

The British butterfly collection at The Manchester Museum

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ABSTRACT

Information on the Manchester Museum holding of British butterflies is presented and access to it is made available. Almost all of the collection has been provided over a period of 200 years by donations from private collectors. We discuss the dates, the pattern of collecting and evidence the material holds of changing attitudes and perceived uses of private collections.

Keywords: Lepidoptera, Rhopalocera, Manchester, museum collections

INTRODUCTION

There was interest in the British butterfly fauna by the beginning of the 18th century (Ford 1945; Marren 2019). Illustrations in the book Moses Harris prepared for the ‘worthy and ingenious Society of Aurelians’ (Harris 1766) show that by mid-century the practice of collecting was well established (Fig. 1). In the 19th century it was a pursuit, not just for aristocratic gentlemen and ladies but also for scientists, men of affairs and country parsons. Notable collections such as those of Walter Rothschild, Lord Walsingham and the Rev. Frederick William Hope now reside respectively in the Natural History Museum and the Oxford University Museum of Natural History. Many British municipal museums house more modest collections. In addition, and perhaps surprisingly, the newly industrialized cities saw the development of artisan natural history societies and collectors (Cash 1873; Percy 1991). Often there was a competitive element. New sites were sought and long series of rarities were assembled, possibly at the risk of extinction in some cases (Salmon 2000; Thomas & Lewington 2016). There was also a market in specimens, with professional dealers and a dedicated auction house, Stevens’ in Covent Garden, London. Sometimes unprincipled dealers passed off European specimens as British to enhance their monetary value (Salmon 2000). As long as there have been collectors there have been common or vernacular names for all the British species (Marren 2019). These have been remarkably stable throughout, whereas generic names have been subject to change due to taxonomic revision. For the most part, common names will be used here.

THE COLLECTION

The Manchester Museum, which is part of the University of Manchester, is believed to hold the third largest collection of insects in the British Isles, after those in London and Oxford (Logunov 2010). Accumulated over 200 years the butterflies were donated by private individuals, keepers and curators, with occasional additions from other sources. In 2010 it was decided to put the bulk of the British Lepidoptera, which was in miscellaneous, original cabinets, together in new standard pest-safe



Fig. 1. — Illustration from Moses Harris, 1766, *The Aurelian*. A gentleman rests in a wood with open specimen boxes. In the distance another wields a two-handed sweep net. The quotation provides a proper motivation.



Fig. 2. — The Sidebotham cabinet and one of the drawers.

steel cabinets (a move supported by a 2015 grant from the Arts Council PRISM Fund). Apart from the main Museum collection there are three exceptions which, for one reason or another, are kept separately. They are, (1) The Sidebotham collection of butterflies and macro-moths, donated to the Museum in 1919 and retained in its original cabinet as an example of 19th century presentation (Fig. 2, and see Cook & Logunov 2016), (2) a large number of papered specimens donated by Professor R.L.H. Dennis, which are stored in their own boxes, and (3) a series of specimens provided by Dr W.R. Wooff (1929–2006). They are mounted on cards covered in protective film (Dockery & Logunov 2018).

There are, in addition, 114 specimens of 70 British butterfly species in the permanent Museum's display 'Nature's Library'. Displayed in a sealed case, they have been inaccessible for our project. Apart from these and the Sidebotham collection, the material is now listed together, comprising over 12,000 individuals. Most specimens in the museum collection are pinned adults, spread in the conventional manner. A few are pinned with their ventral surfaces showing or folded with one forewing (sometimes only partially evident) and one hindwing on view, while a number of Dennis specimens remain in small polythene bags as collected in the field. In addition, there is a very small number of mounted eggs, larvae and pupae. The collectors have almost always thought of their material as representative of the British fauna. Where labels identify place of origin, however, it is seen that a few specimens come from Europe or even further afield but are species that could occur in Britain. In the counts that have been made all these categories are included together as representative of the efforts of the donors.

There is a wide range in the number of adults of each species, from three specimens of Berger's Clouded yellow (all of which could be British), to 1328 Meadow browns. The number of butterfly species represented in the collection is 69. This is one more than the number of British species noted by South (1906), and includes some rare migrants such as the Camberwell beauty (*Nymphalis antiopa*). Ford (1945) lists 69 species, adding the Monarch (*Danaus plexippus*) to the list of South. Thomas and Lewington (2016) give a chapter to each of 72 butterflies, some of which are infrequently seen, such as the Monarch and the Long-tailed blue. The website of Butterfly Conservation (2020, @savebutterflies) lists 59 species, of which 57 are listed as residents and 2 are regular migrants, the Painted lady (*Vanessa cardui*) and Clouded yellow (*Colias croceus*). Their website also lists 5 extinctions that have occurred in the last 150 years, viz. Mazarine blue, Large tortoiseshell, Black-veined white, Large copper and Large blue, though the latter was successfully re-introduced in 1992 with stock from Sweden (Thomas, 1980, 1995, 1999; Asher *et al.* 2001). The website of the UK Butterfly Monitoring Scheme (UKBMS, 2020) lists 71 species found in Britain and Ireland of which 59 are regularly recorded (56 residents and 3 regular migrants, namely, the Painted lady, Red admiral and Clouded yellow. The Manchester Museum main collection therefore contains the current active list of 69 species plus vagrants or extinctions that have occurred since the 19th century.

