
THE LINNEAN

Newsletter and Proceedings of the Linnean Society of London

Edited by B. G. Gardiner

Editorial

In his statement to the House of Lords Subcommittee on Systematic Biology Research, made in June last year, the President confirmed that the Society's main aim is to encourage the study of biological diversity. We are now all aware that *Homo sapiens* is fast destroying the natural world and its biota, and that a global strategy for salvaging what is left is under urgent consideration (IUCN/UNEP/WRI, 1992—see *The Linnean* *8*(1): 25; *8*(2): 8).

With this 'biodiversity crisis' biologists are faced with a new set of tasks, including the need to find appropriate means of diversity measurement, and learning how to use this information in practical decision-making. Are all species equally important? If not, how should we value them—in terms, for example, of estimates of their ecological significance, or of their taxonomic or genetic difference? Once we have our value judgements, greater ecological understanding will be needed to manage wilderness areas and man-made environments alike. Improved taxonomy, to ensure accurate identification of a far wider range of species, will also be needed to assess progress and monitor change.

The scientific community is now virtually united in its conversion to 'environmentalism'. However, given the new tasks facing biologists, and systematic biologists in particular, what sort of lead should our Society give? Several of our members are actively participating in the debate, such as the Botanical Secretary, part of a team developing new systematic methods for conservation evaluation (e.g. see Vane-Wright, Humphries & Williams, *Biological Conservation, 55:* 235–54, 1991). More generally, Brian Ford (this issue) suggests that the Society needs a new permanent secretariat to handle broader issues of science policy, and consider our responses. If Council acted promptly now, it could emphasize our rôle as *the* Society best able to advise on the biodiversity crisis.

This issue breaks new ground with the publication of a full length paper dealing with Linnaeus's general scientific and philosophical beliefs, based on his collection of printed books in our library. It also contains articles on H. G. Wells's student days and on J. B. S. Haldane's special preference.

SOCIETY NEWS

Notes

Recommendations for Honour and Awards

In 1989, *The Linnean* carried details of the procedures for nominating for Medals and Awards. A nomination form for these is at the back of this issue; it is in A5 size, but can be blown up to A4 size for use. Nominations for awards are due on 31 December each year (30 September for the Jill Smythies Prize).

The 1992 Medal Winners were:

Linnean Medals:	Stephen Jay Gould
	Richard Evans Schultes
Bicentenary Medal:	Stephen Blackmore
HH Bloomer Award:	Kenneth Angus Spencer
Jill Smythies Prize:	John Mark Fothergill
Irene Manton Prize:	Sharon Anita Robinson
	Robert W. Scotland

Citations on the medal winners will appear in the next issue.

The Programme Card is sent with this issue of *The Linnean.* Society meetings have been well attended in the 1991/92 session; evening meetings and, very encouragingly, Sixth Form meetings have averaged 80, and day meetings 70. It

is very gratifying for meetings organizers and staff to see such appreciation of their efforts.

The proceedings of the meeting on the *Impact of Global Change on Disease* on 30 September will be published as part of the Parasitology Symposia by Cambridge University Press and will be available to Society members at the special rate of £12. Further details will be available later.

The meeting on 3 December *Discovering Evolution: Alfred Russel Wallace's Contribution to 'Darwinism'* by Prof. John Durant of the Science Museum originally formed part of the VIth Form Programme. It has been decided to throw the meeting open additionally to members of the Society. The meeting, which starts at 5.30 p.m. will be preceded by tea for members at 5 p.m.

1993 being the 250th Anniversary of the birth of Sir Joseph Banks, two meetings have been planned. The first, with the Natural History Museum, the Royal Society and the Royal Botanic Gardens, Kew, will deal with historical aspects of Banks' contribution to science and will be a two-day meeting on 22/23 April 1993 at the Royal Society. The second meeting will be later in the year entitled *Estimating Extinction Rates*, with the Royal Society. It will form part of the 1993/94 programme.

The meeting *Biodiversity and Environment—Brazilian Themes for the Future* is a two-day meeting at the Royal Geographical Society which followed the suggestion of a Fellow that the Society should interest itself in Brazilian biology. This suggestion was taken up enthusiastically by the Royal Botanic Gardens, Kew and the Society. The aim of the meeting is to focus attention on biological research being carried out by Brazilian scientists in collaboration with British institutes. There are an estimated 150 Brazilian biological scientists in the U.K., mostly pre- and post-doctoral students, hence the need for a somewhat larger venue than the Society's rooms can accommodate. Perhaps this will become a regular event in the Society's calendar.

The Society once again owes a debt to Mr Roger Goodenough, F.L.S. for a further £200 towards the Goodenough Fund, which this year has supported a considerable number of Fellows unable, mainly for currency reasons, to pay their contributions in 1991/92.

The late Kenneth Edwin Adams, F.L.S. left the Society £500 in his will.

On 27 February, the Society presented to the Royal Society of Chemistry a Facsimile of Mutis' botanical drawing of *Cinchona peruviana* sent to Linnaeus in 1764. The RSC is celebrating its sesquicentenary, and one of its former presidents, Sir Robert Robinson, received the Nobel Prize for work on *inter alia* quinine. The picture was received by Sir Rex Richards, F.R.S. on behalf of the RSC, as its current President.

The Royal Society in the U.K. and the National Academy of Sciences in the U.S.A. have taken the unusual step of issuing a joint statement on **Population Growth, Resource Consumption and a Sustainable World.** The statement concludes: "Global policies are urgently needed to promote more rapid economic development throughout the world, more environmentally benign patterns of human activity, and a more rapid stabilization of world population. The future of our planet is in the balance. Sustainable development can be achieved, but only if irreversible degradation of the environment can be halted in time. The next 30 years may be crucial".

Some members may be aware that the Biological Council has merged with the

Institute of Biology. The Linnean Society, which was a member of the original Biological Council, has affiliated with the Institute of Biology, with many of the other former members of the Council. It is hoped that this will strengthen consultation between the nearly one hundred biological societies which originally constituted the Biological Council. For those members of the Society interested in joining the Institute, there are reductions in the first year's subscription and a waiving of the application fee.

Down House, Downe, Kent is now in the care of the Natural History Museum. Its distinguished former resident has been superseded by Mrs Solene Morris, F.L.S., who will be most happy to see members visiting it either individually or *en masse*. Down House can be booked for functions, with or without catering. Telephone 0689 859 119 for more details.

Other meetings

Interacting Stresses on Plants in a Changing Climate, Bristol 14–18 September 1992, M. Jackson, University of Bristol, Dept. of Agric. Sci., Long Ashton Research Station, Bristol.

The Extracellular Matrix of Plants, Santa Fe, New Mexico 9–15 January 1993, Keystone Symposia, Drawer 1630, Silverthorne, CO 80498, U.S.A.

Evolution and Plant Development, Toas, New Mexico 26 January–1 February 1993, as above.

Prediction of Ecosystem Responses to Environmental Change, London 14–17 April 1993, Conference on Global Ecology, c/o Commission of European Communities, HQ, Rue de la Loi 200, B-1049 Brussels, Belgium.

Genetics and the Understanding of Life, Birmingham 15–21 August 1993, Dr Derek Smith, Secretary General, Research Support & Industrial Liaison, University of Birmingham, Edgbaston, Birmingham B15 2TT.

Report on the Nucleic acid Sequences Systematics Meeting of 23 April 1992

Dr P. Humphry Greenwood, F.R.S., former President (1976–1979) and recipient of the Linnean Medal (1982), studied the taxonomy and evolution of cichlid fishes in Lake Victoria over a period of 30 years. No morphological evidence emerged during those three decades to suggest the 'species flock' in Lake Victoria was actually monophyletic (Greenwood, 1980), so he began to explore the alternative hypothesis (Greenwood, 1983), rather, that some of the cichlid lineages in Lake Victoria were most closely related to lineages in other East African Rift Valley lakes. Contra Greenwood, Meyer *et al.* (1990), using nucleotide sequences from the mitochondrial genome, claim to have demonstrated that the species flock of Lake Victoria was monophyletic, and Avise (1990) went so far as to say that the molecular studies 'stand in stark opposition' to those from morphology. Naturally, these claims were noted with interest, and engendered a certain amount of discussion.

The result of these discussions was a decision to hold a one day meeting on the analysis of nucleic acid sequences as it relates to systematics. One viewpoint about molecular systematics is that it is the 'new systematics', and that it should

replace morphology, the 'old systematics'. This view, of course, is mistaken. Molecular data are new, but systematics is the same as it always has been (the search for natural taxa). Analysis of morphological data is not problem free. Is the analysis of molecular data more problem free? This was the issue before the audience.

The aim of the meeting was to inform, rather than to argue. Such arguments rarely enlighten. Five subject areas were chosen. Speakers were asked to present an up-to-date overview of one of the topics, and to then present some of their own research in the area. A generous period of 15 minutes was left at the end of each talk to allow the audience to question speakers.

Dr Richard Thomas, the Natural History Museum, tackled the issue of choice of molecules. Some parts of the genome, nuclear and organelle, apparently evolve (mutate) at a greater rate than others. For example, the control region of animal mitochondria evolves rapidly, the cytochrome b gene does not. Slowly evolving parts of the genome might be more useful in addressing questions concerning great age. Questions about more recent events might be more usefully approached by using rapidly evolving regions. The choice of molecule depends on the problem addressed, and there is no guarantee any particular region will provide an answer for any particular problem. Dr Thomas ended by suggesting that, eventually, problems will be tackled by comparing the results from more than one region (gene), but that due to the expense of the techniques, it was unlikely that more than three or four genes would be available to answer systematic questions.

Dr Jotun Hein, Aarhaus University, Denmark, spoke on the alignment of sequence data. Character information is fundamental to systematics; characters are the unit of comparison. The alignment of nucleic acid sequences establishes the basis of comparison in DNA sequences; sequences must be aligned if base composition at a particular nucleotide position is to be considered a character. Dr Hein explained algorithmic approaches to the alignment problem. Alignment of two DNA sequences is relatively straightforward. Alignment of multiple sequences is not. One approach is to begin the process with a tree (usually derived by a distance matrix method on the raw data), first aligning two sequences appearing next to each other on the tree, then proceeding by aligning a sequence next to the initial two, and so on. Dr Hein observed there should be little surprise over the similarity between a tree resulting from the analysis of sequences aligned in this manner and the tree used to seed the alignment process. In sum, algorithmic approaches to alignment are still relatively primitive. Their employment does not ensure a high quality alignment. It appears those investigators who advocate alignment 'by eye' are vindicated, at least for now.

Dr Andrew Smith, the National History Museum, addressed the question or rooting trees. Branching diagrams need not be rooted, but rooted trees are more informative than unrooted networks and roots provide a hypothesis of evolutionary direction. Ontogeny can root morphology, but is unavailable as an option for sequence data, for which the only recourse appears to be outgroup rooting. Selecting an outgroup is not a simple matter. Outgroups too far removed behave no differently than a random sequence. Single outgroups of adequate propinquity of descent may provide a root, but don't test ingroup monophyly. Also problematic is that outgroups tend to root on long branches. If an ingroup taxon is highly divergent, the outgroup tends to attach to this branch. Dr Smith

compared parsimony, distance matrix and maximum likelihood methods of tree building for placement of a root in a molecular data set (5′ terminal of 23S rRNA). A well corroborated (and with high bootstrap support) cladogram of echinoderms, based on morphology, was used as a standard. A number of interesting observations emerged. No distance matrix method performed satisfactorily, and for the entire sequence data set, only the maximum likelihood method produced a tree identical to the morphological tree. For a reduced data set, which included informative sites only, parsimony methods did recover the morphological tree, correctly rooted. A conservative approach to sequence data appears to move it into the zone where parsimony and maximum likelihood are expected to produce similar results.

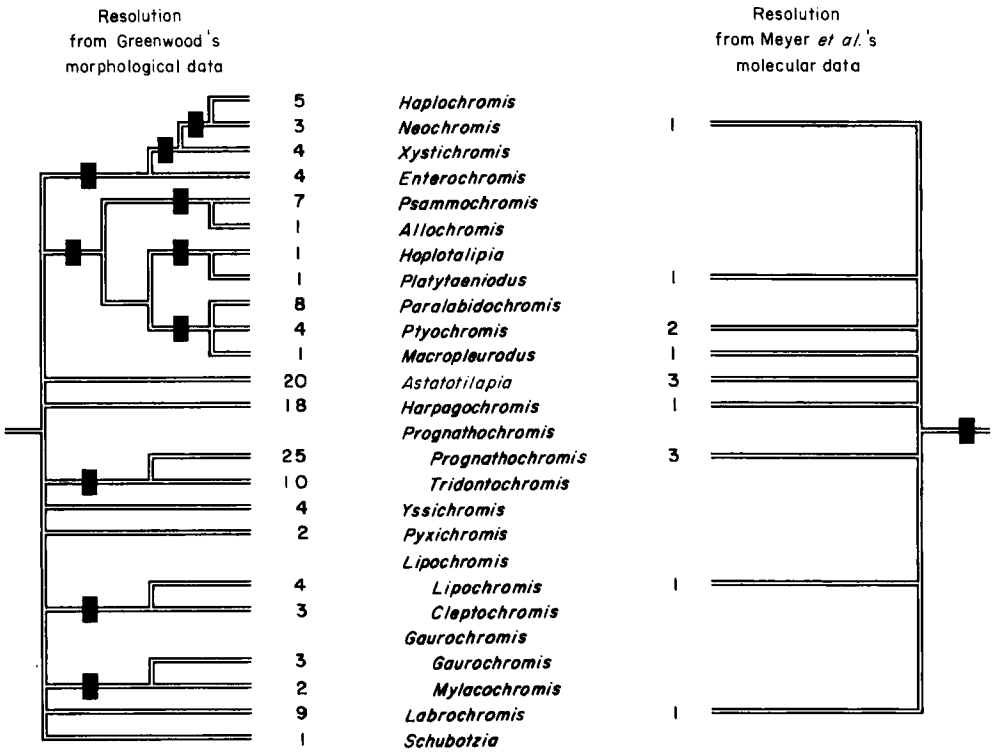
Dr Rod Page, the Natural History Museum, spoke on the topic of gene trees vs species trees. Genes may have a phylogeny of their own, and it need not coincide with the phylogeny of species. Organelle genomes, because the mode of inheritance is different from that of the nuclear genome, may not track nuclear gene phylogeny. Dr Page pointed out that the problem of comparing gene phylogenies with that of species phylogeny is analogous to the problem of comparing the phylogenies of hosts and parasites. One lesson learned from host-parasite comparisons is that mismatches may be due to sampling error of taxa, either of hosts or parasites. A controversial, new suggestion was also explored. Some biologists have suggested that the information from a single gene should be treated as a single, though very elaborate, character state tree. Instead of a sequence providing hundreds, or even thousands of characters, it would provide only one character, the character state tree of a gene. Rather than being swamped by nucleic acid sequence data, morphology could swamp the single character state tree of a gene!

Dr Nick Goldman, the Medical Research Council, explained maximum likelihood approaches to phylogeny estimation. Dr Goldman's research has investigated the adequacy of some of the common probabilistic models used in maximum likelihood approaches to phylogeny reconstruction. Simple, straight forward Poisson process models do not yield likelihoods with the expected range. However, more complex models, such as that proposed by Haegawa, Kishino & Yano (1985), do appear to produce results within an acceptable range of likelihood for some molecules (such as the *eta*-globin pseudogene among primates). In cases where they do not, such as for a functional gene among bacteria, Dr Goldman demonstrated how the deviation might be accounted for by a factor such as parallelism.

Systematics with nucleic acid sequences as data is complex, as each speaker revealed. Each of the topics covered in this meeting has its own problems, some daunting, such as evaluating data sets with large numbers of taxa for likelihood, and some possibly intractable, such as rooting. One member of the audience, a molecular systematist from The Netherlands, commented afterwards that she would like to have seen the meeting end on a more positive note, otherwise one could leave with only a negative impression. The meeting did answer the question posed. The use of nucleic acid sequences in systematic analyses is not significantly less problem free than systematic analyses with morphology. Many problems are the same (such as how to get an optimal tree with a data set that includes a large number of taxa), but some, like alignment, are unknown in morphology. Morphology has an advantage of have been under development for

centuries, the development of molecular systematics has had only about three decades. That so many are interested bodes well for future prospects.

The meeting closed with the following perspective on the initial issue of a conflict between morphology and molecules over the relationships of cichlids of Lake Victoria. Greenwood has concentrated on the study of the Lake Victoria species flock, and only latterly has begun to look at the species flocks of other lakes in detail. Meyer *et al.* have looked across the species flocks of several lakes, they have not examined any lake in great detail. What each has to say about the relationships of Lake Victoria cichlids, however, can be compared. The comparison is surprising, given some of the statements that appeared in *Nature*. In the figure below, cichlid genera from Lake Victoria are listed in the middle column.



To the left are the number of species of each genus or subgenus examined by Greenwood, and his scheme of relationships among the genera. The bars represent nodes supported by synapomorphies. To the right are the numbers of species of each genus examined by Meyer *et al.*, and the scheme or relationships from their data. The results do not conflict, they apply to different levels of the hierarchy and are complimentary. Greenwood was able to make considerable headway on figuring out the phylogeny of Lake Victoria cichlids, even if unable to demonstrate they were monophyletic. Meyer *et al.* did find evidence of monophyly, but were unable to elucidate relationships within the lake, in spite of sequencing the fast evolving control region.

