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Author(s): Cleal, C. J.

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Table 1. Habitats of Red-tipped Cudweed (*Filago lutescens*) in Britain compiled from records. Repeated records from the same site are not included. 114 records (43% of all historic records) have no habitat noted.

Habitat	*Number (and %) of pre-1990 records*	*Number (%) post-1990 records*
Fields or arable	65 (43%)	4 (29%)
Roadsides, lanes, paths, tracks	24 (16%)	3 (21%)
Gravel and sand pits	12 (8%)	2 (14%)
Commons and heathland	12 (8%)	1 (7%)
Sandy or gravelly ground	12 (8%)	1 (7%)
Fallow or stubble fields	7 (5%)	1 (7%)
Railways	6 (4%)	1 (7%)
Gardens	3 (2%)	
Woods (presumably on tracks)	2 (1%)	
Chalk pit	2 (1%)	
Meadow	1 (0.7%)	
Clay pit	1 (0.7%)	
Golf links	1 (0.7%)	
Rubbish tip	1 (0.7%)	
Market garden	1 (0.7%)	1 (7%)

Table 2. Number of records of Small Cow-wheat (*Melampyrum sylvaticum*) and Pyramidal Bugle (*Ajuga pyramidalis*) in herbaria in the Scarce Plants database compared with the total number in each herbarium.

	Small Cow-wheat		*Pyramidal Bugle*	
	No. records in scarce database	*No. records in herbarium*	*No. records in scarce database*	*No. records in herbarium*
BM	2	51	24	26
BRISTM	—	9	—	3
E	3	35	9	23
GL	1	5	—	3
GLAM	—	6	—	1
K	—	21	—	6
LIV	—	15	—	5
MANCH	—	10	—	9
OXF	—	15	1	6

Biostratigraphy and the Biological Curator

Christopher J. Cleal

Department of Biodiversity and Biological Systematics, National Museums and Galleries of Wales.

Introduction

In an ideal world, this paper would be irrelevant to most readers of this journal. Palaeontological collections would be under the care of a qualified Earth science curator, who would be familiar with the background and needs of biostratigraphy. However, we are not in such a world and there are many museums with palaeontological collections where the curator has a mainly biological background. Fossils are of course the remains of once living objects and so do not entirely fall outside of the remit of the life sciences. The reasons for curating a specimen of, say, a dinosaur fossil do not really differ significantly from why we curate a specimen of a modern lizard. However, biostratigraphy is an aspect of palaeontology for which curation plays a slightly different role and which will be briefly discussed in this paper.

What is biostratigraphy?

In biostratigraphy, the distribution of fossil species is used to correlate sequences of rock. The idea is that the species alive at any one place will change with time, through the effects of evolution. At a simplistic level, if a unit of rock in one locality contains the same suite of species as another unit of rock elsewhere, the two units are probably of about the same age. In practice, the exercise is rather more involved than this as environment can obviously significantly influence the composition of faunas and floras, and environmental change will often occur at different times in different places.

The normal practice is to establish the vertical stratigraphical ranges of the species through a rock sequence and to establish patterns, particularly in their appearances and disappearances. Using this pattern, the sequence is divided into units called Zones, which are usually named after one of the characteristic species. By comparing the sequence of zones between different areas, it is possible to establish what are called homotaxial correlations. These are not strictly time-correlations, as many different factors can affect the distribution of zones. However, by a judicious choice of species on which to base the zones, and by comparing homotaxial correlations between different groups of fossils and even with abiotic changes, such biostratigraphy can approach time correlation with a reasonable degree of confidence. It must be remembered that the resolution of time on a geological scale is coarse on a human time-frame; a few thousand years here or there is usually of little importance. Further discussions on the general background to biostratigraphy can be found in Doyle et al. (1994) and Cleal (in press).

The factual basis of biostratigraphy

Such a biostratigraphical model is clearly dependent on a vast array of identifications of fossils at different stratigraphical horizons. When data such as these are presented in a published form, it is obviously impossible to illustrate all of the specimens that have been studied. Usually all that is provided are lists and/or tables of species names. This would be all well and good if the taxonomy of the fossils was stable. But, in many groups, including my own of palaeobotany, the taxonomy is anything but stable and species have a habit of splitting or lumping or changing name, as more is learnt about them.