Labels attached to specimens provide a record of origin and collector. This may, but does not always, include the day, month and year of capture, who collected it and the place of collection, allowing the Ordnance Survey six figure grid references to be provided (see Anon, 1987). Some have one or more items missing; identified as 'unknown' or indicated as '?'. A substantial number are unlabelled and recorded as such.

Species are ordered in the new drawers following the *Checklist of the Lepidoptera of the British Isles* (Agassiz, Beavan & Heckford 2013). A few changes of generic name have been proposed since then (Wiemers *et al.*, 2018). Recording of the information on the collection was completed by December 2019 and the results compiled to an Excel file. A copy can be obtained through a Manchester Museum website: <https://entomologymanchester.wordpress.com/data-sets/>

The information will soon also be made available for the National Biodiversity Network (NBN).

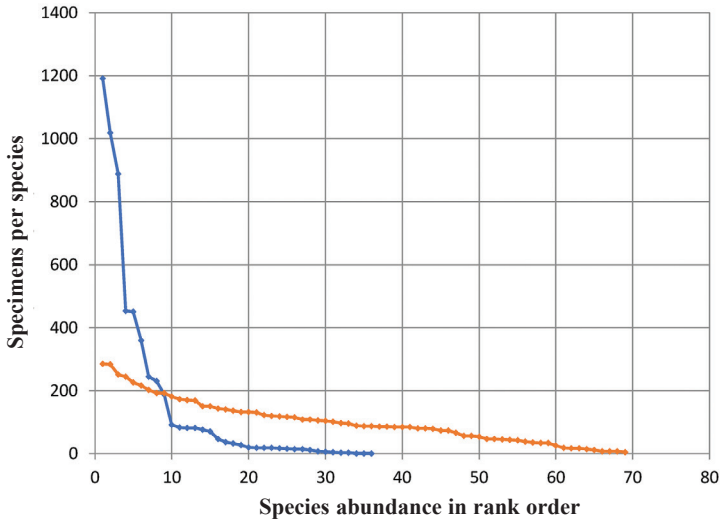


Fig. 3. — Rank order of species abundance in the main collection (red) and the Dennis component (blue).

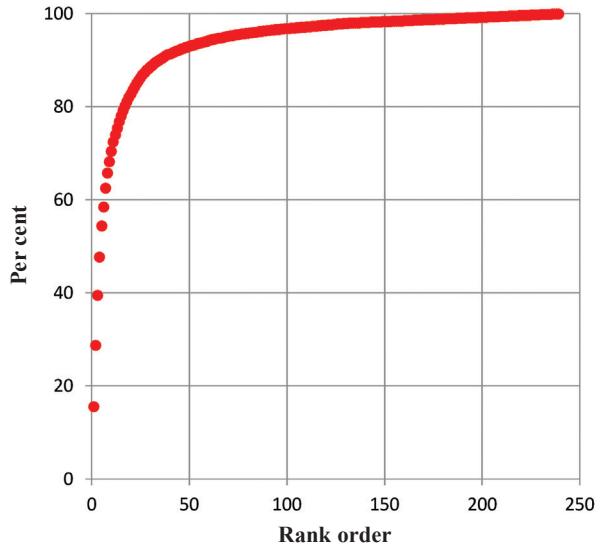


Fig. 4. — Relative contribution of donors to the main collection, excluding the Dennis component.

TABLE 1. CONTRIBUTIONS TO THE COLLECTION FROM DIFFERENT SOURCES.

Category	Total
Total specimens, all developmental stages	12773
Unlabelled or unassigned	1401
Trafford Museum	71
Dennis R.L.H.	5905
Remainder	5396
Some large contributors	
Lloyd R.W.	838
Nathan L.	706
Crewdson R.C.R.	576
B-Eckett U. & B.	442
Michaelis H.N.	359
Stocks W.P.	219
Thomson G.	216
Wooff W.R.	172

PATTERNS OF COLLECTING

Composition. In order to consider the patterns and preferences the total holding is discussed in three sections. These are:

1. The donation provided by R.L.H. Dennis, comprising nearly half of the total, concentrated on a few species. These relate to a programme to elucidate the function and adaptive value of spots and other patterns commonly found on the wings, especially in satyrids. The results have been published in a series of papers (Appendix 1). The balance of species representation is therefore very different from that of other contributors, and it is considered separately.
2. A small collection received from Trafford Metropolitan Borough Council arrived during the 1970s following closure of Altrincham and Stretford Art Galleries and Museums. These were opened during the 1920s–1930s and held collections of natural history and of paintings and artefacts, often associated with local history. The paintings and artefacts are now part of the Trafford Council Art and Heritage Collection. Some butterflies passed to Manchester Museum are now pooled with the main British material, but are identified here to draw attention to the species composition.
3. The main collection. This consists of the bulk of the Manchester British butterfly holding, provided by hundreds of individual donors and curated together as a single unit.

Figure 3 shows the relative abundance of species in the Dennis contribution and in the remaining part of the main collection. The main material, coming from many collectors, has a relatively even distribution. The overall aim seems to have been to obtain a representative selection reflecting relative abundance in the wild. In contrast the Dennis component, obtained with a specific scientific aim, is concentrated on large samples of a few species. The size of donations from different contributors is indicated in Fig. 4 and Table 1.

