THE LINNEAN

Newsletter and Proceedings of
THE LINNEAN SOCIETY OF LONDON
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THE LINNEAN SOCIETY OF LONDON

Burlington House, Piccadilly, London W1J 0BF
Tel. (+44) (0)20 7434 4479; Fax: (+44) (0)20 7287 9364
e-mail: john@linnean.org; internet: www.linnean.org

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Newsletter and Proceedings
of the Linnean Society of London
Edited by B. G. Gardiner

EDITORIAL

This issue contains two articles which have a bearing on my 1996 Presidential Address (see *The Linnean* **18**(2): 33-40).

Louis Somma points out in his paper on 'Reptilian parental behaviour' that I stated that "parental care in amniotes only occurs in crocodiles, birds and mammals". He goes onto document it in a diverse number of oviparous, non-crocodilian reptiles[1]. Nevertheless, my tenet that birds and mammals are sister-groups remains undaunted, substantiated by some 97[2] characters which do not include parental care and I conclude that the Presidential Chair shared an ancestry with both the fellows and the pigeons in Trafalgar Square!

The second article is by John Cloudsley-Thompson 'On Sweating'. Sweat glands are a derived feature of mammals and are absent in birds. "By sweating and thus cooling the body a human being can for a short while withstand a temperature at which water would boil". Many mammals and birds cool themselves by panting while thermo-regulatory salivation also occurs in tortoises. There are two types of sweat gland – epitrichial which is always associated with hair and atrichial, without hair. Feathers and hair are part of the same developmental process in which both have melanin extruded into them (via an epidermal melanin unit). Moreover, in *Ornithorhynchus* the hairs develop as open tubes which sink deep into the dermis just like feathers. Hairs are said to contain only α keratin, unlike feathers which have ß keratin. The quill medulla of the American porcupine, as well as the scales of the pangolin, however, are comprised solely of ß keratin.

Feathers like hair, are arranged in groups and both are used as organs for the sensation of touch. Both birds and mammals also uniquely possess sinus hairs. Though feathers and hair raising are used to control heat loss they are also used, especially in association with exaggerated crests or hackles, to signal aggression. Finally, birds can loose heat through their feet, the only area not usually covered by feathers.

This issue also includes the memorial lecture to Sir Cyril Clark given by Laurence Cook at the Atheneum in Liverpool, on 7th September 2002 (see photograph in the Annual Report).

Elsewhere in this July issue of *The Linnean* there are a variety of items, including a commentary on Arts versus Science, a previously unknown letter from the Reverend Stebbings, information on Greenough's career, an account of Paxton and the Crystal Palace and a belated obituary of Kunth.

BRIAN GARDINER

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[1] A reviewer commented "implicit in Somma's argument is the suggestion that parental behaviour in Anaspida and Squamata is on a level with that in crocodiles and birds, which it clearly is not."

[2] Gardiner, B.G., 1993. *Cladistics* **9**: 369-395.

Society News

Charles Hutt, former Treasurer of the Society, died on 2nd March 2003 following a stroke. He was 91. He was elected a Fellow of the Society in 1969, served as the Society's Treasurer from 1979–89, as Vice-President from 1979–82 and again from 1985–89. His period as *Aerarii praefectus* included the Society's Bicentenary celebrations and he was called upon to exercise stewardship of the Society's finances at this commemoration, involving as it did royal visits, an expedition, and numbers of joint meetings with other organizations, marking the anniversary. A more detailed obituary will appear with the 2003 Annual Report.