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DARRELL J. SIEBERT & DAVID WILLIAMS
The Natural History Museum, London

From the Archives

Mi Lada

Agreabel to yr drections I vent to Barny bee to see arter that there sort of moss that you vonted to have some of so I supplide to Mr Dodington who is rekond the knowinist man in that there parrish who tould me he dint know where none of them there things grows so ve vent into the oldar carr to look for some but there wasn't none there only a wood cock and him we coodn't kill for why becase we hadnt a gun. So I thout we must make shift wi green grass if you hadnt pertickly said moss—then I went for to see the pepil a cuttin a holes to plant trees in and there I seed Mr Cowles a very curous man about verjitables but he be no bottanist as the saying is. And he tould me says he there is a site of moss growin in the meshes so I sent his boy to go to Dodington to tell his boy to bring the hempty basket that he was to put the moss into. And ven he cumd we got out of the slush all twod hold and I ha sent it noa. And this is all the whole account of the affare. I dont know not yet wat spence will be but spose youl say there is a nation littel for money for the carrage ill cost a cruel deal and I ha had a mort o trubel to git it thats for sartin but I dont charge nothing for that and will take a desperate long time to clean and wash out the sile and wot not.

So I remain yrs to command
Humfry Gubbins

PS My spects to the young leddy that was wi ye here wen you vas at Layster.

Howsumewer I dont thank you not much for jokin at me ven the cart rund afore the hoss and jamd the yerbs into the grund and knockt down the vattle fence and I lost my hat off and fritend all the pepel and dint git no hurt for tho twas fun to you and mite a bin a very serous job to yr humble serv^t^ if I hadnt got off without harm.

NB The links were mortal good you was so kind as to send.

I beg pardon bit I had like toha forgot to tell you ven I cum'd home yesterday then I vent to dine at Col. Jones and there I seed Ca'p Bradshaw and Mr Veston who had all his fingers crippeld wi the Gout—and a hape of other Ladys and Gemmen.

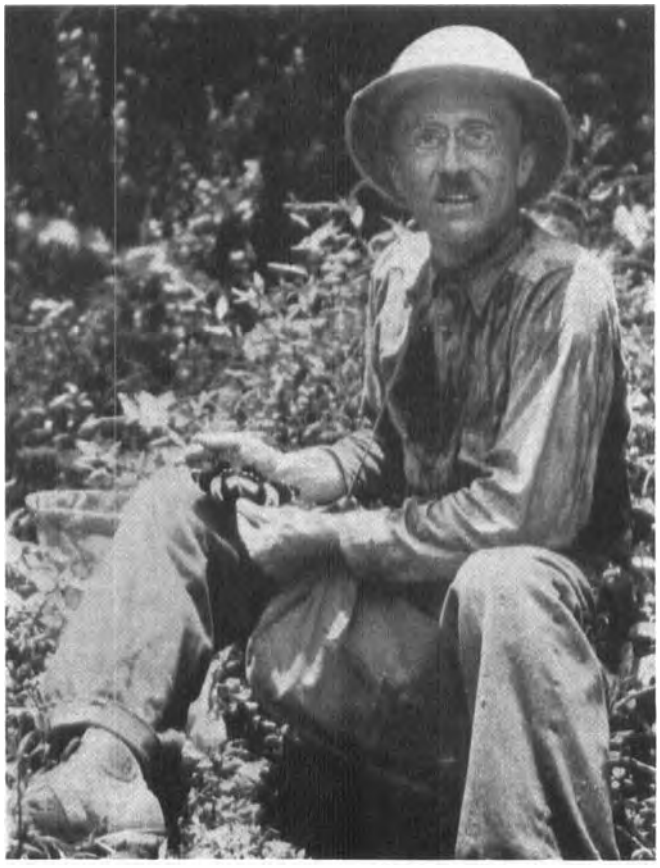
And I ha had a Latter today frum Mr Wallford tho I dont know why a ladder wudnt a dun as wel to get over the vall as a ford to get throw it ven they wer a makin his name but that is neither here nor there and he teld me to persent his best rembrances to you Mi Ladi.

5 Feb 33

This letter was found amongst Lady Smith's correspondence and was probably written by a Lowestoft man as Lady Smith had moved there from Norwich, after the death of her husband Sir James Edward Smith.

M.W.

Picture Quiz



The original caption to this photograph, when first published in 1936, read "Triumphant and a bit dazed by the good luck". Where is he, who is he, and what is the east-west connection?

The March Quiz featured Herbert George Wells (1866–1946), novelist, sociologist and one of the century's great popularizers of science. Born at Bromley in Kent to working class parents (who ran a china shop), Wells left

school at 14 and was apprenticed briefly to a tailor then to a chemist and for a further two years to a draper. He then became a pupil teacher and within a year won a teacher-in-training scholarship to the Normal School of Science, Kensington. Thus in 1884 aged 18 he began what he called "my fifth start in life" when he commenced studying biology under Huxley and Bower (see article on p. 16). He was so stimulated by Huxley ("the great teacher, the most lucid and valiant of controversialists") that he had no difficulty at the end of his first year in obtaining a first-class pass in Zoology (unlike your editor who attended the same college and almost failed!). In his second year Wells studied physics under Guthrie, who after Huxley proved a bitter disappointment (Guthrie, however, was slowly dying). More significantly, Wells turned to socialism of the kind associated with the name of Fabius Maximus and also started a students' college journal (still published today as *Phoenix*). From this point on his degree slowly slipped away from him and he subsequently failed his final examinations in 1887. As he remarked rather poignantly "the path to research was closed to me for ever".

This initial lack of academic success, however, did not prevent Wells from entering the teaching profession. Meanwhile he re-registered with the Normal School of Science and in 1890 was awarded a B.Sc. degree as a consequence of his private studies and the credit built up by his initial two years of passes (1885–6–7).

He remained in the teaching profession until 1893 during which time he published his *Textbook of Biology* (1892). He then became a journalist and his first major novels—*The Time Machine* and *Wonderful Visit* were published in 1895.

In 1943 he was awarded a London D.Sc. for a thesis 'On the quality of illusion in the continuity of the individuals life in higher Metazoa, with particular reference to the species *Homo sapiens*'. As additional support he submitted four publications: *The Outline of History* (1920), *The Wealth, Health and Happiness of Mankind* (1932), *Phoenix* and *The Science of Life*.

See also the letters from R. G. Davies and D. Goodhue under correspondence and the article by A. D. Boney. There was a surprising number of correct answers including K. G. V. Smith, G. Miller and B. O. C. Gardiner.

Correspondence

Department of Biology,
Imperial College,
London SW7 2AZ

2.4.92

Dear Brian,

Picture Quiz—The Linnean, March 1992

The subject of this photograph is H. G. Wells, pictured when he was a student at the Royal College of Science (or, more accurately, the Normal School of Science) in 1883–87. The photograph was taken in the building in Exhibition

Road which was later designated as the Huxley Building and was more recently transformed into the Henry Cole Wing of the Victoria and Albert Museum. A description of this building as it then was is the basis for some of the scenes in Wells's novel *Love and Mr Lewisham* and it remained very much the same until it was vacated by the Zoology Department in 1939. The picture is usually supposed to represent Wells giving an imitation of T. H. Huxley delivering a lecture and I believe it (or a copy) is in the Imperial College Archives. It was reproduced in the booklet *Imperial College: A Pictorial History* by Williams and Barrett (1988).

Incidentally College has a picture of Edward Forbes which you might like to show in a future Picture Quiz.

Kind regards and all good wishes
R. G. DAVIES

Trinity College,
Dublin 2,
Ireland

13.4.92

Dear Brian,

The pictorial puzzle in the Linnean is either yourself, Pete or Dave in your student days (Pete is the one in the suit) or more seriously H. G. Wells as a student. I seem to remember that at the time he was not allowed to sit when in the presence of T. H. Huxley as he was only a scholarship student. How this worked out in lectures I have no idea but I'm glad that when we were at the R.C.S. (was it the Normal S.S. in Wells's day?) we could sit when Richards was lecturing.

I also recollect that although the skeleton was destroyed the skull was extant and we used it in the practical. All that seems a long time ago—never mind about seeming a long time ago, it was a long time ago!

Hope all goes well with you.

Best wishes
DEREK GOODHUE

Harvard University,
Petersham,
Massachusetts,
U.S.A.

22.4.92.

Dear Dr Gardiner:

I would like to point out an error in your news of the Society in the March 1992 issue of *The Linnean*. In discussing the hats sold at the public house in London called "The Sherlock Holmes" you described them as "deerstalkers". In view of the habitat this should, of course, be beerstalkers.

Yours sincerely
BRIAN TOMLINSON
Jeffrey Professor of Biology

Liverpool Museum,
William Brown Street,
Liverpool L3 8EN

26.2.92

Dear Brian,

In the late 1940s and early 1950s, when certain items of food were still rationed, a welcome dietary supplement was provided by Nettle Pudding. My mother and I would collect young nettle shoots in the spring (only the apical 10 cm was collected) from the farmland on the outskirts of Brierfield, in north-east Lancashire. I have only a hazy recollection of the recipe; some experimentation may be required.

Yours
JOHN EDMONDSON

NETTLE PUDDING

500 g fresh-picked nettle tips (gathered when the plants are in rapid growth)
2 onions
1 cob of butter
100 g Pinhead Oatmeal, soaked overnight in 1 litre of water
Salt to taste.

* * * * * *

Peel the onions, chop finely, fry in the butter until golden brown.
Add the nettles, followed by the oatmeal and water; simmer for 5–10 minutes until the mixture is of porridgy consistency. Add salt. Serve as a main course (not as a pudding).

I also received a kind letter on the subject of stinging nettles from Dr Richard Schmidt, a dermatologist, who suggested that the sting fluid may also contain a neurotoxin (most probably a sodium channel toxin) in addition to the simple weal-producing compounds acetylcholine, histamine and 5-hydroxytryptamine. I agree the immediate effect of the first encounter with nettles bears this out Editor.

351 Sutton Common Road,
Sutton, Surrey SM3 9HZ

26.1.92

Dear Professor Gardiner,

Many thanks for your help with the mention of floras in the Linnean Society Newsletter.

The following may also be of interest to your readers:

Kew Bookfair: The fourth Natural History bookfair will again be held at the Royal Botanic Gardens, Kew. The dates are Saturday & Sunday, 26/27 September, 10.00–5.30. Once again 25 specialist booksellers from all over the country will be displaying a wide range of secondhand and antiquarian books on natural history, botany and gardening. New gardening and botany books will also be displayed by the Kew shop.

Yours sincerely
MIKE PARK

School of Biological Science,
Massey University,
Palmerston North,
New Zealand

29.4.92

Dear Dr Marsden,

I would like to convey my thanks to the organizers for a runner-up prize in the picture quiz series. I was sent a fine folio of engravings by Hooker with an anonymous covering note and wish to acknowledge this prize.

With best regards
DAVID FOUNTAIN

124 Wood Lane,
Osterley,
Isleworth,
Middx TW7 5EQ

16.1.92

Dear Brian,

I have checked my memory with Doris, who also knew Haldane well, and what he actually said was: "God has an inordinate fondness for beetles". J.B.S.H. himself had an inordinate fondness for the statement: he repeated it frequently. More often than not it had the addition: "God has an inordinate fondness for stars and beetles". It is important to notice that the present tense "has", not the past tense "had" was used. God is eternal and unchanging and so are his preferences.

Haldane was making a theological point: God is most likely to take trouble over reproducing his own image, and his 400,000 attempts at the perfect beetle contrast with his slipshod creation of man. When we meet the Almighty face to face he will resemble a beetle (or a star) and not Dr Carey.*

Doris joins me in sending our best wishes.

Yours sincerely
PROFESSOR K. A. KERMACK

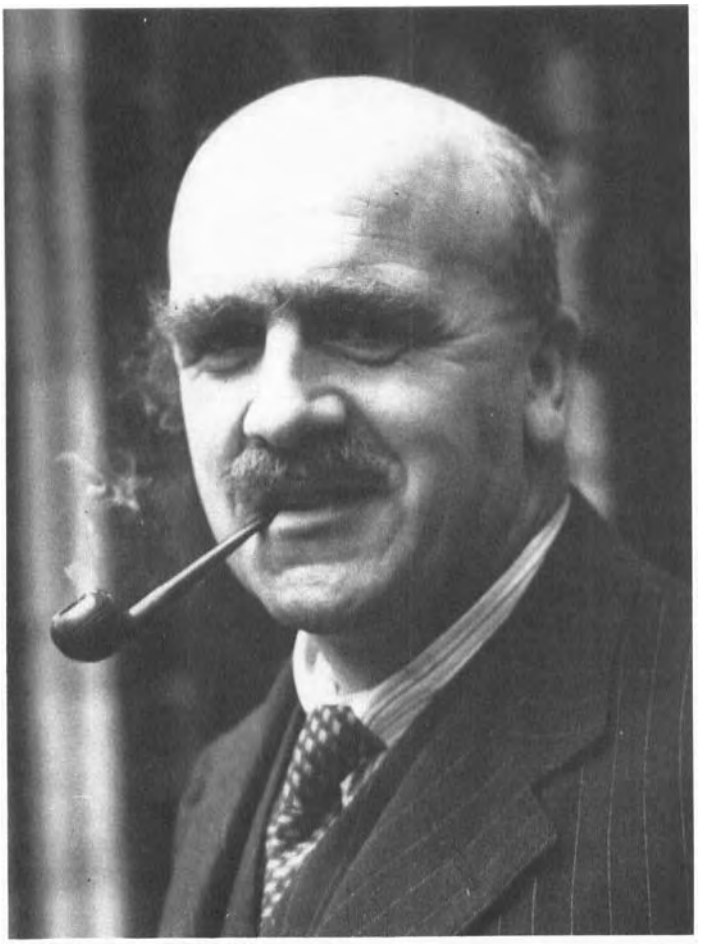
*The Archbishop of Canterbury—Editor.

Haldane's Special Preference

In a recent issue of the *Biological Journal*, Hodgkinson & Casson (1991) once again raise the question of whether J. B. S. Haldane said that the Creator has an inordinate fondness for beetles. Since they submitted their paper, and after it was accepted, a short note in *Nature* leads to the answer. Haldane did say something like that, and no it has nothing to do with T. H. Huxley, J. S. Haldane, Benjamin Jowett or indeed anybody but J.B.S. Nor has it anything to do with Oxford. Huxley was mentioned by Hodgkinson & Casson, J. S. Haldane (who

was J.B.S.'s father) by Passmore (1989) and Benjamin Jowett by May (1989). It was May's suggestion that led to the exchange of letters in *Nature*, notably Colgan's (1990) that supplies the answer.

Jowett, of course, should have known about beetles, and as a clergyman he



J. B. S. HALDANE.

presumably knew about the Creator. He was a famous Master of Balliol College, Oxford, in the nineteenth century and largely responsible for making that college the leading intellectual one. There is a well known poem about him, which is given by the Oxford Dictionary of Quotations (1941) like this:

First come I; my name is Jowett
There is no knowledge but I know it
I am the Master of this college:
What I don't know isn't knowledge

though I prefer another version I've heard "What I know not is not knowledge", with both college and knowledge pronounced with a long o as in know. But,

either way, that last line lets him off knowing about beetles, and as I pointed out (Williamson, 1989), he died before J. B. S. Haldane was one year old.

Before giving the correct quotation, it is perhaps worth noting that the phrase "an inordinate fondness" comes from Hutchinson (1959) who actually said (in a footnote):

> "There is a story, possibly apocryphal, of the distinguished British biologist, J. B. S. Haldane, who found himself in the company of a group of theologians. On being asked what one could conclude as to the nature of the Creator from a study of his creation, Haldane is said to have answered, 'An inordinate fondness for beetles' ".

These words seem to be an invention of Hutchinson's, and if he had a locale in mind it would have been University College, London (Williamson, 1990). What did Haldane actually say?

The reason why the quotation has not been tracked down more easily, is that he did not publish it himself. As Colgan (1990) indicates, what Haldane said was reported by Slater (1951). As that's a rather obscure reference, let me quote from it. The paper is sub-titled "A Report of Professor Haldane's lecture to the Society on April 7, 1951", and says that Haldane prepared it at short notice in place of a promised paper by J. D. Bernal, Haldane "saying that he considered it the duty of another London University Professor to step into the breach".

The paper is a classically amusing one in an unmistakably J. B. S. Haldane style. The passage about beetles comes on page 156:

> "Coming to the question of life being found on other planets, Professor Haldane apologized for discoursing, as a mere biologist, on a subject on which we had been expecting a lecture by a physicist. He mentioned three hypotheses:
>
> (a) that life had a supernatural origin,
> (b) that it originated from inorganic materials, and
> (c) that life is a constituent of the Universe and can only arise from pre-existing life.
>
> The first hypothesis, he said, should be taken seriously, and he would proceed to do so. From the fact that there are 400 000 species of beetles on this planet, but only 8000 species of mammals, he concluded that the Creator, if He exists, has a special preference for beetles, and so we might be more likely to meet them than any other type of animal on a planet which would support life".

Haldane goes on to prefer the second hypothesis. Obviously he would, and equally obviously the first hypothesis is there to allow him to mention an interesting bit of biology. But we still cannot be sure exactly what he said, but my preference is that he said 'special preference' not 'inordinate fondness' or 'predilection'.

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MARK WILLIAMSON

Editor's footnote: I was a research student at University College in the 1950's where thanks to my supervisor– Kenneth Kermack, I was introduced to J. B. S. Haldane and often drank with him, and Kenneth, in the Orange Tree near Euston Station. Naturally I asked Kenneth for his recollections of Haldane and beetles and these are recorded in a letter to me under Correspondence in this issue.

The picture used to illustrate the article is from my personal collection.