Where specimens are labelled it is possible to discern patterns in numbers, date and location between different collectors. There are 1401 specimens that are



Fig. 5. — Continuity. Specimens of Large tortoiseshell (*Nymphalis polychloros*) and Small pearl-bordered fritillary (*Boloria selene*) obtained by T.G. Mason in the 1890s passed to Leonard Nathan in 1929. Scale bar = 1cm.

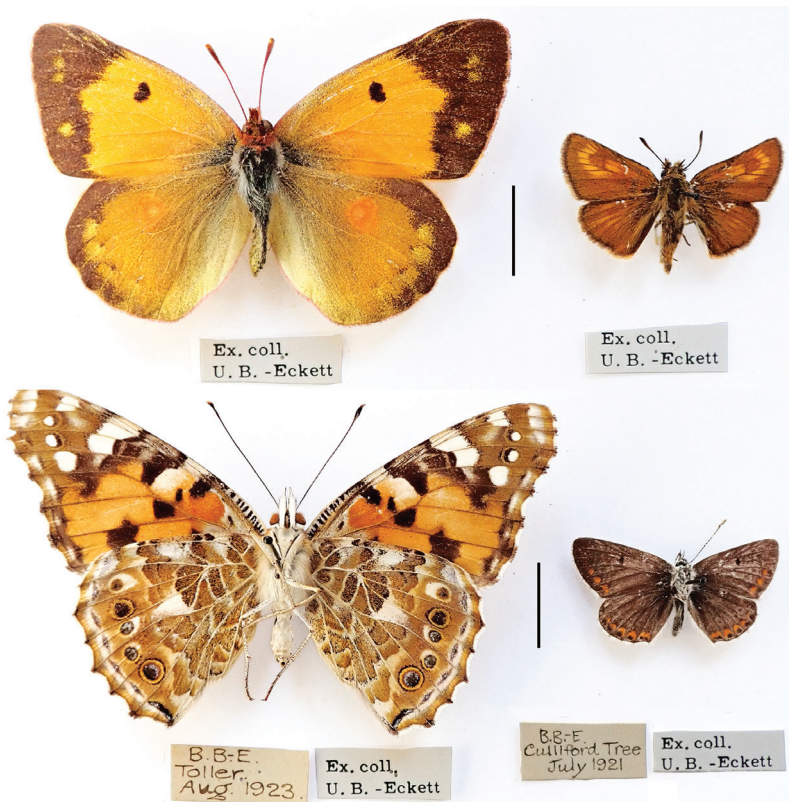


Fig. 6. — Enigmatic collectors with a shared collection. B B-E is Bernard Barton-Eckett, later a specialist in East African butterflies. Specimens of Clouded yellow (*Colias croceus*), Lulworth skipper (*Thymelicus acteon*), Painted lady (*Vanessa cardui*), Brown argus (*Aricia agestis*). Scale bar = 1cm.

unlabelled or do not provide information on collector. The Trafford Museum material consists of 71 individuals, and Dennis donation 5905 individuals. The remaining 5396 were collected by many entomologists, mostly amateur. Those who had the larger collections are shown in Table 1. Seven of them provide over 60 per cent of the total, most being members of the Manchester Entomological Society (MES, Cook & Logunov 2017). A few are labelled *Watkins and Doncaster*, dealers at one time in the Strand, London. These insects may have originated in other collections. L.W. Newman (1873–1949) provided 77 specimens. He was a professional butterfly breeder (Merritt 1954), who also dealt in material bought in auctions, so that his specimens were not necessarily caught by him. However, they date from the first third of the 20th century and except for some Irish Green-veined whites, they are mostly from localities easily accessible from his home in Bexley, Kent. Newman was a friend of Manchester Entomological Society member B.H. Crabtree, and sometimes stayed with him. That might account for the presence of his insects. It was not uncommon for specimens to pass from one collector to another before eventually arriving in the Museum. Thus, the labels show that at least 40 collected by T.G. Mason between 1887 and 1902 came into the possession of Leonard Nathan in 1929 (Fig. 5).

Robert C.R. Crewdson, H.N. Michaelis, Leonard Nathan, W.P. Stocks and W.R. Wooff were all active members of the Manchester Entomological Society. Some members and contributors, who exhibited regularly at society meetings and often participated in running the society, have, with the passing of time, left no further biographical trace. Brief biographies of B.H. Crabtree (1862–1950) and Hugh Nicholas Michaelis (1904–1995) are given by Cook & Logunov (2017). Dockery & Logunov (2018) outline the life of and distinctive preserving methods used by William Raymond Wooff (1929–2006). The career and collecting activities of Robert Wylie Lloyd (1868–1958) are discussed in Cook (2019).

The B-Eckett collection of 442 individuals consists of 375 labelled U. B-Eckett and 67 labelled B. B-Eckett (Fig. 6). Where the labels include a date, the first of these was active in 1917 and 1918, again in 1922 and 1923, and finally in 1928 and 1929. B. B-Eckett contributed in 1921–23 and 1927–29. The name as recorded must be a contraction to fit on the labels. Clearly, they are related and worked together. The material, consisting of the insects, some cabinets and a selection of books, was gifted to the Museum in 1980 by Mrs P. Clarke. In compiling these records we have found no further information on them in the Museum. It seems certain, however, that B. B-Eckett refers to Bernard John Barton-Eckett (1893–1974), a Private in the Royal Warwickshire Regiment in 1915–1917. He moved to East Africa in the 1930s where he became head of Kenyan library services (Carter 1997) and was an expert on the butterfly fauna (Henning 1991). A posthumous publication (Barton-Eckett 1991) shows that he was collecting Lepidoptera in Britain at the appropriate time and places to provide our samples.