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The Society's Bye-Laws have been submitted for revision by Mr. Keith Lawrey, a barrister working for the Foundation for Science and Technology, to which the Society belongs. Changes to laws relating to human rights, to charities and to employment practices, as well as changes, e.g. to delivery of our publications, give our Bye-Laws, which were last agreed after three general meetings of the Society in 1991, an obsolescent look. The Clerk to the Privy Council has also given permission for the Society's Royal Charters, as supplied to Members, to be laid out with section headings rather than marginal notes, making for easier reference. **No changes to the Society's two Royal Charters are planned.**

The draft revisions to the existing Bye-Laws will be put on the Society's www site as .pdf files – this allows the use of colour to mark changes – during the summer. Copies of the documents will also be available in the Library. Under the Society's 1802 Charter, *the Council of the said Society for the time being or any five or more of them all the Members thereof having been first duly summoned to attend the meetings thereof shall and may have power according to the best of their judgement and discretion to make and establish such Bye-Laws as they shall deem useful and necessary for the regulation of the said Society and of the Estate Goods and Business thereof….Provided that no Bye-Law hereafter to be made or alteration or repeal of any Bye-Law which shall hereafter have been established by the said Council hereby appointed or by the Council for the time being of the said Society shall be considered to have passed and be binding on the said Society until such Bye-Law or such alteration or repeal of any Bye-Law shall have been hung up in the Common Meeting Room of the said Society and been read by the President or by any one of the Vice-Presidents for the time being at Two successive general meetings of the said Society and until the same shall have been confirmed by ballot by the Fellows at large of the said Society; such ballot to take place at the ensuing meeting next after such two successive general meetings of the said Society eleven at least of the Fellows of the said Society being present; and provided that no such Bye-Law or alteration or repeal of any Bye-Law shall be deemed or taken to pass in the affirmative unless it shall appear upon such ballot that two thirds of the Fellows present at such meeting shall have voted for the same…* These provisions were not altered in the 1904 Charter, which was primarily concerned with the matter addressed

A REMINDER . . .

that subscriptions for 2003-4 were due on 24th May 2003. If you do not pay automatically through your bank please send your subscription as soon as possible.

by Professor Vines 100 years ago (below). Details of the three general meetings to consider any changes will follow scrutiny of the proposed changes by the Officers and Council and will be announced in *The Linnean*. Agreed changes will then be submitted to the Privy Council.

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100 years ago….

.... taken from the Presidential Address given by Prof. Sidney Howard Vines FRS on 25th May 1903.

"In addressing the Fellows of the Society at their Anniversary Meeting for the third time, I feel that the occasion is one of more than usual interest, not untouched with pathos; for this is doubtless the last Anniversary on which the assembled Fellows will all be of the same sex. The question as to the admission of women to our Fellowship had already been raised when we met here a year ago, and, as I explained in my Address, the Council had taken steps to ensure that every Fellow should have an opportunity of expressing his opinion upon so important a matter. In due course a Special General Meeting was summoned for January 15 of this year, to discuss and vote upon the question, with the result that the proposal was carried by a large majority. The Society having thus committed itself to the new policy, the Council lost no time in taking the necessary steps to obtain the supplemental Charter and to adapt the Bye-Laws to the altered circumstances. I regret that I am not in a position to announce to you today that we already possess the power to exert these new rights and privileges, nor can I tell you when that moment will arrive. That it is somewhat impatiently anticipated in certain quarters is shown by the fact that nominations of Lady-candidates have already been sent in. The process of obtaining a Supplemental Charter is evidently one that cannot be hurried; but I have little doubt that, should you again honour me with your confidence, it will fall to my lot to admit the first Lady-fellow. In this respect, at any rate, my tenure of office will be memorable. Regarding the matter, as I am bound to do, from the point of view of the welfare of the Society, I must confess that I am not altogether free from apprehension as to the future. We are making a somewhat heroic experiment, with no precedent, no working hypothesis, to suggest to us what the results are likely to be. If purity of motive can deserve success, then it should certainly be ours: for this revolution in our constitution is the expression of a sense of justice, of a desire to extend an equal recognition to all, whether men or women, who work in or for biological science. However, we must not shut our eyes to the fact that the Society is passing through a serious crisis and that it claims more strongly than ever all the support that the loyalty of its Fellows can give."

The late President was right about the supplemental Charter. It took its time and there is no further mention of this matter in Society meetings for the remainder of 1903.