Science Policy and the Society

Should the Linnean Society have a permanent Secretariat to handle matters of general science policy? The subject raised its head at a recent meeting of Council, and it would be interesting to know the views of the Membership.

We have Secretaries who handle the disciplinary areas for which our Society has long been renowned—botany and zoology are handled by voluntary Secretaries, and so are editorial matters. Set out like this, there are immediate omissions. We have no 'taxonomy' secretary, for example, and systematics are what the Society is all about.

The reason is that such a topic does not require a full-time Secretarial appointment. That is true—but the subject is raised, none the less, from time to time. Might it not be timely for us to have someone who might deal with enquiries and policy matters in the field when it was raised? We have had a recent example of a policy matter over the future of the London Zoo. It is fair to say, without infringing on the confidentiality of Council discussions, that more than one member felt it would have been useful for us to offer a statement of support for the Zoo. Yet this might have seemed peremptory, even impertinent; and we were caught in a situation where words of sympathy were in need of expression, but the gesture might have been misconstrued.

Policy matters are already in the forefront of Linnean matters. The Government recently launched a Review of plant genetic resources. The subject is one on which our Society is rich in wisdom, replete with insight. We joined with the Institute of Biology in the preparation of a document for submission to the Review committee. The document is an excellent statement of authoritative opinion, founded on the firmest of facts.

The Society also acted as host to a session on the Biodiversity Conservation Strategy Programme—part of the process that led to the great June meeting on the environment in Brazil. Here too, our voice was an important part of the process and our accumulated wisdom was invaluable.

We face a lively and contentious future. The release of genetically-modified organisms into the environment, the concept of conservation and biodiversity, funding in science and the future of specialist centres like the Natural History Museum (quite apart from the Zoo) are special areas on which Fellows have expertise to offer. In cases like these, I feel we ought to have machinery to solicit and coordinate specialist opinions.

The facility under consideration would not be some autonomous group free-

wheeling its own way. The Science Policy Secretariat would help the President and the Executive Secretary in coordinating pressure of opinions, and in generating a sensibly positive lobbying movement. It would be a close parallel to the Curators and Secretaries who are already approached when specialist responsibilities are sought.

I believe the Society has a new rôle to emphasize. We are the premier learned society for biology in Britain. Yes, the Institute of Biology has a major rôle in all this—but the Institute is a professional body. Its function is even broader now that it has subsumed the former Biological Council under its responsibilities. We are academic, rather than professional; learned, rather than technical; practical, rather than applied.

The Linnean Society fosters social contact in a way the Institute does not, and we generate discussion and the exchange of views at our meetings that is unique in British scientific society. Communities are seeking remedies that, increasingly as time goes by, have their origins in the world of biology. Genetic engineering is an extension of the very interests which made the Society what it is, and the need for considered opinions in these matters is going to become urgent in the near future.

What are your own views? A summary of opinions will be presented to Council at the earliest opportunity. Do write. A letter to the Executive Secretary, endorsed 'Science Policy', will home in on the right destination.

BRIAN J. FORD

H. G. Wells and F. O. Bower: a mutual antipathy?

F. O. Bower graduated at Cambridge in 1877 with first class honours in Botany in the Natural Sciences Tripos. There was no opportunity of a Fellowship, and for the next two years he gained a limited amount of teaching experience via a Cambridge committee associated with higher education for women, and by forming a partnership with a zoologist, Adam Sedgwick, to coach students for the 1st M.B. examinations. He left Cambridge in 1879 "... with many regrets", was appointed Assistant (part-time) to Daniel Oliver at University College, London, in April of that year, and spent the 1879 summer vacation and the 1879–80 Winter Semester studying under de Bary at Strasbourg. The opportunity in the summer of 1880 to commence research at the Jodrell Laboratory in Kew Gardens under W. T. Thiselton-Dyer (Assistant Director) was one not to be missed, and gave an additional encouragement to remain in London and await developments. In November 1881 a Lectureship in Botany was advertised for the Normal School of Science in South Kensington. He was duly appointed to this post and at last obtained gainful employment, some four years after graduation.

The Normal School of Science was a new foundation formed by an administrative metamorphosis of the Royal School of Mines, so broadening its scope. Both were under the aegis of the Science of Art Department. The principal function of the School was to train science teachers over a three-year period of full-time attendance. T. H. Huxley was its Dean (a title which was a source of

much amusement to Huxley and his friends), and the head of the professors. These courses for teachers had grown from shorter 'crash' courses initiated by Huxley in 1871, and at first held in the new building of the School of Mines erected at South Kensington. W. T. Thiselton-Dyer was the first botanist to be involved in the teaching of the botanical part of the course in 1875, and in so doing had been instrumental in introducing the so-called 'botanical renaissance'—the laboratory approach to teaching the subject—in Britain. Bower, himself, had obtained a glimpse of the 'New Botany' in his last year as an undergraduate at Cambridge. S. H. Vines, fresh from working with Thiselton-Dyer, brought the new 'gospel' to Cambridge on his appointment as Lecturer in 1876. Thiselton-Dyer continued the spread of the 'gospel' through the appointment of young recently graduated botanists as Demonstrators at South Kensington, including Bower, in the period before his full-time appointment. At the beginning of 1882, however, Bower would have been well pleased with his situation. A Lectureship in London, which also would allow sufficient time during the academic year for him to continue with his researches at the Jodrell Laboratory—teaching in a recognized institution under distinguished and famous scientific leader, and research at a prestigious establishment where he was to become the protégé of both Sir Joseph Hooker (Director) and Thiselton-Dyer: an ideal situation in which to gain experience and await future promotional opportunities.

The Botany classes were of relatively small size at the Normal School. The students either had scholarships from the Science and Art Department or were privately funded. In the jargon of their teachers, scholarship holders were the 'Government men'. Their tuition fees were paid, and they received a weekly maintenance payment. A youthful Oliver Lodge was one such student. In later life he recalled having to sign in before 10.00 a.m. of a morning. After this time, the clerk drew a line in red ink across the page, and any student signing in below this line was fined a small sum from the weekly allowance, which was £1/10/- in Lodge's time.[1] In late September 1884, an excited eighteen-year-old enrolled for the first time at the Normal School. Herbert George Wells had gained his scholarship via an unusual background. After a patchy early schooling, he had experienced an abortive apprenticeship to a tailor in Windsor, followed by an equally short association with a pharmaceutical chemist (an experience later incorporated in his 1909 novel *Tono Bungay*). The need for a knowledge of Latin for the profession led to some coaching from the Headmaster of the nearby Midhurst Grammar School, but the fees necessary for qualifying as a Chemist and Druggist foreshortened this career choice. Then for two years (1881–83) he was again apprenticed, this time to a draper in Southsea, an episode remembered with some distaste, and in later life forming the basis of his novel *Kipps* (1905). He escaped from this drudgery by becoming a pupil teacher at Midhurst Grammar School. By dint of dedicated study he obtained distinctions in a number of subjects in the 1884 summer examinations of the Science and Art Department, bringing rewards both to himself and to the Headmaster. Wells was given a scholarship for the Normal School, and the Headmaster received financial rewards.

In his autobiography Wells described that first day when he walked from his lodging in Westbourne Park to South Kensington and enrolment at the Normal School as "... one of the great days of my life".[2] For the first time he was to work

with animals and plants in a real laboratory—all his previous scientific knowledge had been derived from books. He was to be taught by T. H. Huxley, "... the acutest observer, the ablest generalizer, the great teacher, the most lucid and valiant of controversialists". However, Huxley left London in early October for Italy, there to undergo a prolonged recuperation from his chronic ill-health, not returning until April of the following year. Hence Wells's experience of Huxley's teaching would have come later on in his first year, but for the remainder of his life he would state with pride that he was one of "Huxley's men".

In July 1884, the Council of the Normal School had decided to institute an administrative change in the Elementary Biology course. For the 1884–85 academic session there was to be a "true dichotomy" (as Bower described the change) with Zoology being taught in the first term and Botany, as a separate subject, to be taught in January and February, each course to be separately examined at the end of the period of instruction. Bower kept records of his students and their examination results. In the 1885 Botany course, which commended on 6 January, nine students were enrolled[3]:

Miss L. J. Clarke, Miss A. L. Taylor, T. K. Holden, H. G. Wells, W. H. Hodgson, A. V. Jennings, -. Miller, H. Fisher, M. F. Woodward.

It is not known who were the other 'Government men' besides Wells. Wells's accounts of his South Kensington student days are to be found in three sources: his autobiography,[4] a short story published in 1893 under the title *A Slip under the Microscope*, and the novel *Love and Mr Lewisham* (1900). According to Wells, in both the short story and the novel he rendered "... something of the physical and social atmosphere of that early biological laboratory". In these sources we may hope to see something of his reactions to the 30 days of botanical teaching under Bower.

We look in vain in Wells's autobiography. His impressions of Huxley naturally hold priority—the striking appearance of the man and his elegant style of lecturing. Bower never forgot the first lecture he delivered at the Normal School in May 1882, with Huxley in attendance, and the advice he received afterwards on improving his lecturing style.[5] In later years when Professor at Glasgow, Bower made a point of advising newly appointed Assistants on lecturing styles—to avoid talking to the blackboard (Huxley's advice in the summer of 1882); how to pitch one's voice with large classes; and to take particular care with blackboard diagrams, using different thicknesses of chalk to emphasize points of detail. For Wells, that first year was remembered (on paper) solely in terms of Zoology. With Huxley away in Italy, his Assistant, Thomas George Bond Howes, gave the lectures in that first term. Howes was "a white-faced, black bearded, nervous man, a sort of Svengali in glasses; swift and vivid, never still ... uneasy, brilliant, lecturing and drawing breathlessly, and leaving the blackboard a smother of graceful coloured lines".[4] Howes, of a similar age to Bower, was to succeed Huxley at the Normal School and to become Professor of Zoology in its lineal descendant, the Royal College of Science, in 1895. He died in 1905. According to Wells, that first year at South Kensington, first under Howes and later under Huxley, was one in which he was never happier. He achieved a first class pass in the December Zoology examination (80% and over), and another first class in the summer of 1885 after completion of the Advanced Zoology course.[6] But of the Botany class there is no mention. Bower had Howes and T. Johnson, who was later to hold a professorship in Dublin, as

Demonstrators that year. According to Bower's records, the Botany examination in late February 1885 gave the following results: Miss L. J. Clarke 34%, Miss A. L. Taylor 69%, T. K. Holden 83%, H. G. Wells 76%, W. H. Hodgson 65%, A. V. Jennings 83%, -. Miller 66%, H. Fisher 69%, M. F. Woodward 70%.

Together with the two first class passes there were six in the second class (60% and over) with Wells heading that group. If Wells knew of his marks he may well have resented coming so close to a first class pass mark. In the previous Zoology course only he and M. F. Woodward had achieved first classes. Of the members of the group, A. V. Jennings became a close friend in that first year. Jennings, the son of a master in a London school, was somewhat better read that Wells, but the two enjoyed lively discussions on religion, politics and science. As a 'Government man', Wells's maintenance allowances of £1/1/- weekly paid out on a Wednesday (seemingly reduced from Lodge's time?), left him 1–2/- per week for midday meals. Usually by the Monday following he was broke. As Wells described, he spent that year " ... shabby, getting shabbier, ill-housed", but at the same time, studying "with enthusiasm and exhaustively". Jennings had insisted on standing him at least one square mid-day meal. As Wells was to note, this personal concern " ... still glows bright in my memory".[4] A few years later, Jennings, by now a Lecturer at Birkbeck College in London, again came to the rescue when the newly married Wells was in dire financial straits as a struggling author.[7]

In the absence of any reference to the Botany course in Wells's autobiography, can anything be learned from the short story *A Slip under the Microscope?* According to Wells, this was "A very carefully done short story". The story revolves around three people and a Botany practical examination at the Normal School, Hill, a cobbler's son and a "Government man", Wedderburn, a fee-paying student, and the botanist Professor Bindon, a Cambridge graduate who carries out research at Kew Gardens in addition to teaching at the Normal School. In the examination, the candidates are asked to identify a specimen on a slide, already focused and fixed on the stage of the microscope. Strict instructions were also given that the slide must not be moved, since this would enable a more ready identification of the "spot". Each student in the class is allowed time in rotation to examine the slide. Hill immediately recognizes that it is a section of the lenticel of an Elder stem. Inadvertently, and from force of habit, he moves the slide—unnecessarily since he has already recognized both the structure and the plant from which it was obtained. He immediately restores the slide to its required position. Having broken a strict rule of the examination he now agonizes whether he should record his answer, and at the last minute decides to do so. In the list of results published soon afterwards, Hill heads the list just ahead of Wedderburn. But Hill continues to agonize about the ethics of his 'slip', and eventually he confesses to Bindon. Bindon throughout the story appears the least attractive of characters. In appearance he is described as a "fat, heavy man, with a white face and pale grey eyes". His manner is described as "fussy and conscientious", with some pedantic examination rules, such as placing a 'Door Closed' notice outside an obviously closed and locked door. Bindon's response to Hill's confession is one of outrage, primarily concerned with the administrative difficulties which will arise from such an avowal. His diatribe includes " ... Professors in this College are machines ... I am a machine and you have worked me ...I can't understand this avowal. You're a type of student—Cambridge

men would never dream—why did you cheat?" Hill is subsequently expelled, and Wedderburn, who by implication also moved the slide but saw no reason to confess, moves into the first place on the list of results.

Was Bindon in any way modelled on Bower? Not in physical appearance. Bower was of stocky build with a healthy colour—a one-time medical student of his in the 1900s described him as a stocky bearded man looking like a sea captain.[8] Fussy and conscientious? Both colleagues and students have paid tribute to his conscientiousness in class work. He was a strict disciplinarian when necessary, and not unknown to exhibit a fiery temper on occasions. But that was handling large classes of 200–300 medical students at Glasgow! Perhaps a strict application of rules might be interpreted as fussiness? Had Wells considered that the Botany course was not as well taught as Zoology he would surely have said so. In the following 1885–86 session he studied Physics under Professor Frederick Guthrie and his Assistant, C. V. Boys. Wells was critical of Guthrie's lack of dynamism in lectures, and the poor organization of the practical classes, although acknowledging that Guthrie was mortally ill at the time. But the lectures of C. V. Boys on thermodynamics were castigated. Boys was already recognized as a brilliant physicist, but according to Wells he was largely inaudible in lectures, " ... one of the worst teachers who ever turned his back on a restive audience, messed about with the blackboard, galloped through an hour of talk, and bolted back to the apparatus in his private room".[4] Boys was the same age as Bower, and was to be elected F.R.S. in 1888. After a distinguished life in Physics, he was to be knighted in 1935—the year after publication of *Experiment in Autobiography*. Hence, if Bower's teaching had been at fault, Wells would not have restrained from criticism, which would be voiced irrespective of the age and eminence of the person concerned. The year with Physics was a disappointment after the inspiration of the first year, and Wells was relieved to obtain a second class which at least enabled him to retain his scholarship for a third year, this time in Geology under Professor Judd. Judd was a better teacher than Guthrie or Boys, but without the imaginative flair exhibited by both Huxley and Howes. According to Wells, Judd tried to mould his students in his own geological image by a process of over-control. Whilst with Huxley the science came first and foremost, with Judd the goal was to produce Judd-like geologists, similar in their approaches, thoughts, analyses, and all with identical records and drawing in their practical notebooks. The physical appearance of the botanical Professor Bindon in the story more closely resembles that of Judd—together with, possibly the fussy and over-conscientious attitude?

In *Love and Mr Lewisham* we read of an ambitious young man, George Edward Lewisham, a teacher in a small private school at the start. His qualifications enable him to enter the Normal School—all part of the *Schema* he had laid down regarding his future academic career. The main part of the story joins him in his third (biological) year. His lovelife and early marriage have somewhat interfered with the passage of his *Schema* and with the attendant interference with his studies, at the end of the first term and the Zoology examinations he " ... ingloriously headed the second class". Lewisham considers the practical examination to have been unfair, and the written examination to have included questions quite outside the syllabus. In this instance it is a Professor Biver who comes in for castigation. Later in the book this result is again referred to as a "... disaster of an examination". The domestic distractions lead to inattention and a

poor attendance in the following Botany course, when the lamentable standard of his section cutting (a fern root) draws an observation from the botanist, again Professor Bindon, that "... never had a student been so foolishly overrated".