Comparisons of relative abundance. The relative representation of the different species in the Museum collection reflects the preferences of the collectors, which may have varied with time and differ from relative abundance in the wild. To examine this, comparisons of relative numbers in different species in the main and the 19th century Sidebotham collections have been made with recent UK estimates. Numbers in many species have changed greatly over the last 30 years, and it is difficult to find a suitable record to represent the present situation. However, data for

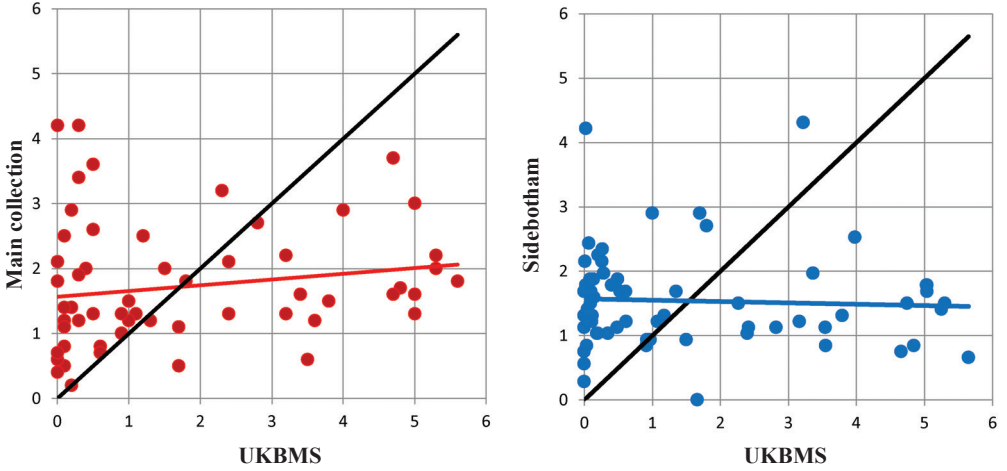


Fig. 7. — Relative Frequency per cent of each species on the UKBMS list in comparison with frequencies in the main and Sidebotham collections.

relative abundance are available from the UK Butterfly Monitoring Scheme sites for 1976–2014 (Fox *et al.* 2015).

The diagram (Fig. 7) shows per cent frequency for the two sets of data. Comparing the Manchester main collection with UKBMS data there is a general upward trend. If relative frequency was the same in both groups the points would follow the black diagonal; the shallower line indicates the actual trend. Commoner species tend to be represented in larger numbers than rare species in the collection, as might be expected, but there is, nevertheless, over-representation of some of the rarer species. Thus, the Adonis blue, Marsh fritillary and Scotch argus make up 0.3, 0.3 and 0.1 per cent of the UKBMS total but 3.4, 4.2 and 2.5 per cent of the main



Fig. 8. — Two species Ex. coll. Trafford Museum: Black-veined white (*Aporia crataegi*) (left), Large copper (*Lycaena dispar*) (right). Scale bar = 1cm.

TABLE 2. SPECIES RECEIVED FROM TRAFFORD MUSEUMS.

<i>Thymelicus acteon</i>	Lulworth skipper	1
<i>Hesperia comma</i>	Silver-spotted skipper	1
<i>Ochlodes sylvanus</i>	Large skipper	9
<i>Papilio machaon</i>	Swallowtail	1
<i>Colias hyale</i>	Pale clouded yellow	3
<i>Colias croceus</i>	Clouded yellow	1
<i>Aporia crataegi</i>	Black-veined white	2
<i>Pieris rapae</i>	Small white	1
<i>Pieris napi</i>	Green-veined white	1
<i>Pontia daplidice</i>	Bath White	2
<i>Anthocharis cardamines</i>	Orange-tip	1
<i>Thecla betulae</i>	Brown hairstreak	1
<i>Favonius quercus</i>	Purple hairstreak	1
<i>Satyrrium w-album</i>	White-letter hairstreak	2
<i>Satyrrium pruni</i>	Black hairstreak	2
<i>Lycaena dispar</i>	Large copper	2
<i>Lampides boeticus</i>	Long-tailed blue	1
<i>Cupido minimus</i>	Small blue	3
<i>Lysandra coridon</i>	Chalkhill blue	4
<i>Lysandra bellargus</i>	Adonis blue	3
<i>Cyaniris semiargus</i>	Mazarine blue	1
<i>Celastrina argiolus</i>	Holly blue	2
<i>Maculinea arion</i>	Large blue	2
<i>Aricia agestis</i>	Brown argus	1
<i>Aricia artaxerxes</i>	Northern brown argus	1
<i>Aglais urticae</i>	Small tortoiseshell	1
<i>Nymphalis polychloros</i>	Large tortoiseshell	2
<i>Fabriciana adippe</i>	High brown fritillary	2
<i>Mesoacidalia aglaja</i>	Dark green fritillary	2
<i>Melitaea athalia</i>	Heath fritillary	2
<i>Erebia epiphron</i>	Mountain ringlet	2
<i>Erebia aethiops</i>	Scotch argus	2
<i>Melanargia galathea</i>	Marbled white	3
<i>Maniola jurtina</i>	Meadow brown	2
<i>Coenonympha pamphilus</i>	Small heath	2
<i>Coenonympha tullia</i>	Large heath	2