One option is of course to go back and re-collect from the original sites that were studied, but this is not always possible. Many sites are temporary exposures, such as quarries, which are often seized on by local authorities as waste-fill sites. Even natural exposures are not always immune from destruction; coastal cliffs can be covered as part of coastal defence work, and river sections flooded by damming. Much biostratigraphical data comes from borehole cores, which can be re-drilled, but the cost is normally prohibitive.

Particularly when dealing with the older literature, it is vital that the original specimens are re-examined, as this is the only way of checking what the biostratigrapher was meaning when he or she used a name in a list. This is where the museum comes into its own. The collections stored in museums are normally the only link between a biostratigraphical model and the palaeontological reality on which it is based. It may mean large collections of such fossils need to be kept, which might make for practical problems, especially within smaller institutions. However, without these specimens, the entire biostratigraphical model loses its credibility.

Case histories — the David Davies and Emily Dix collections of plant fossils

David Davies was an agent and then colliery manager in South Wales during the early part of the 20th century (Thomas, 1986). His occupation gave him an almost unrivalled opportunity to collect vast numbers of plant fossils from the coalfield, which he did for much of his working life. His collection, which he donated to the National Museum of Wales, consisted of some 30,000 specimens and provides a magnificent record of the vegetational changes that took place in South Wales during the Westphalian Epoch (about 315-306 million years ago).

The plant biostratigraphy of the South Wales coalfield had been studied by several geologists and was widely recognized to be the most complete sequence of floras of this age from anywhere in Europe or North America. However, most studies had been based on relatively small collections and several outstanding problems remained, in particular the age of the topmost part of the sequence. These topmost rocks are mostly very poorly exposed and the opportunity to collect new material was limited. Emily Dix, who was a young palaeobotanist in the later years of Davies' life, had suggested that these beds were younger than the Westphalian, extending into the succeeding Stephanian Epoch (Dix 1934), but most geologists dismissed her conclusions partly because she did not have that many specimens for these upper beds.

Dix was aware of Davies' collection and mentioned part of it in her 1934 paper, but she did not refer to his material from the topmost beds in the succession, which was far more abundant than her own. However, when this problem was being re-examined in the middle 1970s, the evidence from the Davies collection was incorporated (Cleal 1978). At that time, large parts of the collection were still wrapped in newspaper and stored in old shoe boxes, but every specimen was carefully labelled, localized and numbered (it should be made clear that the collection has now been re-housed and is stored in Cardiff under excellent conditions!). The c. 10,000 specimens from the upper beds provided exactly what was needed. The key index species were indeed in the uppermost beds, confirming that Dix was correct: the topmost beds are Stephanian in age. The collection in fact allowed a total revision of the biozonal classification for the rocks of this age, a scheme which has since been widely used in Europe and North America (Cleal, 1978, 1984; Zodrow & Cleal, 1985; Wagner & Alvarez-Vázquez, 1991). Without the stewardship by the National Museum of Wales of Davies' extensive collection, our understanding of the vegetational changes occurring at that time, and of the exact dating of the South Wales Coal Measures, would have been significantly poorer.

It is not just large collections that can be important to biostratigraphy, though. An example where just a single specimen played a vital role in unravelling a biostratigraphical problem relates again to the work of Emily Dix. Although initially interested in the South Wales Coal Measures, she later extend her interests to the English Midlands. The problem here is that the top part of the sequence consists of red-beds that are very poor in fossils. Nevertheless, Dix and her colleagues did find some rare examples, which she briefly recorded in a short paper (Dix 1935). One of the species that she recorded was particularly important *(O. cf. schlotheimii* Brongniart) as it suggested that these rocks were in fact Permian rather than Late Carboniferous in age. If this was correct, it implied that there was probably a major break in the sequence of rocks, which in turn suggested a major bout of uplift and mountain-building (tectonics). This would have major consequences for understanding the geological evolution of this part of Britain, with a knock-on effect on the wider geological evolution of northern Europe.