Hence the only references to the Botany course in the Normal School from Wells are the indirect ones of an unfavourable nature. Nor does the fictional Professor of Botany come across as a very attractive character. (Nor for that matter is a good impression made on the reader by *The Botanist*, the companion to the narrator in the 1905 book *A Modern Utopia*). C. P. Snow, in a brief but perceptive review of the life of Wells, described him as a very honest man.[9] All available evidence points to Bower having been a good teacher from the start. In the 1884–5 session he would have had some three years of class experience, and some peer testimonials in 1883 when he made an unsuccessful application for the Sherardian Chair of Botany at Oxford underlined his prowess as a teacher. In the spring of 1885 Bower (to his complete surprise) was appointed to the Chair of Botany of Glasgow. In this new appointment he soon established himself as an accomplished teacher, much appreciated by his students[11]—medical students in their hundreds who had a tradition of vociferous disapproval of poor performances in the lecture room (as suffered for many years by one of Bower's Glasgow predecessors, G. A. Walker Arnott (1845–68) who seemingly lacked any ability for class control). Wells could not criticize the teaching and laboratory organization of the 1885 Botany course, which was certainly of a higher standard than in the Physics course although not attaining the heights of the Huxleyan lectures. In later life, Wells acknowledged that the second class passes in the Physics and Geology courses were to be expected—at the time even accepted with relief in that the continuation of his scholarship was thus guaranteed. That first year studying the biological sciences at the Normal School was to be one of outstanding memory—one of the happiest years in his young life. There was the one blemish—the second class pass in Botany to set against the first classes in Zoology. Was there a lingering resentment on Wells's part? Whilst Bower could not be criticized directly, was there some character transposition with Judd being the real model for Professor Bindon in the 1893 short story? Wells had begun to flex his intellectual muscles during that first year at the Normal School. Discussions with A. V. Jennings on science, religion and politics had brought constructive reactions, and in his second and third years at the School these interests in the wider fields began to compete seriously with a lowered interest in the relevant science courses, especially with his involvement with the School's Debating Society. Here his socialist leanings and anti-religious views gained him some notoriety. Bower by background and upbringing was a staunchy conservative individual, and remained so throughout his long life. His abhorrence of 'Bolshevism' in any form was to become apparent in later years.[11] Did he find these revolutionary manifestations of one of his pupils mildly irritating? The teaching staff at the Normal School met regularly for lunch in the nearby Natural History Museum, and there were lively discussions in which the progress and attitudes of their students would have featured. Bower, however, was essentially a fair-minded person, so that Wells's second class may have been justified. Notably, in the small notebook in which the records were kept of his students and their results at the Normal School,[3] Wells's name is doubly underlined in pencil and asterisked—a much later addition when the one-time student was a world famous author.

Whether Bower read extensively of Wells's works is not known. He certainly enjoyed reading the Victorian novelists—e.g. Trollope's Barsetshire novels, and much of Dickens. The latter's *Bleak House* was favoured holiday reading in Bower's latest years. If Bower knew of Bindon (and well he might), there could have been some lingering resentment on his part. Some evidence of this is to be found in later correspondence with C. W. Wardlaw, his Assistant at Glasgow in 1925 at the time of his retirement. In 1937, Wells was President of the newly formed Section L (Education) at the Nottingham meeting of the British Association for the Advancement of Science. His presidential address was something of a *tour-de-force*—an outline curriculum of general education covering the entire school life of a child. This would have a sound scientific basis, linked with history, geography, personal sociology, politics and social organization skills. The address gave rise to a welter of comment, favourable and unfavourable—just as Wells would have expected and hoped for. Bower received a report on the address from John Walton, at that time Lecturer in Botany at Manchester, and in due course to be Regius Professor at Glasgow (1930–1962). In his letter to Wardlaw, Bower included the following:[12]

" . . . Walton writes to say that H. G. Wells acted the clown . . . Talked only in terms of the eighties . . . Wells simply showed himself what I always thought of him—a very clever man but not first rate. I gave him a second class in Botany at S. K. in the early eighties".

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A. D. BONEY

Was Linnaeus a Rosicrucian?

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Linnaeus's collection of printed books, now in the Linnean Society's possession, is mainly a working library of zoology, botany, mineralogy, materia medica and medicine, but it also contains a number of occult or semi-occult treatises, at least one of which was actually bought by him in his impoverished youth. Historians have been reluctant to take seriously Linnaeus's theory of the cortex and medulla as the means of evolution of most plants by hybridization and the key to all medicine. They have noted with amusement his extremely conceited estimate of his personal relations with God. If he viewed himself as an illuminatus, or magus, both become intelligible; he was discovering active *principia* and thereby seeing further into the secrets of Nature than anyone else, for which he gave due thanks. He differed from Renaissance neo-Platonists and Hermetic magi in rejecting astral influences on Man, and from the original Rosicrucians also in not taking Christ as the Archimagus. His lack of references to Christ, however, is shared even with wholly orthodox Anglican naturalists and natural theologians, and cannot be taken as evidence for his unorthodoxy. His use of *affinitas* has probably been taken in too modern a sense. It is suggested that some of the correspondences he noted in the Testacea encouraged him to believe that the rudiments of the plan of Creation were already becoming visible.

KEY WORDS: Linnaeus – magi – *principia* – Rosicrucians – *affinitas* – plan of Creation – Testacea.

CONTENTS

INTRODUCTION

No one, to my knowledge, has examined Linnaeus's library as a whole, to find out what his general scientific and philosophical beliefs were—if indeed they can be found out now. We know from his pupil Fabricius (in Stoever, 1794: 280–281) that:

> " ... he dared not, as he himself assured me, publish those observations [of the "most secret mysteries of nature"] during his life, because he was afraid of the excessive violence of the Swedish divines, who, frequently too faithful, and too bigotted to their own arguments, do not consider, that nature as well as revelation proclaim in unison of principle, the hands of that GREAT MASTER, who formed both. LINNAEUS had the example of his pupil

> FORSKAL before his eyes, who immediately after his return from *Goettingen*, saw himself involved in so many theological disputes, as would, perhaps, have been carried too far, had he not left the field of litigation, by setting out on his voyage to *Arabia*".

That Linnaeus himself was not always regarded as wholly orthodox, we also know; some indications on this are given in important essays by Broberg (1980), Lindroth (1983) and Frängsmyr (1983).

The question of what Linnaeus really believed is forcibly brought up by an examination of his library. Most of it was a thoroughly utilitarian assemblage of medical, pharmaceutical, botanical, zoological and mineralogical texts. We are told by Stoever (1794: 261–262) that:

> "He loved the *Belles Lettres* and even when old age had chilled the brilliancy of his imagination, would frequently read OVID and VIRGIL, and rehearse with ease and pleasure several passages from the works of these poets".

Ovid's *Epistles* and *De arte amandi* are indeed in the Linnean Society's lists, but not Virgil, and little else classical except Seneca and Pliny. One or two books of history, one or two legal works, two or three religious ones (only one, perhaps, to be called theological), a few maps and charts, a few treatises on Swedish antiquities and several funeral orations almost exhaust the non-professional works (if we call him a medico-naturalist)—with an important exception. There is a certain number of treatises which must be called occult or at least semi-occult. By 'occult' or 'magical' I mean employing the action of hidden powers and/or intelligences other than God or Man to explain natural phenomena. By 'employing' I mean either using them as explanations, or actually invoking them, or both.

The original Rosicrucians in the early 1600s, as depicted by Yates (1972), were intensely pious Protestants, acutely aware of the necessity for a reformation of religion, science and society, and expecting it to be fulfilled soon partly by their own efforts. They looked to a vast survey of Nature, and to the development of experimental and especially technological science, to produce such benefits for all men that Mankind would in large measure regain the dominion over Nature exerted by Adam before the Fall, and the insight into the operations of nature which he had possessed. Their sciences included all the wisdom of the past, magical, cabalistic, astrological, alchemical and medical, to be tested and added to by the observational, mathematical and experimental methods of the present. The investigation of God's works in Nature, as effected by his Son, would illuminate the mind and raise it closer to God's; it was an occupation of the highest piety.

In Scandinavia in Linnaeus's day, religious reform had been established already. Mathematics and experimental physics were not suited to his particular genius. Nevertheless, there was much in Linnaeus corresponding to this characterization, including thoughts and theories usually passed over as ridiculous but of the highest importance to him.

SOURCES OF INFORMATION

Unfortunately (for the present purpose) a considerable number of general and medical works from Linnaeus's library were returned by the Linnean Society of

London to Sweden (the Royal Academy of Sciences, Stockholm) in 1894, presumably as being of little interest to taxonomists. The relevant Council minutes read as follows:

> "The old medical books from the library of Linnaeus which had been inspected by Dr Carruthers and Mr Daydon Jackson, it was decided should be offered to the Royal Academy of Sciences at Stockholm. The sale of certain other volumes which had belonged to Sir J. E. Smith was also sanctioned ... [Council Minute Book no. 7 (1891–1902), 7 June 1894].
>
> Pursuant to directions given by the Council, the Medical and other works from the Library of Linnaeus proposed to be presented to the Royal Academy of Stockholm have all been arranged and catalogued, the titles of all being checked with the annexed list, (Guard Book [no. 3] page 24), of which a duplicate was sent to the Secretary of the Academy, together with a letter from the Senior Secretary [Council Minute Book no. 7 (1891–1902), 1 November 1894].

They include many, but not all, of those specially interesting here. I have not been able to travel to inspect them, but the nature of several is well known and extensively discussed.

I have compared three lists and catalogues to get as full an idea as possible of Linnaeus's library. These are (i) Sir J. E. Smith's MS checklist of Linnaeus's library, 1784, as annotated in 1923 by the then Linnean Society librarian, Spencer Savage; (ii) the 1866 catalogue of the Linnean Society's library, extracted for Linnaean items and extensively supplemented in an unknown hand, and (iii) the very careful MS catalogue by J. M. Hulth, 1925, of the books returned, annotated by Spencer Savage (probably).

Linnaeus's library has passed through some vicissitudes. Smith noted in his checklist that he gave away a few works, and in his letter printed in Stoever (1794: 311–316) he mentions that he gave a few English books from it to Johan Gustav Acrel, who acted as his agent in Sweden for the acquisition of the Linnaean library and collections. The library went with the Linnean Society in its various moves, and at one time was in Sir Joseph Banks's library. According to the annotations several books are missing, though fortunately some turn out to have been sent to Stockholm, as is known from Hulth's catalogue (as is the fact that a few sent there are not Linnaeus's). There are certainly volumes of his elsewhere, but the bulk of it is in London.

Hulth's catalogue and Savage's *Synopsis* (1940) of annotations in Linnaeus's books also enable one to list a number of dates of acquisition and (rarely) how they were acquired. Linnaeus made such annotations (as against those on subject-matter) almost entirely when he was at school, at the gymnasium, and in his first University years; very few indeed are later.

THE NATURE OF LINNAEUS'S LIBRARY

As Savage has already said (1940), Linnaeus's library is that of a working naturalist and medical man with no interest in books as such. It is difficult to classify into distinct subjects, many of the botanical and some of the chemical having some, or much, relevance to materia medica. Figure 1 shows the

distribution by date of publication of those roughly classified by Sir J. E. Smith as medical and general. (The only effect of some being misclassified should be to blur the differences in the distributions.) One is struck by the immense period backward in time that is occupied. This is mainly due to the slowness with which some medical books became out of date at that period. The peak about 1680–90 seems to be of books still modern when Linnaeus was in medical training. He continued to acquire medical books but in decreasing numbers. If one takes the dates of works sufficiently outstanding to be mentioned in Garrison's history (1921) of medicine (dotted line), there does seem to be a falling-off in Linnaeus's interest in medicine. A graph based on the Hulth catalogue of the returned

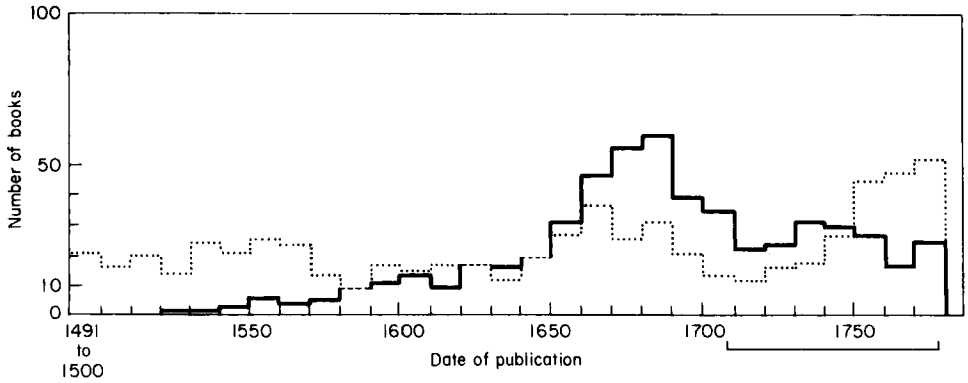

Figure 1. Distribution by date of publication of Linnaeus's books classed by Sir J. E. Smith as medical and general. Dotted line, distribution of medical books in the same period, mentioned in Garrison's history of medicine (1921). The bar below the abscissa gives Linnaeus's life-span (1702–1778).

medical and general works (Fig. 2) which is a subset of that shown in Fig. 1 agrees very closely with it. (Indeed, it comprises most of those in Fig. 1 in the last 30 years of Linnaeus's life; one wonders on what principle it was selected.)

The opposite is true for his acquisitions in natural history (Fig. 3). He himself, no doubt, spurred on others, who would gladly send him copies of their works, which may well have contributed to the very high peak about 1760–70. Even if we halve this peak, the contrast with Fig. 1 is remarkable.

The distribution by dates of publication and acquisition of the works in which Linnaeus noted the date (and occasionally the method) of acquisition is shown in Fig. 4B. A number came to him from his father-in-law, Johan Moraeus, town-physician of Falun (it is not recorded whether by sale, gift or inheritance). In none of these did Linnaeus note his date of acquisition but in nearly all, Moraeus noted *his* date, and the resulting distribution is shown for comparison in Fig. 4A. For both owners the range of date of publication is huge, from the 1550s (Moraeus) and 1530s (Linnaeus) until the then present year or nearly. Moraeus had a 1555 Brassavoli on purges, a 1627 introduction to medicine by Heurnius, and a 1639 Hippocrates. Linnaeus had a 1553 and a 1609 Hippocrates, a 1573

Salernitan regimen, and a 1585 general practice of medicine by Wecker. Moraeus acquired medical books even in the year of publication, Linnaeus usually only after a few years' delay at the earliest.

The number of books in which Linnaeus put dates of acquisition falls off rapidly, and after 1740 is too small to be of use. But there is a strong suggestion (Fig. 4B) that the later the acquisitions, the more modern they were. His very old works, therefore, were not acquired as the result of antiquarian interests in his old age. All of Moraeus's acquisitions that were transferred to Linnaeus were medical with one exception (a Barclay's *Argenis* of 1623) and obtained, according to his annotations, in Leyden (most of them), Amsterdam, Hamburg and Paris, presumably when he was taking his medical degree abroad in 1703–4, just as his prospective son-in-law Linnaeus was to do at his insistence in 1735. Linnaeus right from the start was acquiring not only medical but also natural history and other scientific works. Some such as Clusius's Latin edition of Acosta's history of aromatics and medicaments (1593) could be regarded as partly natural-historical, as well as medical. Sennert's epitome of the natural sciences (1636), Bang's compendium of them (1599) and Burser's introduction to them (1652)

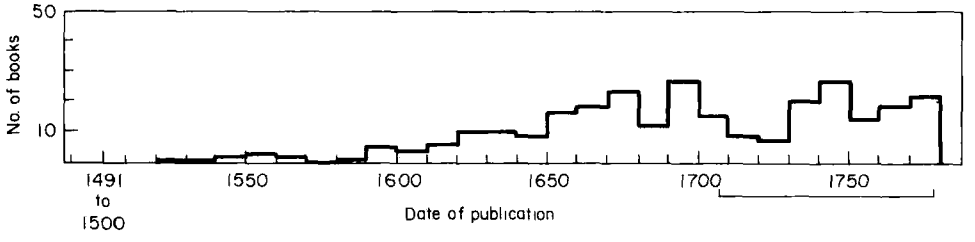

Figure 2. Distribution by date of publication of Linnaeus's medical and general works returned to Sweden in 1894, from Hulth's MS catalogue. Bar as in Fig. 1.

suggest wider interests even if they are old-fashioned and highly Aristotelian. Of particular note here are those that seem definitely occult—and the one or two that may be anti-occult.

LINNAEUS'S OCCULT BOOKS

Among the books with dates of acquisition are the collected works of Henry Cornelius Agrippa of Nettesheim (1531) inscribed as actually bought by Linnaeus at Växjö, 8 October 1725; this was at a period when funds were presumably not plentiful. It is the first book he bought for which we have an exact date of acquisition. This suggests strongly that he had a real interest in it—it was not merely a gift, for example, which he might have accepted out of politeness (and he also annotated the text). Agrippa's status as a Renaissance magus, if a highly Christian one, has been commented on by Yates (1966, 1979), Nauert (1966) and French (1972).

This is the only outright magical book for which we have a date of acquisition but among those undated are several others, magical or semi-magical. All are listed in the Appendix, and Fig. 5 gives their distribution by date of publication. The earliest are editions of Agrippa, Ficino, Isaac, Lullius, Roger Bacon, Gratarolus and Lemnius, stretching from nearly the original printings of Renaissance neo-Platonist magi to late reprints of mediaeval authors. One is a reprint as late as 1717 of a work of 1611, Albinius's *Magia astrologica*. It was republished together with Camillus Leonardus's *Speculum lapidum* and Peter Arlensis de Scudalupis's *Sympathia septem metallorum ac septem selectorum lapidum ad planetas*. This volume was only seven years old—very up to date—when Linnaeus entered the Växjö gymnasium in 1724.

A work of 1647 entitled *Tractatus aliquot chemici singulares* contains among other items the *Rosarium, secretissimum philosophorum arcanum comprehendens* of the English alchemist John Daustin or Dastin, who flourished about 1320, and *Fragmenta* of Edward Kelley (1555–1595), the alchemist, scryer and assistant to the notorious John Dee. Van Helmont appears in a *Theatrum sympatheticum* of 1661 (along with Digby, Papin and others) and in his minor medical works (1664). Nathan Albineus's *Bibliotheca chemica contracta* (1673) includes the anonymous *Arcanum hermeticae philosophiae opus* with the motto *Spes mea in agno* ("My hope is in the Lamb", i.e. Christ). Two or three books refer to hermetic remedies or the hermetic art in their titles. There is also a German chiromantic and physiognomonic collection *(Klee-blat)* of 1695, and a (I presume pseudo-) Lullian treatise *Elucidatio secretorum . . . lapis philosophorum* of 1602. Lullius does not appear as an exponent of the Combinatorial Art, the analysis and magical manipulation of the world by combinations of mystic numbers, but there is the *De arte magna . . . sive combinatoria* (1674) of Quirinus Kuhlmann.