collection. The tendency to collect rarities is more marked in the Sidebotham collection, which shows no relation to modern frequencies. It contains series of individuals from species known only as migrants, such as the Queen of Spain fritillary (*Argynnis lathonia*) and *A. niobe*, as well as extinct species such as the Black-veined white (*Aporia crataegi*) and the Large copper (*Lycaena dispar*). Sidebotham sometimes bought his material. Thomas & Lewington (2016) give an account of the high prices achieved for specimens of the Large copper as habitat loss reduced their numbers. Because of their value there was a risk of being misled. Labels on some of Sidebotham's rarer purchases show that they came from a dealer known for dishonest claims that they were British (Cook 2015).

Some rare species. There are 71 specimens representing 36 species labelled *Ex. Coll. Trafford Museum* (Table 2, Fig. 8). These have no further information on collector, location or date. They cover a range of taxa and habitats with an emphasis on local, rare or extinct species, namely the Swallowtail, Lulworth skipper, Large blue, Long-tailed blue, Bath white, Black-veined white, Large copper, Mazarine blue, and Large tortoiseshell. The last four are all extinct in Britain. The Long-tailed blue is a rare migrant.

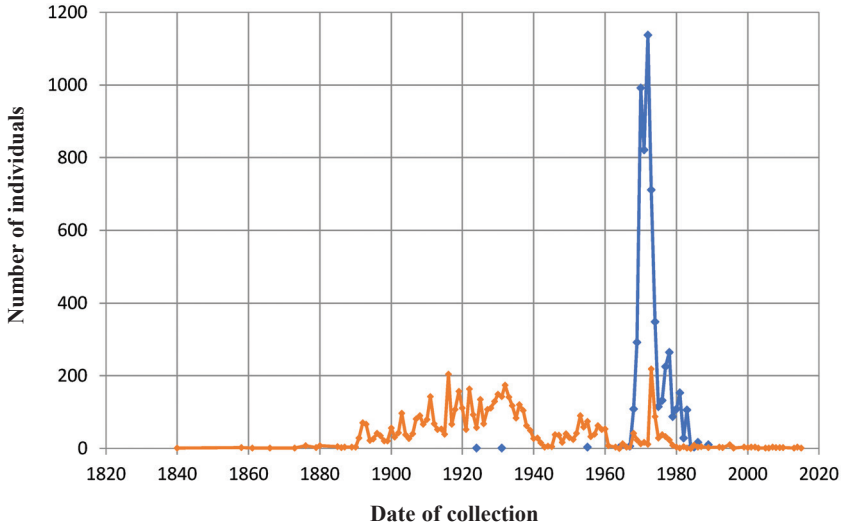


Fig. 9. — Time of collection of dated specimens in the main (red) and Dennis sections (blue).



Fig. 10. — The oldest specimen, a Small skipper (*Thymelicus sylvestris*) from the Isle of Wight, 1840. Scale bar = 1cm.

Berger’s clouded yellow (*Colias alfacariensis*), the least well represented species, is named for its discoverer, Belgian lepidopterist Lucien Adolphe Berger (1907–2000). It was recognised as a distinct species in 1945, and formerly may sometimes have been mistaken for the Pale clouded yellow (*Colias hyale*) (Salmon 2000). The three specimens in the collection were reared, and there is no information as to

origin. This species is an occasional visitor to Britain, as is the Short-tailed blue (represented by two German specimens and three of unknown origin). A number of the rarities lacking labels may be continental specimens.

Dates of collection. Dennis' collecting took place in the late 1960s and the 1970s. Most of the other contributions with labels date from the first half of the 20th century (Fig. 9). The Museum opened to the public in 1888 but sometime after 1867 its original foundation had already received material from the Manchester Society for the Promotion of Natural History, an organization that had gone into liquidation. It also inherited specimens from the Banksian Society, which existed between 1824 and 1836 (for more details, see Owen *et al.* 1962). It is therefore possible that some butterflies in the collection date from this period; if so they are unlabelled. The earliest dated specimen is from 1840 and is a Small Skipper (*Thymelicus sylvestris*) taken at Yarmouth, Isle of Wight, by an unidentified collector (Fig. 10). In 1858 someone named Oakley captured a Purple Emperor (*Apatura iris*) at Kettering, Northhamtonshire, and another, named H. Schaffer, a Mountain ringlet (*Erebia epiphron*), locality unknown. In 1861 J. Ray Hardy obtained a Heath fritillary (*Melitaea athalia*) at Burnt Wood. This is probably a location in Staffordshire, popular with entomologists at the time. Hardy (1844–1924) was responsible for the entomology material in the Museum from 1881 to 1908 (Logunov 2010). In 1866 W.H. Nash obtained a Bath White (*Pontia daplidice*) in Epping, Essex. A Camberwell beauty is reported from Oldham, near Manchester in 1873, collected by J. Clegg. That was the year after there was a large migration of this species from the continent (Salmon 2000).