These specimens were never figured. The situation became worse when Dix fell ill with a debilitating mental disorder, which prematurely terminated her career at the end of the 1940s. Her collection, which was then housed at Bedford College in London, was partly dispersed. Nevertheless, Dix's identification repeatedly found its way into the literature as justifying the very young age for these beds in Warwickshire.

A search was made for this specimen in the early 1990s, including the NMW, but with no success. The problem was then pursued through the pages of the Geological Curator, the journal of the Geological Curators' Group. In their 'Lost and Found' section, where such problems can be aired, a request was made for any information on this material. This elicited a letter from John Faithfull of the Hunterian Museum to the effect that they had discovered at least some of the specimens in question. Although their catalogue had been checked during the initial trawl for information, these specimens had been kept in the Hunterian Museum's secondary stores and so had not been included in their catalogue.

When examined, this specimen proved to have nothing to do with *O. schlotheimii,* but was probably a fragment of *Odontopteris cantabrica* Wagner frond, a species poorly known in Dix's day, but now known to occur rarely in the basal Stephanian of Britain, Spain and Nova Scotia. Without the stewardship of this material by the Hunterian, a vital piece of the story of the geological evolution of Britain would have remained an enigma. The specimen in question is undoubtedly poorly preserved and might not be deemed to have much scientific merit. It is however identifiable and when put in its proper biostratigraphical context, provides a vital clue to this problem.

Concluding remarks

Museums play an essential role to play in most aspects of the Natural Sciences, but are especially important in biostratigraphy. As it is still the best means of correlating sedimentary rocks, biostratigraphy is central to the development of our understanding of the geological evolution of the planet. It also plays a vital role in many aspects of economic geology, such as exploration for resources such as oil, coal and gas. The more biologically orientated palaeontology studies normally include photographs of the key specimens. Such images are obviously not the same as the actual specimen, but at least they provide some direct insight into what a palaeontologist is describing and interpreting. Biostratigraphers in contrast usually only have published lists of identifications to work with, which on their own are not enough. They must be able to check the original specimens to confirm their identification, and whose conservation by Museums is therefore crucial.

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A National Strategy for UK Systematic Biology Research

The UK Systematics Forum

Systematic biology, the comparative study of living and fossil organisms, underpins all other natural sciences. It is commonly accepted as being fundamental to the conservation of biodiversity, sustainable development and areas such as pest control, food production and health.

Systematics research is carried out at a large number and wide variety of institutions around the UK, including national, local authority and university museums, botanic gardens and zoos, culture collections, research institutes and universities, and it is funded by a correspondingly wide range of bodies. The structure and organisation of the community is such that a coordinated approach is not easily achieved. A national strategy for systematic biology research aims to strengthen UK systematics by demonstrating its importance and by establishing a community-wide commitment to working in collaboration and co-operating at policy level.

The UK Systematics Forum was set up in 1994 as part of the Government's response to the House of Lords' report on Systematic Biology Research[1]. It was initially funded with the broad aim of promoting coordination and communication between the major collections holding institutions and the wider systematics community. In 1996, the Forum was awarded funding for a further period to develop the national strategy.

Aims and objectives of a national strategy

A national strategy for systematic biology research will help to:

- reaffirm the primary value of systematic biology research
- ensure that users' future needs are met effectively
- promote best possible use of available resources
- enhance co-operation and collaboration between institutions
- strengthen the case for funding
- create a powerful voice for UK systematics

As in many areas of public spending, resources are limited. The strategy therefore needs to demonstrate what the systematics community is doing to ensure that the best possible use is being made of existing resources as well as showing clear priorities for where new funding should be directed. By increasing collaboration between institutions and presenting a clear case for what additional resources could achieve, the strategy will help strengthen the case for funding and for systematics.

The national strategy document will set out:

- what systematics is and why it is needed;

1 Systematic Biology Research, HL Paper 22-I, HMSO, 1992.