In view of the close association between emblems, magic and memory, we should include here also two emblem books by Camerarius (1590 and 1595) and Mylius (1597), even if Linnaeus did put an air of scientific respectability on them by including them in his *Bibliotheca botanica* as printed in the *Philosophia botanica* (1751) (not in earlier editions).

It is true that Linnaeus had one apparently sceptical book, Anton Günther's *Thessalus in chimicis redivivus, id est de vanitate medicinae chymicae, hermeticae, seu spagiricae dissertatio fundamentalis* (1640)—I have not been able to examine this. In the collected works of Agrippa is his *De vanitate scientiarum* originally published in 1530, which appears to be highly sceptical of all merely human knowledge; exactly how far it was meant seriously is discussed by Yates (1964). The general impression given, however, by Linnaeus's collection is of considerable interest in the magical and occult.

It might be thought that this interest was a youthful and passing phase. Linnaeus's great friend of his student days, Artedi, was certainly a devotee of alchemy as distinct from chemistry, as Linnaeus tells us in his so-called diary (Pulteney, 1805: 519). But the acquisition of several books on the hermetic art or related topics suggests an interest on which he was prepared to spend money—and he kept the books. Moreover, a youthful enthusiasm, without being followed up in detail, may colour a whole life. Nothing can be proved as yet, but it would be unwise to dismiss the possibility of a strong magical tendency in Linnaeus's thinking, Christianized of course—but then, so was Henry Cornelius Agrippa's.

POSSIBLE INDICATIONS OF LINNAEUS'S THOUGHT

Linnaeus's insistence on several occasions in works of his maturer years that the Creator worked from the simple to the composite and his calculation of the total possible number of genera suggest a combinatorial trend in his thinking. This is especially noticeable in his theory of the evolution (in the modern sense) of living things by combinations of various cortices and medullae, the first combinations being by the direct action of God, the later by Nature. The ancient theory (it is found in Theophrastus and Pliny) that plants are made up of an inner medulla and outer cortex was elaborated by Linnaeus into a theory of

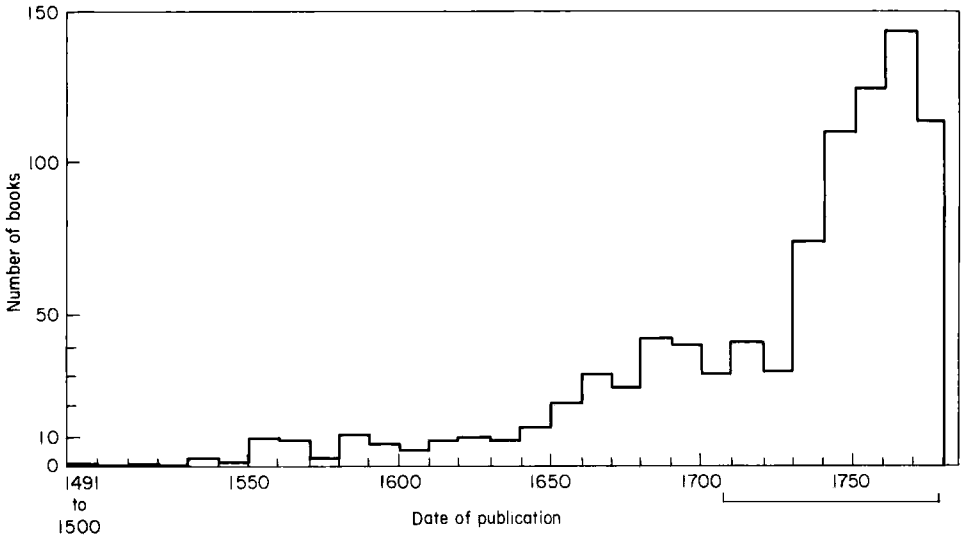

Figure 3. Distribution by date of publication of Linnaeus's books classed by Sir J. E. Smith as of natural history. Bar as in Fig. 1.

sexuality, the outer cortex producing the male organs, the inner medulla the female ones. This he held to be true for all living things. He actually refers to the reproductive faculty in animals, or the body cavity containing it, as *Genialis spermatica, combinatoria*, in the 12th edition of the *Systema Naturae*, Vol. 1: 16 (1766a). His occasional statements that the arcana of Nature can be penetrated only by the few, and his ecstatic thanks to the Creator for favouring him (Linnaeus) so highly in allowing him to see so many of them, might well suggest that he thought himself to be one of the great illuminati.

In the 12th edition, 1766a, of the *Systema Naturae* (12 SN, Vol. 2) paragraph 26 Linnaeus discusses the *principle* of fructification *(principium fructificationis)*, gives detailed expression to this progress from simple to composite by the Creator, and refers to "the first vegetable principle" (*a primo Vegetabili principio*) out of which He made as many plants as there are now Orders. The Lichfield translation by "a Botanical Society" (Erasmus Darwin and others, 1783) gives this phrase as

"at the beginning of Vegetation"; von Hofsten (1958) renders it as "the first vegetable principle"—surely correctly. Linnaeus does indeed use *principium* for a beginning (e.g. in the *Philosophia Botanica*, 1751, para. 132). But he also refers to *principia physiologico-mechanica* (*Phil. Bot.* para. 49) and to a *principium constitutivum* (4 SN, 1744, *Methodus*; 6 *Genera Plantarum*, 1764: *Ordines naturales* 1; translation in the 1957 facsimile of *Species Plantarum*, 1753). His usage does not have full logical or philosophical rigour, but apparently, he can think of *principia* as agents, like the forms of Aristotle. This appears to be that meaning of *principium* which Bremekamp (1953: 247) found incomprehensible.

Von Hofsten (1958), in discussing Linnaeus's theory of the evolution of new forms by crossing, remarks (p. 74) "This theory was absurd"—which it cannot have been to Linnaeus—"Linnaeus realizes the difficulties in so far as he declares that the blending and crossing of the primordial plants, representing orders, was accomplished by the Creator "by an art reserved to Himself" ... the nature of which—for excellent reasons—remained unexplained ..." (pp. 74–75). But the action is no more mysterious than the creation of anything in the first place (compare 1 SN, *Observationes in Regna III Naturae*, para. 7) or indeed of the action of the magnet on iron but not on brass. And later (p. 77):

> "Linnaeus certainly believed in his new idea, but he never pretended that his arguments were conclusive. Certainly the hypothetical form is not, or not essentially, a veil put on for fear of offending current scientific or theological doctrines, but is quite honest. Linnaeus, perfectly aware of having no proofs of his ideas, must have recoiled from the consequences; probably, at least in his subconscious mind, he had a felling of building on shifting soil".

(The extravagant consequences are that Man arose from a crossing of the primordial type of the Primates and something from another order according to von Hofsten (1958: 79). Surely it need only be within the Primates—but with the miraculous special gift of reason).

I differ from von Hofsten only with hesitation, but I think another interpretation may be more likely, that Linnaeus had found two *principia*, hybridity and the cortex/medulla constitution of all living things, in which he believed fully, and which were of just the sort he wanted if his general attitude to the creation was that of an illuminatus. The hypothetical form of his argument probably was adopted as a part-protection against theological objections. But the reader should consult the whole of von Hofsten's paper, and Lindroth (1983). We must not forget Linnaeus's basing of the whole of medicine on the cortex/medulla *principium* in his *Clavis duplex medicinae* (1766b) of which he was very proud. In this all diseases are either medullary or cortical, and the plant remedies for them are recognized by smell which goes direct to the brain and is therefore medullary, or taste, perceived by a cortical organ, the tongue.

It is worth recalling that Petrus Ramus in his highly influential reform of Aristotelian logic had to insist in 1543 that *Principia igitur artium definitiones, divisiones sunt; praeterea nulla* (Ong, 1983). The principles of the arts [sciences] are definitions and divisions: beyond that, nothing. Perhaps for Linnaeus there was still something *praeter ea*.

If so, one can appreciate his feelings of extraordinary exaltation, of being let into the secrets of God in classifying.

> "[The Lord himself hath] permitted him to visit his secret council chambers. —permitted him to see more of the creation than any mortal before him ... The Lord hath been with him whithersoever he hath walked, and hath cut off all his enemies from before him, and hath made him a name, like the name of the great men that are in the earth. 1. Chron. XVII. 8" (Pulteney, 1805: 564).

If finding the natural genera, order, and classes is discovering the plan of Creation, it is no wonder that he thought highly of himself and his work, as in the quotation from his so-called diary just given. And even the plainest and (apparently) least magical definition of anything would be the formulation of what that thing really is. In days when all flesh could be taken merely as flesh (a single homogeneous substance, according to Aristotle), all blood as just blood, all bone as bone, the only differences between adult animals would be in disposition and relative quantity of these building materials, to make different classes, orders, genera and species. A Linnaean classification, therefore would reveal all that there was to be known. As soon as its *principia* could be recognized, so that it would become a *divisio* (Cain, 1958), it *was* the analysis of Creation. To that extent, number, figure, proportion, site are the essential features to be seized on, as he said not infrequently in the *Philosophica Botanica* and elsewhere. Moreover, the *name* (for Linnaeus the *diagnosis*, the *nomen specificum legitimum* not the trivial epithet) would point out the essential difference of each species. For him it was the very opposite of a modern name. I cannot insist too strongly on this opposition. Modern naming bestows a largely arbitrary verbal symbol, or mode of reference, on a new species; in itself it need tell us nothing useful about it at all, and is often looked on as a necessary but irritating triviality. Linnaeus's naming was a diagnosis, which expressed the essential difference of each species, and thereby defined its peculiar character, what made it what it was—it was part of his analysis of the real world. Similarly, a proper figure of an organism, showing all these characters would be not merely a representation but an emblem in the Renaissance sense, with all its parts full of cosmic significance. To regard a Linnaean classification or naming as superficial would be to make a diametrical error in Linnaeus's view, although for completeness of understanding the role of each form in the economy of Nature had also to be borne in mind, as the end for which it was created. No wonder he was upset when attacked.

A number of Linnaeus's utterances which seem to be merely orthodox outpourings may have borne that character for him, but with a deeper meaning than is obvious now. The expression about Man (12 SN, Vol. 1: 12):

> *qui sapientiae radios reflectet versus majestatem radiantem duplicata luce,* who reflects the rays of wisdom against the radiating majesty with doubled light;

in view of the hermetic interpretation of light, and Kircher's *Ars magna lucis et umbrae,* which he owned; or about Wisdom (12 SN, Vol. 1: 13),

> *SAPIENTIA, divinae particula aurae, summum est attributum Hominis Sapientis,* WISDOM, a particle of the divine exhalation [aura], is the highest attribute of Discerning Man;

or about Nature (12 SN, Vol. 1: 11)

> *NATURA lex immutabilis Dei, qua res est id quod est & agit quod agere jussa est,* NATURE, the immutable law of God, which is what it is and acts as it is ordered to act,

with a surprising reference to van Helmont *(Helmontii definitio)* on the production of minerals (4 SN, *Obs. in Regn. Lap.*),

> *Primogenitas Terras ... e quibus, Elementorum ope, totum Regnum Lapideum existimamus esse productum. Hinc reliqui Lapides temporis, a Creatione praeterlapsi progenies sunt.* The Firstborn Earths ... out of which, with the assistance of the Elements, we consider the whole Mineral Kingdom to have been produced. Hence the remaining Stones are children of the time elapsed since the Creation;

or of his last purpose in writing the *Systema Naturae* (12 SN, Vol. 1: 7), that

> *Teleologiae primae lineae ducantur,* if thereby the main lines of Teleology [the science of ends or purposes] may be educed

—these are most likely to be interpreted in a somewhat deeper sense. Certainly Nature plays virtually the role of a Demiurge in 12 SN, Vol. 2, para. 1 on the Vegetable Kingdom,

> *Natura creata, continuato Semine, ope elementorum, modificat Terras in* Vegetabilia, *vegetabilia in* Animalia, *vix contra; utraque resolvit in* Terras, *circulo perenni aucto.* Created Nature, perpetuated by the Seed, with the assistance [by the supply] of the elements, modifies Earths into Vegetables, vegetables into Animals, not contrarily; each of the two she dissipates into Earths, increased by the perpetual cycle.

Nature a demiurge, the Seed a *principium*, the Elements the materials acted on—a hermetic philosopher would hardly have disagreed, but would have regarded Nature as an angel or demon. A Rosicrucian would have invoked instead Christ as the Archimagus.

LINNAEUS'S THEOLOGICAL AND COSMOLOGICAL POSITION

Linnaeus's unorthodoxy as a Christian (Broberg, 1980) has been taken as indicated by the extreme rarity of his references to Christ; most usually they are to God and Nature. Also, he was fascinated by sexuality, hardly an orthodox attitude, witness his extraordinary outburst about the bivalve *Venus dione* in 10 SN, Vol. 1. He appears to have ascribed it, as did Agrippa, Fludd, and (one should add) the Hermetic treatise *Poimander* (which is remarkably sexually explicit according to Burkert, 1987) to the Fall—Broberg has an important discussion on this point. Linnaeus was eminently encyclopaedic, and to be so was a religious duty both to the Rosicrucians (see Yates, 1972) and to the neo-Platonists of the Renaissance, since a firm grasp of the whole contents and order of the Creation would raise the mind nearer to God's, and, according to some, enable the illuminatus to manipulate it magically. It was hardly necessary for the salvation of the ordinary Christian.

In his encyclopaedism, his interest in practical applications, his apparent interest in hermeticism and alchemy, then, Linnaeus comes near to the Rosicrucians of the 1600s, as depicted and discussed by Yates (1972). Joachim Jung, whose definitions in botany Linnaeus adopted, was spoken of as the author of the Rosicrucian manifestos, the *Fama* and *Confessio*. Jung was certainly a member of the circle of Count Michael Maier, very probably a Rosicrucian, and Linnaeus had Maier's *Cantilenae intellectuales* (1622). Linnaeus also had two copies

of Jonston's *Thaumatographia naturalis*. Jonston was a close friend of Johan Valentin Andreae, an undoubted Rosicrucian, and quotes (dedication, A3 verso) from his *Institutio magica*. He also refers to a Michael Henry, "Hermeticus eximius" and "ephor" of his patrons, princes of the Radziwill family (presumably Protestants—one would like to know much more about eastern European Protestantism and magic). Jonston also quotes Maier (though only about the barnacle goose) and Hermes Trismegistus four times; Linnaeus wrote a quotation from this latter eminently magical (and mythical) author into his copy of the separate issue of *Curiositas naturalis* (1748; see Savage, *Annotations:* 8). The quotation is:

Homo ideo effectus est
ut Divini operis,
rerumq. creatarum contemplator existeret
et cum admiraretur creaturam
ejus Auctorem agnosceret
Hermes.

Man was made in order that a contemplator of the Divine work and of created things should exist and that when he admires the thing created he should acknowledge the Author of it [or of himself].

The sentiment seems innocuous but probably savoured more to Linnaeus of the dignity and worth of (restored) Man in the Renaissance tradition than of the abasement of man before his Creator in the Lutheran tradition.

Where Linnaeus parts company with the original Rosicrucians is in his apparent disregard of Christ as the efficient Word (i.e. the arch-magus). Such a motto as that quoted on the Lamb (p. 28 above) appears wholly foreign to his works, liberally sprinkled as some of them are with quotations (mainly pious exclamations) from the Old Testament, plus many from Pliny and Seneca. In his quotations he is less specifically *Christ*-ian than, say, Henry Cornelius Agrippa. It is not surprising, considering his subject-matter, that he should quote Pliny extensively and Aristotle; but when moralizing, Linnaeus especially delights in Seneca, mainly but not wholly in his *Quaestiones naturales*. The Old Testament is the source of most of his exclamatory quotations, and a few technical ones too, e.g. Job on the ostrich's eggs left in the sand.

Is this devotion to the Old as against the New Testament really unorthodox? Omitting references to miracles of healing, not relevant here, there are far fewer suitable references in the New as compared with the Old Testament, quite apart from the much greater extent of the Old Testament (three times that of the New). Not that there are none; 15 are obvious, and a little ingenuity could easily double this number. Two are of especial relevance, from the Gospel of St. John, 1, verses 3 and 10. In the Authorized Version these are:

3. All things were made by him [the Word]; and without him was not anything made that was made.
10. He [the true Light witnessed by John the Baptist] was in the world, and the world was made by him ...

To a Christian speaking as a magus or illuminatus about the natural world, these would be essential for demonstrating his Christian piety.