It is evident from Fig. 9 that the decades of the 1920s, 1930s and 1970s are the periods when most butterflies were collected, as they account for over half of the total number of specimens. Later acquisitions have been more modest and no doubt reflect the increasing focus on conservation and a more measured approach to collecting. For example, G. Wotherspoon donated 44 British butterflies caught between 1955 and 2010. This relatively small number was almost exclusively made up of two individuals from each of 21 species, illustrating the tendency in the last few decades to be mindful of current conservation and ethical considerations.

Locations. The map (Fig. 11) shows the distribution of sampling sites in the main series for specimens with labels that provide identifiable locations. These are displayed in relation to the UK National Grid 100km squares. There is a very wide coverage, but as is to be expected, collecting sites are concentrated in North Wales (East 200, North 300) and the south Lancashire, north Cheshire region (East 300, North 300), where there are also more specimens per site than elsewhere (over 3000 and over 1000 respectively; in the figure the Dennis samples have tended to be occluded). The next most favoured region, the south of England, has many sites that have long been popular with lepidopterists because they include holiday resorts, often known for their rarities. It accounts for several hundred individuals.

DISCUSSION

The earliest collections which could form the basis of public museums were often no more than cabinets of curiosities. Taxonomy, relying on comparison of large numbers of species, began with such figures as John Ray (1627–1705) in England and J.P. de Tournefort (1656–1708) in France. Carl Linnaeus (1707–1778)

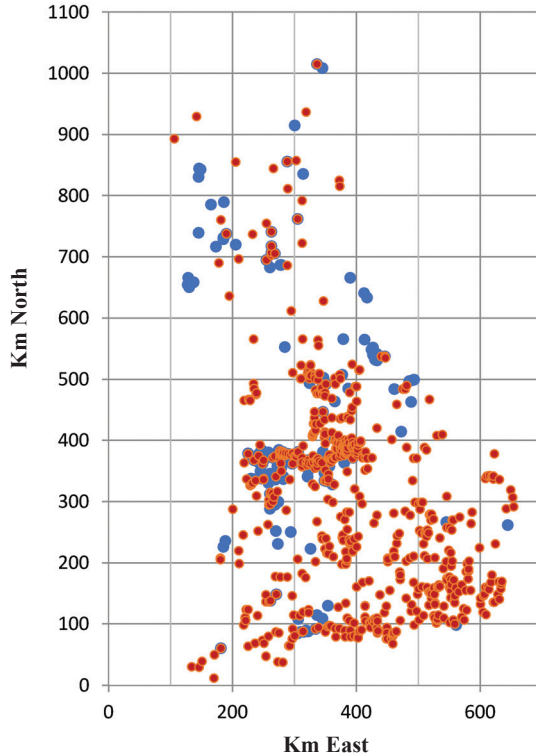


Fig. 11. — Distribution of recorded collecting sites in Great Britain displayed in relation to the UK National Grid 100km squares. Red: main series, blue: Dennis.

published *Systema Naturae* in 1738, creating the basis for the modern system of nomenclature and classification. As expansion of knowledge of the natural world increased dramatically so museums became vital repositories for the study of taxonomy and comparative morphology. Today, advances in molecular genetic and functional anatomical techniques make non-destructive use of such material more practical.

An example of possible application can be seen when considering the changing distributions of some species of British butterflies in response to climate change. For example, Hill, Thomas & Huntley (1999) draw attention to how in Speckled wood (*P. aegeria*) the 'pioneer' individuals differ from the bulk of the population in having smaller abdomens (so females lay fewer eggs) and bigger thoraxes (for stronger flight). So pioneers moving into potential new areas, of Scotland for example, could be compared with museum specimens to determine if there are genetic or morphometric differences from the source populations.

While methodology is now increasingly specialized, curation and display of collections in museums has tended to become less valued, and at the same time experience and knowledge of the natural world by the public has declined. Existing museum holdings are an important resource to encourage public interest in natural history and conservation. It is hoped that making this information available will be

a step towards its use not only for research but also to further the Museum's commitment to public engagement.

In the future the Manchester Museum may still receive collections from private individuals, although probably of more modest size, bearing in mind the more conservative approach to research and collecting in the last few decades. Currently, there is no funding source like the Cockayne Trust, which allows the Natural History Museum to purchase material. Nevertheless, the collections here are being used productively in a number of projects with other museums, university departments and research institutions.

In some respects we see a connection here between butterflies and what is now called Brexit. Because of the sea barriers between the islands, and their Atlantic climate, the British Isles have a butterfly fauna differing somewhat from that of continental Europe and differing between Great Britain and Ireland (Beirne 1947; Dennis 1977; Dennis & Hardy 2018). It is composed of year-round residents and a smaller array of species augmented by, or entirely dependent on, continental migrants. It has long been the practice to emphasise the insular status. The early Victorian Banksian Society instructed its artisan members to 'reject or label as 'Foreign' any doubtful specimens' (Cash, 1873). Joseph Sidebotham, an affluent member of the collecting community, had specimens of several butterfly species that fall into the foreign category. Among his Coleoptera, and perhaps his hawk moths, he may have deliberately claimed continental examples to be British in order to be hailed as discoverer of new residents (Morris & Johnson 2005; Cook 2015).

