer neglect, infilling, development and restorative environmental works.

Finally:" . . . *there has been a growing interest among those organizations and individuals who manage countryside and heritage resources in communicating with*

the increasing 'market' of visitors. This desire to communicate has come either from a need to attract people (and their money) or from a deep-seated feeling that people should know about this place, they should understand it and care about it. ***Conservation education is important."*** (Barrow,1993,p.271).

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