In fact, not only Linnaeus but also unimpeachably orthodox Anglican naturalists, and others of various religious backgrounds, do not mention them, even when writing works of natural theology, and use for the scientific expositions almost entirely Old Testament references. For example, John Ray in his *Wisdom of God manifested in the works of creation* (4th edition, 1704) gives in the main part of the text, expounding the wonders of creation, 35 references from the Old Testament, one from the Apocrypha, and only five from the New Testament, none of the last being from the Fourth Gospel. In the second part of the book, the practical inferences for a Christian life, it is not surprising that far more are from the New Testament, especially from Paul's highly exhortatory

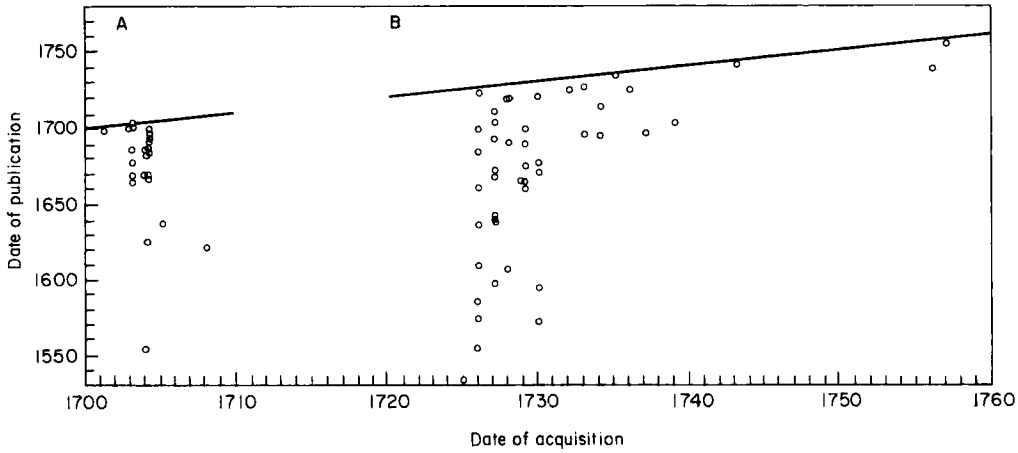

Figure 4. Distribution by date of publication and by inscribed date of acquisition, of works in Linnaeus's library. A, Works originally acquired and inscribed by Samuel Moraeus, Linnaeus's father-in-law, and passed eventually to Linnaeus. B, Works acquired and inscribed by Linnaeus himself. The sloping lines mark the extreme possible position, of books acquired in the year of publication.

epistles; there are 29 Old Testament references and two Apocryphal to 27 New Testament ones. In his *Three physico-theological discourses* (3rd edition, 1713) the first two (of Creation and the Flood) have 30 Old Testament references and no others. The third, which treats of the dissolution of the world, not surprisingly has only 37 Old Testament to 77 New Testament references in the body of the text; the exhortation to an appropriate life has 13 Old to 31 New Testament references, like the practical inferences of the *Wisdom of God.* Similarly William Derham in his *Physico-Theology* (6th edition, 1723) and *Astro-Theology* (5th edition, 1726) gives a preponderance of Old Testament references. Ray has one reference to the Fourth Gospel in the practical inferences of his *Wisdom of God,* two in his exhortation to a proper mode of life in the *Discourses;* none of these are to the first chapter. Derham does not use the Fourth Gospel at all in the works examined.

Elsewhere we find the same story; Aldrovandi, in the 4th volume of his huge

encyclopaedia of zoology (1606), gives his Biblical references for each species or genus under the headings MYSTICA and MORALIA, which are mainly moralizing. He gives 11 Old Testament and no Apocryphal to seven New Testament ones, mentioning Christ by name twice, but not quoting the Fourth Gospel. Lesser and Lyonnet's *Théologie des insectes* (1724) does have a single quotation from it, but it is chapter 14:2, 3 (In my Father's house are many mansions etc.).

In contrast to these, the highly magical *De miraculis occultis naturae*, 1604, of Lemnius begins on the very first page with the first chapter of the Fourth Gospel. He gives in the main text 148 Old Testament and 10 Apocryphal to 88 New Testament references, and in the *Exhortatio*, corresponding to Ray's practical inferences, again far more New Testament references– 167 as against one

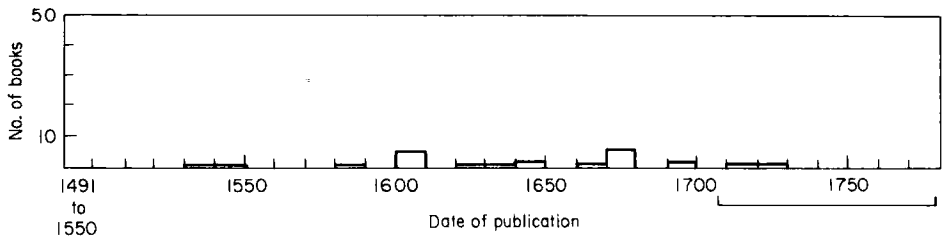

Figure 5. Distribution by date of publication of occult or related works in Linnaeus's library. Bar as in Fig. 1.

Apocryphal and 125 Old Testament. Johnston's *Thaumatographia* (1665), which contains several occult references, as mentioned above, has 17 Old Testament references, one Apocryphal, and four New Testament, but surprisingly does not refer to the Fourth Gospel at all. I have not been able to consult Linnaeus's own copy of the works of Henry Cornelius Agrippa, but an edition of the same date in the library of the Royal College of Physicians has printed with his works a number of almost black-magical tracts. In those works definitely ascribed to Agrippa, there is an infinity of references (sometimes explicit, usually oblique) to the Bible, and to Hermes Trismegistus, Dionysius (the pseudo-Areopagite), Virgil, Abaris, Orpheus, (pseudo-)Pythagoras, the Sibyls and other authorities beloved of occult authors. In the treatise *De triplici ratione cognoscendi Deum* chapter and verse are given. It has 14 Old Testament, two Apocryphal and no less than 40 New Testament references, two of which are from the Fourth Gospel, one only being to the first chapter, on the impossibility of Man ever seeing God. The name of Christ occurs frequently.

One wonders whether, if these two examples are a guide, the name had become too closely associated with occult and magical works to be used frequently in writings on natural magic, natural science generally, and natural theology. It is true that in the 17th century, and earlier, the Fourth Gospel had been recited in part as a charm, and sold whole as an amulet (Thomas, 1971: 34, 39, 60, 296–7, 328, 725). Perhaps it is significant that in the *Ars magna lucis et*

umbrae (1646) of the Jesuit Athanasius Kircher (which Linnaeus owned), part of the Catholic counter-attack on the Protestant monopoly of natural magic and technology, there are 17 Old Testament, three Apocryphal and 12 New Testament references. Of the last, although the name of Christ is mentioned several times, there is only one reference to the Fourth Gospel; it is to chapter 3 verse 30 (He must increase but I must decrease). None is to the first chapter.

Linnaeus does have one reference to the Fourth Gospel. It is in that store of Biblical quotations, the thesis *Specimen de curiositate naturali* (1749) defended by Olaf Söderberg on 30 June 1748 at Uppsala. But again the quotation is not from the first chapter; it is chapter 3 verse 12:

> If I have told you earthly things and ye believe not, how shall ye believe, if I tell you of heavenly things?

The rest of the quotations (in all 36 Old Testament, two New Testament) are almost all from Ecclesiastes.

Purely technical works, as against those of natural theology, often had no Biblical quotations at all or only a motto on the reverse of the title page or some similar place. Examples from various countries are:

Charleton, W.	1677	*Exercitationes de differentiis et nominibus animalium* (2 OT, 1 Apoc.)
Charleton, W.	1693	*Exercitationes physico-anatomicae de oeconomia animali* (none)
Ray, J.	1693	*Synopsis methodica animalium quadrupedum et serpentini generis* (1 OT).
Ray, J.	1703	*Methodus plantarum emendata et aucta* (none)
Klein, J. T.	1731	*Descriptio tubulorum marinorum* (none)
Klein, J. T.	1734	*Naturalis dispositio Echinodermatum* (1 OT, motto)
Klein, J. T.	1740	*Sciagraphia lithologica curiosa* (3 OT, all in the prefatory letter)
Haller, A.	1749	*Opuscula sua botanica* (none)
Klein, J. T.	1753	*Tentamen methodi ostracologicae* (none)
Bohadsch, J. B.	1761	*De quibusdam animalibus marinis* (none)
Brisson, A. D.	1762	*Regnum animale in classes IX distributum* (none?)
Klein, J. T.	1766	*Ova avium* (none)
Pallas, P. S.	1766	*Elenchus zoophytorum* (none)
Müller, O. F.	1776	*Zoologiae Danicae prodromus* (none)

In general Linnaeus's references are, like those of the other authors investigated, mainly from the Old Testament. I have checked the following editions of the *Systema Naturae:*

1 SN	1735	Old Testament, 1, Apocryphal, 0, New Testament, 0.
4 SN	1744	1,0,0.
9 SN	1756	1,0.0.
10 SN	1758,	*Imperium Naturae* and *Regnum Animale* 13,0,0.
10 SN	1759	*Vegetabilia,* 2,1,0.
12 SN	1766	*Regnum Vegetabile,* 4,2,0.

Except occasionally, Linnaeus used few Biblical quotations. There are none in his edition of Artedi's *Ichthyologia* (1738) nor in the *Philosophia botanica* (1751), the *Species plantarum* (1753), the 5th edition of the *Genera plantarum* (1754), or the 2nd edition of the *Fauna suecica* (1761) in spite of its long introduction on the nature of

the world and the taxonomic position of Man. The 6th edition of the *Genera plantarum* (1764) has only one, from the Old Testament. There are none at all in the two *Mantissae* (1767 and 1771). In the theses on natural history, medicine and rural economy printed in the *Amoenitates academicae*, Vols 1 to 7 inclusive, all of which could have had at least a pious motto on the title-page if he had so wished, 134 have no Biblical references at all, 12 one, 1 two, 1 three and 2 four, usually purely factual (e.g. colours of garments in a thesis on plants for dyeing). Several of these theses that could be taken as being essays in natural theology, e.g. *Oeconomia naturae, Cui bono, Politia naturae, Metamorphosis humana* have none; only *Specimen de curiositate naturali*, as described just above, has many, and is exceptional with its total of 39. Many of the theses, of course, could only have pious exclamations; there is nothing in the Bible about tea or chocolate or the guinea-pig; but all of them could have been so decorated, and most were not.

This makes all the more remarkable the sudden increase already noted in Biblical references in the 10th and 12th editions of the *Systema Naturae*. As the cosmic parts of these books are only a few introductory pages, the numbers cannot be expected to compare with those in, for example, Ray's *Wisdom of God*. The proportions of Old Testament to New Testament references, however, are quite similar. One wonders whether Linnaeus meant to emphasize the religious significance of his most comprehensive classificatory work on Nature, and whether he felt it necessary to do so under pressure from theologians while enjoying its cosmic significance privately.

One would like to know far more about the use of Biblical and other quotations in works of science and pseudoscience from the 15th century onwards. In particular it would be highly desirable to see whether the suggestion made above that certain Biblical references become associated with occult literature is correct.

The general lack of New Testament quotations in Linnaeus, then, can hardly be taken as evidence of his unorthodoxy, although his remarks on the age of the earth, and the production of most species of plants (and, apparently, minerals) *after* the initial creation certainly could be.

In one further respect at least he departs from the doctrines of the neo-Platonists and original Rosicrucians; he omits altogether, or on occasion explicitly rejects, the influences of the stars on the human body and mind. In view of the obvious influence of the sun and moon on tides, and the moon on monthly periods, for a naturalist this was quite a bold step to take. He explicitly rejects astrological causation of diseases by the stars in the thesis *Cura generalis* (1789) defended by J. G. Bergman on 10 Dec. 1766 at Uppsala, contrasting astrological and other medical schools unfavourably with the *Mechanica*. Linnaeus insisted much on teleology, and he must have wondered what the stars were for in the economy of nature. In the thesis *Censura simplicium* (1760, defended by G. J. Carlbohm, 19 Dec. 1753) he rejects as erroneous and superstitious their influence on (medically useful) plants. Probably he felt it sufficient that the heavens, the work of God's fingers (Psalm 8), should declare His glory (Psalm 19). His remarks in the thesis *de Curiositate naturali* (1749) would suggest just that.

If, however, we consider, and take seriously (as he did), Linnaeus's doctrines of the cortex and medulla and the evolution of plant species (and no doubt of animal species too) by combinations of different originally created cortices and

medullae, the doctrine of conversion of the elements into each other, the doctrine of metamorphosis of plants (and insects, and Man), the emphasis Linnaeus laid on *Omne vivum ex ovo* and the seed (often treated in occult works), his peculiar doctrine of sexuality in relation to the cortex and medulla (and the Fall), his emphasis on the Creator proceeding from the simple to the complex, it would appear that he was searching for *principia* of an at least semi-occult sort (in the sense of being hidden except to the instructed, and underlying the world of living things) which would unify his zoology, botany, mineralogy and medicine. It is exceedingly difficult to know exactly when some authors of the sixteenth and seventeenth centuries were indulging in real magic, in natural magic (i.e. scientific parlour tricks such as optical illusions) and in real science as understood today. Indeed, it is not probable that most of them could have drawn any definite practical boundaries between these categories. The evidence from his library does not allow us to do so in Linnaeus's case, but does raise forcibly the question of how far he regarded himself as an illuminatus. It would not at all surprise me to learn that there was in the Swedish (and other) universities in the 18th century an occult underground, in which Linnaeus was a participant. One wonders also what his early relations were also with Swedenborg, several of whose works he owned, and how far both were influenced by the neo-Platonists and by Behmen. To find out more about such subjects, and the contents of private libraries open to Linnaeus is a task for scholars in Sweden. To come to any definite conclusion at the moment would be premature; but any serious consideration of the ideas taken very seriously by Linnaeus himself certainly sets him closer to the Renaissance neo-Platonists and the 17th century Rosicrucians than anyone has realized before. The most that can be done in the present paper is to open up possibilities.

THE PLAN OF CREATION

If Linnaeus thought he was uncovering the actual plan of Creation (or at least considered it was his God-given task to do so), what was it that made him think so? A study of his successive classifications of shells (Cain, in preparation), his Testacea, and how he ties them into the preceding and succeeding orders, the Mollusca and Lithophyta, shows evidence of a *Scala Naturae*, with a vast improvement of it in the 10th edition of the *Systema Naturae* (Animal Kingdom). His well-known remarks in the preface to the 2nd edition (1761) of the *Fauna svecica* about a *gradus perfectionis* exemplified by Vermes, Insecta, Pisces, Amphibia, Aves, Quadrupedia (and of course Man) would confirm it. Yet equally celebrated are his remarks on the affinities of the natural orders of plants being multiple, like the proximity of one country on a map to several others (see especially *Philosophia botanica* and Giseke's *Praelectiones*). There appears to be a contradiction here.

If the very tentative suggestion made above that Linnaeus viewed the Creation as combinatorial is right, a solution may be possible. It is only too easy for us today to read *affinitas* as it was used in the early 19th century in opposition to *analogia*, and in the later 19th century as meaning phylogenetic relationship, and indeed Giseke (1792) refers to genealogical relationships. If it meant to Linnaeus that two entities share a common *principium*, e.g. two plants with different cortices have the same medulla—so that they have a genuine affinity,

both interpretations can be correct. There will be an ascent in grades of perfection based on differences in the medulla, but within each grade the diversity stemming from variation in the cortex will correspond to that in every other grade. Reptiles and fishes are scaly (but not all of them); and so is one mammal, the pangolin, and many birds have scales on their legs. Flying squirrels glide, but so does a primate. Feathers are characteristic of birds, but also, according to Aristotle, of some moths (plume moths?). The ostrich has feet like a camel, hence its trivial name (and Linnaeus would certainly know the famous passage about its resemblances both to birds and to quadrupeds in Aristotle's *Parts of Animals*, 4, 13, and similar remarks in his other zoological works). It would be anachronistic to expect Linnaeus to regard these as merely analogous in the modern sense; he was quite happy to compare an elephant's and a weevil's trunk (in the thesis *de Memorabilibus in Insectis*, (1752) defended by Abraham Bäck on 3 Oct. 1739) although he knew that the mouth was terminal in the latter.

Such resemblances crop out all over the Animal Kingdom, and there is an equal display of them (bulbs and tubers, pinnate leaves, tendrils, for example) in plants as well. There would be quite sufficient of such affinities to hold out hopes that when the whole Creation was known, a complex but definite pattern would be revealed. In Linnaeus's own lifetime the almost overwhelming flood of new species would show conclusively that no complete plan could be expected for many years—it is not surprising that he dated its arrival to coincide with the squaring of the circle (Pulteney, 1805: p. 560).

Within the Testacea there are indications of a recurrent pattern even in the 10th *Systema Naturae,* Vol. 1. Earlier, he had taken turriculate gastropod shells to be a genus, but his examination of the characters of their mouths showed him that they belonged with very different shells with normally-produced spires. So in 10 SN, Vol. 1 he distributed them into his genera 288 *Buccinum,* 289 *Strombus,* 290 *Murex,* 291 *Trochus* and 292 *Turbo,* putting them last in each case. Tall shells are also last in 283 *Nautilus* and 286 *Bulla,* and nearly last in 293 *Helix,* in which the very last is neritoid, to form a transition to the next genus, 294 *Nerita.* Here is evidence, I suggest, of a recurrent pattern, awaiting further discoveries to be completed. There is so great an expansion and so complete a revision between the 9th and 10th *Systema Naturae* that there can be no question that this arrangement is intended; it is not a matter of a few species being redistributed and simply tacked on to the ends of the appropriate genera.

Linnaeus thought enough of other more scattered resemblances in the Testacea to commemorate them in trivial epithets, either repeating the stem of a current, or reviving an old, generic name, or repeating a descriptive word. Thus he has 46 *Tellina donacina* (compare the genus 273 *Donax*), 192 *Anomia Gryphus* and 137 *Chama gryphoides,* 193 *Anomia Pecten* (cf. the first section, *Pectines,* of his genus 278 *Ostrea*), the unnumbered *Bulla Cypraea,* after species 241 and explicitly compared with 317 *Cypraea spurca,* 527 *Turbo Neritoides* and 619 *Helix Neritoidea,* and even 655 *Patella Neritoidea,* compared with 294 *Nerita.* These give numerous correspondences between genera, which Linnaeus may well have taken as *affinitates.* It is noteworthy that he does not use *affinitas* as a regular technical expression, but varies it with such relating expressions as *instar, ut in, accedit ad,* or a simple genitive, e.g. in *Simia sciurea,* a primate, *Corpus sciuri.* Nowhere is Linnaeus at all lavish with his use of the words *affinis, affinitas,* as far as my

reading goes. His most frequent use of them is in the *Philosophia botanica* (1751—I have used the 1770 Vienna reprint). None of their occurrences (pp. 26, 27, 89, 101, 124, 130, 136, 137, 138 twice) allow one to specify what sort of relationship as defined at the present day, are included under these terms.