The limits of the British Isles butterfly fauna were established at an early stage, so that it was possible for the collector to aim at seeing them all. The only species discovered here in recent years are Berger's clouded yellow and the Irish or Cryptic wood white (*Leptidea juvernica* stat. nov., recognised by Williams 1946, and see Dincă *et al.* 2011). The latter species is not represented in the collection. The small number of continental examples of other species owned by our donors may stem from the desire to possess examples of rare species unseen by the collector but known to be in the extended British fauna. Britain is, however, a part of Europe, and the notable exponent of a Europe-wide viewpoint is R.W. Lloyd. He ranged widely across the continent with a special interest in its mountains (he was an active member of the Alpine Club) and in the higher altitude butterfly species (Cook 2019). The British examples were simply a component of this broader survey. His collection reveals the similarities and divergences of species associated with habitat diversity and isolation, opening up different vistas from the strictly island approach. W.R. Wooff also had a broad view. Besides Europe, he collected extensively in Africa and the New World (Dockery & Logunov 2018).

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REFERENCES

- Agassiz, D.J.L., Beavan, S.D. & Heckford, R.J. 2013. *Checklist of Lepidoptera of the British Isles*. Telford: Field Studies Council.
- Anonymous 1987. *The Ordnance Survey Gazetteer of Great Britain*. Southampton: Ordnance Survey.
- Asher, J., Warren, M.S., Fox, R., Harding, P., Jeffcoate, G. & Jeffcoate, S. 2001. *The Millenium atlas of butterflies in Britain and Ireland*. Oxford: Oxford University Press.
- Barton-Eckett, B. 1991. Sugaring for moths in England. *Metamorphosis* 2: 21–24.
- Beirne B.P. 1947. The origin and history of the British Macrolepidoptera. *Transactions of the Royal Entomological Society of London* 98: 275–372.
- Carter T. 1997. *Birmingham pals*. Barnsley: Pen & Sword.
- Cash J. 1873. *Where there's a will, there's a way: or, science in the cottage; an account of the labours of naturalists of humble life*. London. Reprinted CUP, Cambridge, 2011.
- Cook L.M. 2015. Joseph Sidebotham: vicissitudes of a Victorian collector. *Archives of natural history* 42: 197–210.
- 2019. Beetles, butterflies and bibliophilia: the entomological legacy of Robert Wylie Lloyd. *Entomologist's Monthly Magazine* 155: 3–14.
- Cook L.M. & Logunov D.V. 2016. Joseph Sidebotham's Lepidoptera. *The Linnean* 32: 9–16.
- 2017. The Manchester Entomological Society (1902–1991), its story and historical context. *Russian Entomological Journal* 26: 365–388.
- Dennis, R.L.H. 1977. *The British Butterflies. Their Origin and Establishment*. Faringdon, Oxford: E.W. Classey.
- Dennis, R.L.H. & Hardy, P.B. 2018. *British and Irish Butterflies: an island perspective*. Wallingford: CABI.
- Dockery, M. & Logunov D.V. 2018. The Lepidoptera Collection of William Raymond Wooff (1929–2006) in the Manchester Museum. *Entomologist's Monthly Magazine* 154: 271–295.
- Dincă, V., Lukhtanov, V.A., Talavera, G. & Vila R. 2011. Unexpected layers of cryptic diversity in wood white *Leptidea* butterflies. *Nature Communications* 2: 324. <https://doi.org/10.1038/ncomms1329>
- Ford E.B. 1945. *Butterflies*. London: Collins New Naturalist.
- Fox, R., Brereton, T.M., Asher, J., August, T.A., Botham, M.S., Bourn, N.A.D., Cruickshanks, K.L., Bulman, C.R., Ellis, S., Harrower, C.A., Middlebrook, I., Noble, D.G., Powney, G.D., Randle, Z., Warren, M.S. & Roy, D.B. 2015. *The State of the UK's Butterflies*. Wareham, Dorset: Centre for Ecology & Hydrology. Available at: <https://butterfly-conservation.org/butterflies/the-state-of-britains-butterflies>
- Harris, M. 1766. *The Aurelian or natural history of English insects; namely, moths and butterflies. Together with the plants on which they feed*. London, for the author.
- Henning W.H. 1991. Bernard Barton-Eckett. *Metamorphosis* 2: 21.
- Hill J.K., Thomas C.D. & Huntley B. 1999. Climate and habitat availability determine 20th century changes in a butterfly's range margin. *Proceedings of the Royal Society of London B*. 266: 1197–1206.
- Logunov, D.V. 2010. The Manchester Museum's entomology collections. *Antenna* 34: 163–167.
- Marren, P. 2019. *Emperors, admirals and chimney sweepers. The weird and wonderful names of butterflies and moths*. Dorset: Little Toller Books.
- Merritt, J.R. 1954. Butterfly farmer. (review). *Lepidopterist's News* 8: 49–50.
- Morris, M.G. & Johnson, C. 2005. Sidebotham's weevils (Curculionidae). *The coleopterist* 14: 101–103.
- Owen, D.E., Seyd, E.L., Smith, S. & Brindle, A. 1962. Fauna, pp 87–108. In: Cater, C.F. (ed.). *Manchester and its region, a survey prepared for the British Association*. Manchester: MUP.
- Percy, J. 1991. Scientists in humble life: The artisan naturalists of South Lancashire. *Manchester region history review* 5: 3–10.
- Salmon, M.A. 2000. *The Aurelian legacy. British butterflies and their collectors*. Colchester: Harley Books.
- South, R. 1906. *The butterflies of the British Isles*. London: Warne.
- Thomas, J.A. 1980. Why did the Large Blue become extinct in Britain? *Oryx*, 15: 243–247.
- 1995. The ecology and conservation of *Maculinea arion* and other European species of butterfly. In *The ecology and conservation of butterflies*, (Pullin, A.S. ed.), pp. 180–197. London: Chapman & Hall.
- 1999. Return of the Large Blue. *Butterfly Conservation News* 71: 18–21.
- Thomas, J. & Lewington, R. 2016. *The butterflies of Britain and Ireland*. Gillingham: British Wildlife Publishing.

- UKBMS. 2020. United Kingdom Butterfly Monitoring Scheme. www.ukbms.org
- Wiemers, M., Balletto, E., Dincă, V., Fric, Z.F., Lamas, G., Lukhtanov V., Munguira, M.L., van Swaay, C.A.M., Vila, R., Vliegthart, A., Wahlberg, N., Verovnik, R. 2018. An updated checklist of the European Butterflies (Lepidoptera, Papilionoidea). *ZooKeys* **811**: 9–45.
- Williams, H. 1946. The Irish form of *Leptidea sinapis*. *The Entomologist* **79**: 1–2.

Appendix 1

PAPERS BY R.L.H. DENNIS AND OTHERS RELATING TO STUDY OF WING PATTERN VARIATION

- Dapporto, L., Hardy, P.B. & Dennis, R.L.H. 2019. Evidence for adaptive constraints on size of marginal wing spots in the grayling butterfly, *Hipparchia semele*. *Biological Journal of the Linnean Society* **126**: 131–145.
- De Keyser, R., Breuker, C., Hails, R., Dennis, R.L.H. & Shreeve, T. 2015. Why small is beautiful: wing colour is free from thermoregulatory constraint in a small *Polyommatus* butterfly. *PLoS ONE* **10**: e0122623. <https://doi.org/10.1371/journal.pone.0122623>
- Dennis, R.L.H. 1970. *Eumenis semele thyone* Thompson (Lep., Satyridae). Comparisons and remarks. *Entomologist's Record and Journal of Variation* **82**: 168–175.
- 1972. *Eumenis semele* (L.) *thyone* Thompson (Lep., Satyridae). A microgeographical race. *Entomologist's Record and Journal of Variation* **84**: 1–11, 38–44.
- 1972. *Plebejus argus* (L.) *caernensis* Thompson (Lep., Lycaenidae). A stenoecious geotype. *Entomologist's Record and Journal of Variation* **84**: 100–108.
- 1972. A biometrical study of a Welsh colony of the large heath butterfly, *Coenonympha tullia* (Müller) (Rhopalocera). *The Entomologist* **105**: 313–326.
- 1977. *The British Butterflies. Their Origin and Establishment* Faringdon, Oxford: E.W. Classey.
- (ed) 1992. *The Ecology of Butterflies in Britain*. Oxford, Oxford University Press. 354p. Ch. 1 Islands, regions, ranges and gradients; Ch. 10 An evolutionary history of British butterflies.
- 1993. Predation in a northern population of *Pieris napi* (L.) (Lep., Pieridae). Evidence from wing fragments. *Entomologist's Gazette* **44**: 157–159.
- Dennis, R.L.H., Porter, K. & Williams, W.R. 1984. Ocellation in *Coenonympha tullia* (Mueller) (Lep., Satyridae). I. Structures in correlation matrices. *Nota Lepidopterologica* **7**: 199–219.
- 1986. Ocellation in *Coenonympha tullia* (Mueller) (Lep., Satyridae). II. Population differentiation and clinal variation in the context of climatically-induced anti-predator defence strategies. *Entomologist's Gazette* **37**: 133–172.
- Dennis, R.L.H. & Shreeve, T.G. 1989. Butterfly wing morphology variation in the British Isles. The influence of climate, behavioural posture and the hostplant-habitat. *Biological Journal of the Linnean Society* **38**: 323–348.
- Dennis, R.L.H., Shreeve, T.G., Isaac, N.J.B., Roy, D.B., Hardy, P.B., Fox, R. & Asher, J. 2006. The effects of visual apparency on bias in butterfly recording and monitoring. *Biological Conservation* **128**: 486–492.
- Joyce, D.A., Dennis, R.L.H., Bryant, S.R., Shreeve, T.G., Reday, J. & Pullin, A.S. 2000. Do taxonomic divisions reflect genetic differentiation? A comparison of morphological and genetic data in *Coenonympha tullia* (Müller), Satyrinae. *Biological Journal of Linnean Society* **97**: 314–327.
- Middlebrook, I., Hardy, P. B., Botham, M. S. & Dennis, R.L.H. 2019. The importance of unique populations for conservation: the case of the great orme's head grayling butterfly *Hipparchia semele* (Linnaeus, 1758) (Lepidoptera: Satyrinae). *Journal of Insect Conservation* **23**: 381–391. <https://doi.org/10.1007/s10841-019-00137-x>
- Shreeve, T.G., Dennis, R.L.H. & Williams, W.R. 1996. Uniformity of wing spotting of *Maniola jurtina* (L.) (Lep., Satyrinae) in relation to environmental heterogeneity. *Nota Lepidopterologica* **18**: 77–92.