In looking for such relationships, correspondences, or affinities in other groups than shells, it is necessary for us to accept the wildest analogies as genuine resemblances. It would be fascinating to take Linnaeus's *natural* classification of plants and see how far fragments of patterns of recurrence appear. I do not have the necessary botanical knowledge.

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APPENDIX

Occult or semi-occult works in Linnaeus's personal library

(This is a provisional list only, to demonstrate the interest of the subject, compiled from the catalogues of Linnaeus's library. Where works have been seen, fuller details are given).

1. AGRIPPA ab Nettesheym, Henr[icus] Corn[elius], [1531?] Opera in duos tomos concinne digesta et nunc denuo ... recusa. Lugduni per Beringos Fratres.
2. ALBINEUS, Nathan, 1673. Bibliotheca chemica contracta ... Coloniae Allobr. (Contains: Novum lumen chemicum, cui accessit Tractatus de sulphure. Autoris anagramma Divi Leschi. Enchiridion physicae restitutae. Arcanum hermeticae philosophiae opus).
3. ALBINIUS Villanovensis, Petrus Constantus. [1611]. Magia astrologica, hoc est ... Clavis sympathiae septem metallorum, lapidum ad planetas. Pro majore illius illucidatione Opus tam astrologis, quam chymicis perutile & jucundum. Liber olim impressus Paris 1611 apud Carol Sevestre & David Gillium. Jam propter eius raritatem recusus Hamburgi, apud Christian. Liebezeit. Anno 1716 (1717 on the common title page).
4. ARLENSIS de Scudalupis, Petrus, 1717. Sympathia septem metallorum ac septem selectorum lapidum ad planetas. Hamburg. (In a single volume with items 3 and 19.)

5. BACON, Roger, 1603. De arte chymia scripta. Francofurti. (Bound with item 20).
6. CAMERARIUS, Joachim, 1590. Symbolorum et emblematum ex re herbaria desumtorum centuria una collecta. *Bound with* Symbolorum emblematum ex animalibus quadrupedibus desumtorum centuria altera collecta, 1595. Norimberg.
7. CAMERARIUS, Joachim, 1628 and 1652. Sylloges memorabilium medicinae, et mirabilium naturae arcanorum, centuriae 9-12; (1652) centuriae 13–16. Augusta Treb.; Silberdinae, Argentinae.
8. DAUSTENIUS, Johan, Anglus, n.d. Rosarium secretissimum philosophorum arcanam comprehendens. (In item 26.)
9. FICINUS, Marsilius, 1549. De vita libri tres, nunc a mendis ... vindicati. Basileae.
10. GRATAROLUS, Guilielmus, 1604. De memoria reparanda, augenda, conservandaque ac de reminiscentia etc. Francofurti.
11. GÜNTHER, Antonius, 1640. Thessalus in chymicis redivivus: id est de vanitate medicinae chymicae, hermeticae, seu spagyricae dissertatio fundamentalis etc. Francofurti ad Moen.
12. ISAACUS, Joh., Hollandus, 1600. Opera mineralia, sive de lapide philosophico, omnia, duobus libris comprehensa. Middelburgi.
13. JONSTONUS, Johannes, 1661. Thaumatographia naturalis in decem classes distincta etc. Amstelodami.
14. KELLAEUS, Edwardus, n. d. Fragmenta. (In item 26.)
15. KIRCHER, Athanasius, 1646. Ars magna lucis et umbrae in decem libres digesta quibus admirandae lucis et umbrae in mundo, atque adeò universa naturae, vires effectusq. speciminum exhibitione, ad varios mortalium usus, panduntur. Romae: Hermann Scheus.
16. [ANON.], 1695. Klee-blat, höchst fur kreflichstes Chiromantisch- und Physiogomisches, bestenhend aus drey herrlichen Tractaten etc. Nürnberg.
17. KUHLMANN, Quirinus, 1674. Epistolae duae prior de arte magna sciendi sive combinatoria. Lugduni Batavorum.
18. LEMNIUS, Levinus, 1604. De miraculis occultis Naturae. Francofurti. (Also a copy, 1581 Romae, now apparently missing.)
19. LEONARDUS, Camillus, n. d. Speculum lapidum. (Reprinted with items 3 & 4, 1717 on the common title-page.)
20. LULLIUS, Raymundus. 1602. Elucidatio secretorum, Das ist Erklärung der Geheimnissen, wie der Lapis Philosophorum funden, etc. Frankfurt.
21. MAIERUS, Michael, 1622. Cantilenae intellectuales in triades q. distinctae, de Phoenice redivivo, hoc est, medicinarum omnium pretiosissimum. Rostock.
22. MYLIUS, Martinus, 1597. Hortus philosophicus consitus. Gorlicii.
23. "PYTHAGORAS", 1678. Carmina aurea. Cum annotationibus etc. Ulmae. (Together with orations of Isocrates, and a Plutarch, De liberorum educatione libellus.)
24. "PYTHAGORAS", 1661. Theatrum sympatheticum, in quo sympathiae actiones variae, singulares & admirandae tam macro quam microcosmicae exhibentur. Opusculum ... Digbaei, Papinii, Helmontii, aliorumque recentiorum scriptorum exhibens ... ipsius Pulveris sympathetici ... exponens. Ed. 2. priori emendatior. Amstelaedami.

25. THOMSON, Georg, 1573. Epilogismi chymici observationes nec non remedia hermetica longa in arte hiatrica exercitione constabilita. Lugduni Batavorum.
26. THOMSON, Georg, 1647. Tractatus aliquot chemici singulares. Geismariae. (Includes items 8 and 14, etc.)

Library

Fellows are reminded that even though they may not be able to use the Library in person, most books can be borrowed by post to those in the U.K. on refund of the postage. We also have a photocopier and will do our best to provide all Fellows with photocopies of anything we hold, although on occasions the size and condition of the book or journal may make this impossible. Please be as specific as you can with such requests: we are quite happy to search for the vital description you need for your work but do not generally have the time to copy large numbers of pages. The current costs are 10p for an A4 page and 20p for A3, plus postage (and VAT in the U.K.). We can also enlarge text and try for maximum contrast to help make keys and illustrations more legible.

By the time this is published we should have completed our usual summer session of reorganizing the older European journals. This year we hope to start on those from France. We have also had a major effort to clear some of the backlog of cataloguing that has been occupying the Library annexe since the redecoration last year. These include book sale donations kept for the Library and much other older material. Mrs Dimitrova has been working through the Eastern European material, particularly those in Cyrillic script and we have also made a special effort to deal with many of the miscellaneous conservation publications, including local natural history society journals. By the beginning of the Autumn session we hope to have the Library free of some of the existing clutter of boxes. That will at least allow room for accumulation of books for the next book sale in the spring of 1993.

Donations

As we have had a large number of 'bulk' donations, arising partly from the book sale, it has not been possible to list all such items individually. Thanks are due to Prof. R. J. Berry, Prof. R. G. Davies, Dr R. W. J. Keay, D. Taylor Pescod, P. Tuley and R. Wilding for filling a number of gaps, especially in the field of tropical agriculture, evolution, genetics and entomology. We also thank all those who continue to supply us with journals and miscellaneous publications, including Richard Fitter and Dr G. Pontecorvo. The list of other accessions is also limited to more recent publications.

Dr S. I. Ali	Ali, S. I. & Nasir Y. J., Eds. *Flora of Pakistan, No. 192, Labiatae by I. C. Hedge.* 310 pp. illustr., Islamabad, 1990.
Dr G. Beale	OXFORD, Voltaire Foundation, *Studies on Voltaire and the 18th century.* 422 pp. Oxford, Alden Press, 1991.
G. D. R. Bridson	Hansard, Peter & Silver, Burton, *What bird did that?* 64 pp. col. illustr., London, Grubb Street, 1991.

F. Brightman	Chinnock, R. J. *Common fern and fern allies in New Zealand.* 77 pp. col. illustr., Auckland, Reed Methuen, 1987. Phillips, Roger, *Grasses, ferns, mosses and lichens of Great Britain and Northern Ireland.* 190 pp. col. illustr., London, Ward Lock, 1980. Schmidly, David J., *The bats of Texas.* 188 pp. illustr., 16 col. pl., maps, College Station, Texas A & M, 1991. Sealander, John A. & Heidt, Gary, *Arkansas mammals, their natural history, classification and distribution.* 308 pp. illustr. some col., maps, Fayetteville, Univ. Arkansas Press, 1990.
Dr H. F. Burdet	Spichiger, R. & Ramella, L., *Flora del Paraguay, Sapindaceae by M. S. Ferrucci.* 144 pp. illustr., maps, Geneva, Cons. & Jard. Bot., 1991.
J. A. Burton	Burton, John A., *Field guide to the mammals of Britain and Europe.* 192 pp. col. illustr., maps, London, Kingfisher, 1991. Burton, John A., *Mammals of North America.* 192 pp. col. illustr. Limpsfield, Dragon's World, 1991. Burton, John A., Ed. *The atlas of endangered species.* 256 pp. col. illustr. maps, New York, Macmillan, 1991. Smith, James Edward, *A compendium of the English Flora (annot. copy ex. Rev. Edward Simms).* 219 pp. London, Longman, 1829.
R. Dales	Zoological Society of London, *The environmental impact of burrowing animals and animal burrows, edited by Peter S. Meadows and Azra Meadows.* 349 pp. illustr., maps, Oxford, Clarendon Press for Zoological Society, 1991.
Darwin letters project	Burkhardt, Frederick, Ed., *The correspondence of Charles Darwin, Vol. 7, 1858–1859.* 671 pp. Cambridge, CUP, 1991.
Dr L. N. Derrick	Thompson, Peter, Ed. *Global warming, the debate.* 130 pp. Chichester, J. Wiley for Strategy Europe, 1991. Treshow, Michael, *Air pollution and plant life.* 486 pp. illustr. maps, Chichester, J. Wiley, 1984.
G. Douglas	GENEVA, Societe de Physique et d'Histoire Naturelle, *Societe de Physique et d'Histoire Naturelle de Geneve: Bicentenaire de la fondation de la Societe (Memoires, Vol. 45).* 3 vols, Geneva, 1990.
Dr J. Edmonds	Edmonds, Jennifer M., *Distribution of* Hibiscus *L. subsection* Furcaria *in tropical East Africa.* 60 pp. maps, Rome, IBPGR 1991.
Dr M. English	English, Mary P., *Victorian values, the life and times of Dr Edwin Lankester.* 187 pp. illustr., Bristol, Biopress, 1990.
Dr J. Feltwell	Feltwell, John, *Recycling, a practical guide to recycling in the school grounds.* 26 pp. illustr. some col., Crediton, Landscape Design Trust, n.d.
Dr S. de M. Figueroa	Lopes, M. M. & Figueroa, S. F. de M., *O conhecimento geologico na America Latina: questoes de historia e teoria.* 317 pp. Campinas, Inst. de Geociencias, 1990.

Dr O. Hagelin	STOCKHOLM, Swedish Society of Medicine, *Rare and important medical books in the Library of the Swedish Society of Medicine, a descriptive and annotated catalogue.* 176 pp., illustr., Stockholm, Svenska Lakaresallskapet, 1989. STOCKHOLM, Swedish Society of Medicine, "*The byrth of mankynde, otherwyse named The Woman's Book ...*" *an illustrated and annotated catalogue of rare books in the Library of the Swedish Society of Medicine.* 176 pp., illustr., Stockholm, Svenska Lakaresallskapet, 1990.
Dr P. T. Harding	Institute of Terrestrial Ecology, *Biological records of changes in British wildlife, proceedings of a conference ... held in March 1990, edited by Paul T. Harding.* 78 pp. maps, London, HMSO, 1992.
Dr D. L. Hawksworth	Hawksworth, David L., *The biodiversity of micro-organisms and invertebrates: its role in sustainable agriculture.* 302 pp. illustr., maps, Wallingford, CAB International, 1991.
Dr A. Hollman	Mott, Kenneth E., Ed. *Plant molluscicides.* 326 pp. Chichester J. Wiley, 1987.
Hunt Institute	PITTSBURGH. Hunt Institute for Botanical Doc. *Botanico Periodicum-Huntianum/Supplementum. edited by Gavin D. R. Bridson ...* 1068 pp. Pittsburgh, Hunt Institute for Botanical Doc., 1991.
C. M. Hutt	Kitchener, A., *The natural history of the wild cats.* 280 pp. illustr. some col., maps, London, C. Helm, 1991.
Dr H. H. Iltis	Blatz, Charles V., *Ethics and agriculture, an anthology on current issues in a world context.* 674 pp. Moscow, Idaho, University of Idaho Press, 1991.
Prof. J-C. Liao	Liao, Jih-Ching, *The taxonomic revisions of the family Fagaceae in Taiwan.* 239 pp. illustr., 8 col. pl., Taipei, College of Agriculture, 1991.
House of Lords Select Cttee	UNITED KINGDOM of GB. & N. Ireland, *House of Lords Report of the Select Committee on Science and Technology. Systematic Biology Report.* 106 pp. London, HMSO, 1992.
Dr K. Marhold	Bertova, Lydia, Ed. *Flora Slovenska, Vols. IV, nos 1, 2 & 3.* Bratislava, VEDA, 1984–1988. Majovsky, J. & Murin, A., Eds. *Karyotaxonomicky prehl 'ad flory Slovenska.* 436 pp. Bratislava, Slovak Academy of Sciences, 1991.
Dr J. Marsden	Lefroy, H. Maxwell & Finlow, R. S., *Inquiry into the insecticidal action of some minerals and other compounds on caterpillars. (Mem. Dept. Agri. Indian Entom. Ser. IV 5)* pp. 269–327, 1912.
Dr E. C. Nelson	Gregorio, Mario A. di, *Charles Darwin's marginalia, Vol. 1.* 895 pp. New York, Garland Publ., 1990. Nelson, E. Charles, *The Burren, a companion to thee wildflowers of an Irish limestone wilderness.* 343 pp. col. illustr., Aberystwyth, Boethius Press, 1991.

Dr H. Ohba	Ohba, Hideaki & Akiyama, Shinobu, *Catalogue of the type specimens preserved in the herbarium . . .* 39 pp.+ 207 pl., Tokyo, University Museum, 1990.
	Ohba, Hideaki & Malla, Samar B. *The Himalayan plants, Vol. 2,* 269 pp. illustr. some col., Tokyo, Tokyo Univ. Press, 1991.
William Oliver	Uminski, Tomasz, Zwieizeta i ocany, popularna zoogeografia wod morskich. 235 pp. illustr. maps, Warsaw, Wydawnictwa Szkolne i Pedagogiczne, 1986.
Dr G. Panigrahi	Purohit, K. M. & Panigrahi, G., *The family Rosaceae in India (revisionary studies on some genera, Vol. 1).* 356 pp. illustr., Dehra Dun, Bishen Singh Mahendra Pal Singh, 1991.
D. Taylor Pescod	Gould, Stephen J., *Bully for Brontosaurus.* 540 pp. illustr., London, Hutchinson Radius, 1991.
Dr D. Porter & T. Wieboldt	Terwilliger, Karen, *Virginia's endangered species.* 672 pp. illustr. some col., maps, Blacksburg, McDonald & Woodward, 1991.
Dr A-F. M. Rizk	Rizk, Abdel Fattah, M. & Al Nowaihi, Abdel Salam, *The phytochemistry of the horticultural plants of Qatar.* 285 pp. col., illustr. Oxford, Alden Press for Univ. of Qatar, 1989.
Dr N. K. B. Robson	Sivarajan, V. V. & Robson, N. K. B., Ed. *Introduction to the principles of plant taxonomy.* 290 pp. Cambridge, CUP, 1991.
Systematics Association	Blackmore, S. & Barnes, S. H., Eds. *Pollen and spores, patterns of diversification. (Special Vol. No. 44)* 391 pp. illustr., Oxford, Clarendon Press for Systematics Association, 1991.
	Johns, D. M., Hawkins, S. J. & Price, J. H., Eds. *Plant-animal interactions in the marine benthos (Special Vol. No. 46),* 570 pp., Oxford, Clarendon Press for Systematics Association, 1992.
	Paterson, David J. & Larsen, Jacob, *The biology of free-living heterotrophic flagellates. (Special Vol. No. 45)* 505 pp. illustr., Oxford, Clarendon Press for Systematics Association, 1991.
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G. Waterhouse	Waterhouse, Gordon, *Wildlife of the Salcombe and Kingsbridge estuary.* 64 pp. illustr., maps, Dartmouth, Harbour Books, 1992.
Wiley Liss	Barbosa, Pedro, Krischik, Vera & Jones, Clive G. *Microbial mediation of plant-herbivore interactions.* 530 pp. New York, Wiley-Liss, 1991.
Dr E. C. Zimmerman	Zimmerman, Elwood C., *Australian weevils (Coleoptera: Curculionoidea).* col. pl. 1–304, East Melbourne, CSIRO, 1991.

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Anderson, Anthony B., May, Peter H. & Balick, Michael J., *The subsidy from nature, palm forests, peasantry and development on an Amazon frontier.* 233 pp. illustr., maps, New York, Columbia University Press, 1991.

Baker, Sylvia, *Endangered vertebrates, a selected, annotated bibliography 1981–1988.* 197 pp. New York, Garland Publ., 1990.

Beissinger, Steven R. & Snyder, Noel F. R., *New World parrots in crisis, solutions from conservation biology.* 288 pp., illustr., map. Washington, Smithsonian Institution Press, 1992.

Berglund, Bjorn E., Ed. *The cultural landscape during 6000 years in southern Sweden, the Ystad project. (Ecol. bull. No. 41).* 495 pp., col. maps, Copenhagen, Munksgaard, 1991.

Bettancourt, Julio L. & others, *Packrat middens, the last 40 000 years of biotic change.* 467 pp. illustr., Tucson, Univ. Arizona Press, 1990.

Birkhead, T. R., *The magpies, the ecology and behaviour of black-billed and yellow-billed magpies.* 270 pp. illustr., maps, London, Poyser, 1991.

Bishop, George, *Travels in Imperial China, the explorations and discoveries of Pere David.* 192 pp. illustr., 20 col. pl, maps, London, Cassells, 1990.

Block, W., *An annotated bibliography of Antarctic invertebrates (terrestrial and freshwater).* 263 pp., illustr., Cambridge, 1992.

Bolos, Oriel de & Vigo, Josep, *Flora dels paisos Catalans, Vol. 1: Licopodiacies—Capparacies.* 736 pp. illustr., maps, Barcelona, Barcino, 1984.

BOMBAY, Bombay Natural History Society, *Conservation in developing countries; problems and prospects, edited by J. C. Daniels and J. S. Serrao.* 656 pp. illustr., maps, Bombay, Oxford University Press, 1990.

Bowden, M., *The rise of the evolution fraud (an exposure of its roots).* 227 pp., illustr., Bromley, Sovereign, 1982.

Bowden, Malcolm, *Science vs. evolution.* 238 pp. illustr., Bromley, Sovereign Publs., 1991.

Bowlby, John, *Charles Darwin, a biography.* 511 pp. maps, illustr., London, Pimlico Books, 1991.

Bowler, P. J., *The Mendelian revolution, the emergence of hereditarian concepts in modern science and society.* 207 pp. London, Athlone, 1989.

Brock, Juliet Clutton-, *The walking larder, patterns of domestication, pastoralism and predation.* 368 pp. illustr., maps, London, Unwin Hyman, 1990.

Bruijnzeel, L. A., *Hydrology of moist tropical forests and effects of conversion: a state of knowledge review.* 224 pp. illustr. some col., maps, Amsterdam, Free University Press, 1990.

Burger, Joanna & Gochfeld, Michael, *The common tern, its breeding biology and social behaviour.* 413 pp., illustr., maps, New York, Columbia University Press, 1991.

Caldwell, Lynton Keith, *Between two worlds, science, the environmental movement and policy choice.* 224 pp. Cambridge, CUP, 1990.

Calvin, William H., *The ascent of mind, ice age climates and the evolution of intelligence.* 302 pp. illustr. New York, Bantam, 1991.

Carey, Philip G., *Marine interstitial ciliates, an illustrated key.* 351 pp., illustr., London, Chapman & Hall, 1992.

Chang, Hung Ta & Bartholemew, B., *Camellias.* 211 pp., illustr., London, Batsford, 1984.

Chen, Fengwai, *Flora of Guangdong, Vol. 1.* 600 pp., illustr., Guangdong, Science & Technology Press, 1987.

Cittadino, Eugene, *Nature in the laboratory, Darwinian plant ecology in the German empire, 1880–1900.* 119 pp. illustr., Cambridge, CUP, 1990.

Clark, Ailsa M. & Downey, Maureen E., *Starfishes of the Atlantic.* 794 pp., illustr., London, Chapman & Hall, 1992.

Clifford, Hugh F., *Aquatic invertebrates of Alberta, an illustrated guide.* 538 pp., illustr., some col., Edmonton, Univ. Alberta Press, 1991.

Collins, Mark, *The last rainforests.* 200 pp., col. illustr., maps, London, M. Beazley, 1990.

Cox, Paul Alan & Banach, Sandra Anne, *Islands, plants and Polynesians, an introduction to Polynesian ethnobotany.* 228 pp., illustr., Portland, Diosorides Press, 1991.

Croker, Robert A., *Pioneer ecologist, the life and work of Victor Ernest Shelford, 1877-1968.* 222 pp. illustr., Washington, Smithsonian Institution Press, 1991.

D'Arcy, William G., Ed. *Solanaceae, biology and systematics.* 603 pp. illustr., maps, New York, Columbia University Press, 1986.

Darwin, Erasmus, *Zoonomia; or the laws of organic life.* 2 vols. London, J. Johnson, 1796.

Davidson, John, *Natural creation or natural selection? A complete new theory of evolution.* 275 pp., illustr., Shaftesbury, Element Books, 1992.

Davis, Joel, *Mapping the code, the human genome project.* 294 pp., illustr., New York, J. Wiley, 1990.

Davis, B. K. N. (and others), *The soil. (New Naturalist No. 77)* 192 pp., illustr. some col., maps, London, Harper Collins, 1992.

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Dawkins, M. S., Halliday, T. R. & Dawkins, R., Eds. *The Tinbergen legacy.* 146 pp., illustr., London, Chapman & Hall, 1991.

DeVos, Louis, & others, *Atlas of sponge morphology.* 117 pp., illustr., Washington, Smithsonian Institution Press, 1991.

Feltwell, J., *The story of silk.* 233 pp., illustr., some col., Stroud, Alan Sutton, 1990.

FINNIDA Institute, *Whose trees, a people's view of forestry aid.* 138 pp. illustr. maps, London, Paros, 1991.

Fogg, G. E. & Smith, David, *The exploration of Antarctica, the last unspoilt continent.* 224 pp., col. illustr., maps, London, Cassells, 1990.

Forbes, Anna, *Unbeaten tracks in islands of the Far East.* 305 pp., map, Singapore, Oxford University Press, 1987.

Fryer, Geoffrey, *A natural history of the lakes, tarns and streams of the English Lake District.* 368 pp., illustr., maps, Ambleside, Freshwater Biological Association, 1991.

Gallistel, C. R., *Animal cognition.* 203 pp., Cambridge, Mass., MIT Press, 1992.

Gentry, Alwyn H., Ed. *Four neotropical rainforests.* 627 pp. maps, New Haven, Yale Univ. Press, 1990.

George, Wilma & Yapp, Brunsden, *The naming of beasts, natural history in the medieval bestiary.* 231 pp., illustr. some col., London, Duckworth, 1991.

Gibbons, J. Whitfield & Semlitsch, Raymond D., *Guide to the reptiles and amphibians of the Savanna River site.* 131 pp., illustr., maps, Athens, Univ. of Georgia Press, 1991.

Goodwin, B. & Saunders, P., Eds. *Theoretical biology, epigenetics and evolutionary order from complex systems.* 230 pp. Edinburgh, Edinburgh Univ. Press, 1989.

Green, Richard, *Wild cat species of the world.* 163 pp., col., illustr., Plymouth, Basset Publ., 1991.

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Hecht, Susanna & Cockburn, Alexander, *The fate of the forest, developers, destroyers and defenders of the Amazon.* 349 pp., illustr., maps, London, Penguin, 1990.

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Heuss, Theodor, Anton Dohrn, a life for science (translated from the German). 399 pp., illustr., Berlin, Springer, 1991.

Ho, Mae-Wan & Saunders, Peter T., *Beyond neodarwinism.* 376 pp., London, Academic Press, 1984.

Hodges, Elaine R. S., Ed. *The Guild handbook of scientific illustration.* 575 pp., illustr., some col., New York, Van Nostrand Reinhold, 1989.

Homewood, K. M. & Rodgers, W. A., *Maasailand ecology, pastoralist development and wildlife conservation in Ngorongoro, Tanzania.* 298 pp. maps, Cambridge, CUP, 1991.

Howse, Derek, *Background to discovery, Pacific exploration from Damier to Cook.* 210 pp., illustr., maps, Berkeley, Univ. California Press, 1990.

Ingle, Ray, *Larval stages of northeastern Atlantic crabs, an illustrated key.* 362 pp., illustr., London, Chapman & Hall, 1992.

Isaac, Susan, *Fungal-plant interactions.* 418 pp., illustr., London, Chapman & Hall, 1992.

James, Matthew J., Ed. *Galapagos marine invertebrates.* 474 pp., illustr., maps, New York, Plenum, 1991.

Johnsgard, Paul A., *Crane music, a natural history of American cranes.* 136 pp., illustr., Washington, Smithsonian Institution Press, 1991.

Johnson, Dennis, Ed. *Palms for human needs in Asia: palm utilization and conservation in India.* 258 pp., illustr., Rotterdam, Balkema, 1991.

Jones, Whitney R. D., *William Turner, Tudor naturalist, physician and divine.* 223 pp., London, Routledge, 1988.

Keiter, Robert B. & Boyce, Mark S., Eds. *The Greater Yellowstone ecosystem, redefining America's wilderness heritage.* 428 pp., illustr., maps, New Haven, Yale University Press, 1991.

Kohlstedt, Sally Gregory, *The origins of natural science in America.* 411 pp., illustr., Washington, Smithsonian Institution Press, 1991.

Kozlov, N. P., Ed. *Earth's nature from space.* 275 pp., illustr., some col., maps Rotterdam, Balkema, 1991.

Kuhnlein, Harriet V. & Turner, Nancy J., *Traditional plant foods of Canadian indigenous peoples.* 633 pp., illustr., Philadelphia, Gordon & Breach, 1991.

Kuschel, G., *Beetles in a suburban environment: a New Zealand case history.* 118 pp., illustr., Nelson, DSIR, 1990.

Lanner, Ronald M., *Trees of the Great Basin.* 215 pp., illustr., some col. maps, Reno, Univ. of Nevada Press, 1984.

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The House of Lords Select Committee Report on Science and Technology: Systematic Biology Research

Society members will, no doubt, recall the reply in *The Linnean* of August 1991 to the above Committee's questionnaire by my predecessor, Professor Claridge, and myself stating the views of the Society on the continuing importance of systematic biology research.

I was also asked, on behalf of the Society, to give oral evidence to the Committee and a copy of my statement appears in *The Linnean* of January 1992. Volume II will contain evidence submitted after 21 May 1991, whilst Volume III has already appeared and contains evidence submitted before that date. Volume I is the Report itself and was released on 28 January 1992.

This latest volume is clearly of very great interest and importance to members, who may remember that two Past-Presidents of the Society, Professors Bill Chaloner, F. R.S. and Mike Claridge, acted as advisers to the Committee. The Report of more than 100 pages clearly cannot be contained in *The Linnean*, but I have felt it to be of such importance that I have asked the Editor to allow me to publish Chapter 9—a summary of conclusions and recommendations—together with more detailed conclusions and recommendations added to the summary.

Summary of conclusions and recommendations

9.1 Systematic biology research is not only of central importance to evolutionary theory but also provides an essential framework to most other branches of applied biological science. Its benefits to mankind both in economic and human terms can be also large. (3.24)

9.2 The quality of the systematics collections and the expertise of our systematists also places the United Kingdom in a unique position to contribute a firm scientific base to the current world drive to conserve biological diversity. (3.25)

9.3 Systematics research and curation of the collections on which it depends should therefore be maintained in good order. (3.26)

9.4 Ultimately, and properly in our view, public funding of one sort or another bears the brunt of expenditure on systematic biology research. But public expenditure policy has meant that core funding of the major institutions has not been maintained in real terms and this has affected both the quality of curation and the amount of research performed. The criteria of originality applied by the research councils has meant that applications for support for many kinds of traditional systematic research have gone unfunded. And universities' own research facilities, on which systematists have relied, are themselves under pressure.

9.5 As an academic subject in the institutes of higher education it has been widely displaced by newer areas of biological science and the increasing average age of systematists in the faculties is such as to render them almost an endangered species in themselves.

9.6 In our view these circumstances have all conspired to place systematic biology the research itself, the curation of the collections, and its position at the universities at a risk which the nation can ill afford and which reflects poorly upon the traditional, peer review, mechanisms for the funding of science today.

9.7 Our principal recommendations are that in future core funding for research at and curation of the collections in the major systematics institutions be maintained in real terms; that ABRC establish a special fund for five years on £1 m a year for systematic biology research; that OAL set up a rolling programme of up to £0.5 m a year to assist systematics collections outside the grant-in-aided institutions; that a new forum of systematics institutions be established to rationalize holdings and expertise; and that ABRC assess the need for trained systematists and fund MSc courses in line with those requirements.

9.8 Taken together with our other recommendations we hope that these modest measures will give systematic biology research a much needed stimulus, after which we expect the subject to take its place with other branches of science.

9.9 Our more detailed conclusions and recommendations are:

Decline in Research Funding

9.10 Funding for and manpower engaged in systematic biology research have fallen in real terms in recent years because core funding of the major institutions by Government has not been maintained in real terms; support from the research councils through "responsive mode" funding or research grants has fallen; and universities own free funds for research are being squeezed by other factors. (5.47–48; 5.53)

9.11 There is for the foreseeable future no viable alternative to Government core funding of systematic biology research, which should be maintained in real terms. (5.47–48)

9.12 The Office of Arts and Libraries should continue to fund the Natural History Museum but should establish an expert scientific panel to advise it on the Museum's requirements. Such a panel might also be consulted on the annual spending bids of any other natural history grant-in-aided institution, whatever the parent Government Department. (5.49)

9.13 The Cabinet Office and research councils should press for the inclusion of more systematic

research in the next EC Framework, subject only to a relaxation of Treasury practice relating to attribution and additionality so as to guarantee some element of additionality. (5.50)

9.14 The Government should monitor closely the way in which the World Bank's Global Environment Facility funds are disbursed. (5.52)

9.15 Systematic biology research has not fared well under the research councils. ABRC, using its powers to protect subjects which fall between the research councils' responsibilities, should set up a fund of £1m per annum for five years exclusively for systematic biology research beyond the routine research activity associated with monitoring the collections. (5.54)

9.16 All grant-in-aided institutions should, like the Natural History Museum, be eligible for research council grants. (5.55)

9.17 Aid projects funded by the Overseas Development Administration and dependent upon systematics should as a general rule include funding for a United Kingdom based research project at one of the major institutions with appropriate overheads. (5.56)

Curation of the Collections

9.18 United Kingdom institutions hold systematics collections which are unique and of inestimable value to world science. These collections are indispensable to systematic biology research and should be properly maintained so that they remain accessible. (6.40)

9.19 Our own survey showed that expenditure on curation had risen overall in real terms between 1980 and 1990 and we suspect that curation has been preserved at the expense of research. Notwishstanding this, we think that all collections have encountered financial difficulties, especially university and local authority holdings. This is now beginning to affect the quality of curation and their accessibility. (6.41)

9.20 Core funding from Government for grant-in-aided national institutions should be maintained in real terms to ensure the long term well being of the collections. This shall include care and maintenance of the collections and such research as is consistent with their preservation as a scientific resource (see also para 9.11 above). (6.42)

9.21 OAL should establish a Biological Collections Fund of up to £0.5 m a year to be administered on a rolling basis to assist any systematics collections with research potential outside a grant-in-aided institution. (6.45)

9.22 There is as yet no case for repatriating any of the collections. (6.48)

9.23 Ideally, collections should be the responsibility of a staff member who has an active research interest in the field. At second best, honorary curators from other institutions may be contracted to take on curatorial work. No important collections should be left without regular, though not necessarily continual, attention from a research or scientific officer who is contracted so to do. (6.50; 6.51)

9.24 A new forum should be established by the major systematics institutions to generate a national curatorial policy through discussions on rationalization of holdings, staff appointments and areas of specialization. A committee of award drawn from this forum should advise the OAL on applications to the proposed Biological Collections Fund (6.45; 6.55)

Universities

9.25 Systematic biology has contracted at British universities to such an extent that it may be in danger of extinction as a sustainable discipline. (7.27)

9.26 Systematic biology is a necessary adjunct to other biological sciences and should be taught to undergraduates as a part of those courses. (7.28)

9.27 ABRC should assess the need for taught MSc courses and fund studentships according to those requirements. (7.29)

9.28 Candidates for higher research degrees should be assisted by grants and studentships from the new ABRC money for systematic biology research (see 9.15 above). (7.31)

9.29 Closer links should be established between the institutions and the universities to formulate taught MSc courses, to supervise doctoral candidates, and to facilitate access to molecular facilities. (7.33–34; 8.24)

Modern Methods

9.30 Systematic biology research should be enabled to take advantage of all that modern science can provide including recent developments in molecular biology and in information technology. These developments should supplement rather than supplant traditional taxonomic expertise. (8.23)

9.31 Systematists should be allowed access to molecular biology facilities at the universities. (8.24)

9.32 Research into IT for systematics should be eligible for assistance from the extra provision from ABRC for systematic biology research, having regard to, and favouring collaboration with, work under way in the United States. (8.27)

Advisory Groups

9.33 National museums and gardens should, to the extent that they have not already done so, appoint standing groups of experts to advise on scientific programmes and standards of curation. (8.29)

A copy of the full report is available in the Society's Library for consultation by members.

If the Report is to have any effect, it will need to be brought to the attention of Government, and for the Government to take action along the lines suggested. We can only hope that this will happen, but members in a position to do so might discuss the Report with their MPs or others with Government connections. This could be a considerable help in ensuring action on the recommendations made in the Report.

PROFESSOR JACK HAWKES
President