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Over the past year, the Society has been deeply concerned with the second enquiry by the House of Lords into systematic biology (the first was eleven years ago), and details of the Society's involvement in the enquiry which led to the publication of the report *What on Earth: the threat to the science underpinning conservation* have appeared in these pages. The response of Her Majesty's Government to the report and the Society's invited response to the response are reproduced, with permission, below:

GOVERNMENT RESPONSE TO THE THIRD REPORT OF THE HOUSE OF LORDS' SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY: WHAT ON EARTH? THE THREAT TO THE SCIENCE UNDERPINNING CONSERVATION (2001/2002 SESSION)

Introduction

1. The Government welcomes the Committee's report which highlights the important role of systematics in the conservation of biological diversity. The number of species in the world yet to be identified and classified represents a significant and important challenge to the systematics community.

2. This year, at the World Summit on Sustainable Development in Johannesburg, more than 180 Governments committed themselves to significantly reducing the rate of loss of biodiversity by 2010. Improving our knowledge and understanding of the forms of life which need to be conserved will be an important element in fulfilling this target. But the challenge cannot be tackled by one country alone, although the UK has an honourable tradition of contributing a significant part of the global systematics effort. The Government stresses too that conservation effort should not be dependant on a perfect knowledge and understanding of species yet to be identified, which may be unattainable. We can and should support conservation effort alongside the development of the science of systematics.

The Committee's Recommendations

1.1 In view of the Government's commitments to biodiversity conservation we recommend that they increase grant-in-aid to the major systematics institutions. We envisage this as providing support to collections – the databases used by systematic biologists and conservationists. In accordance with the recommendation of the Dainton Report, grant-in-aid funding should be increased to the level it would have been had the 1992 figures been maintained in line with inflation. This would allow further digitising of the collections.

3. The Government values the work of the three major systematics institutions, not only for their expertise in relation to UK and international systematics but also for their contribution to the country's educational and cultural goals.

4. It will not be possible for the Government to increase grant-in-aid funding to the level it would have been taking account of inflation since 1992. However, the Government is making substantial new resources available to each of the three institutions as follows:

- **Royal Botanic Gardens, Kew**: Defra has awarded an additional £3 million towards Kew's operating costs in 2003/04, increasing its operating grant-in-aid baseline to £17.299 million. It has also been granted a capital allocation of £3.4 million in 2003/04; and further capital bids will be entertained should additional money become available during the year.
- **Natural History Museum**: An increase of 4% in 2004/05 and 5% in 2005/06 on the 2003/04 resource grant-in-aid has been provided, to a total of £37.98 million in 2005/06. In addition, £2.1 million has been allocated for capital expenditure in each of the years 2004/05 and 2005/06.
- **Royal Botanic Gardens, Edinburgh**: As noted by the Committee, the Scottish Executive has already increased its recurring grant-in-aid to the institution by some £300,000 per year and, following Spending Review 2002, it now plans to increase funding by almost £600,000 over the next three years to a level of just under £6 million by 2005/06.

5. These additional resources are intended to help the institutions to meet the totality of their functions, of which their work on systematics is of course an important part. It is for the institutions themselves to decide how to allocate the resources in accordance with the objectives set out in their Corporate Plans or Funding Agreements which are approved by Sponsor Departments.

6. Currently, the institutions invest in digitisation largely through use of their grant-in-aid or through project funding. As the Committee have noted, Kew made a successful application to the Capital Modernisation Fund for its electronic Plant Information Centre.

1.2 We recommend that the Government consider providing support to systematics collections as part of a bigger project to support biological resource centres, as recently highlighted by the OECD.

7. The Government supports the broad objective of the OECD initiative on Biological Resource Centres, which is to seek to ensure the conservation of biological resources and associated information in an efficient and effective way through the creation of a global network of biological resource centers and, through such a network, to provide improved access to biological resources of an appropriate quality to *bone fide* users in the fields of life sciences and biotechnology. Proposals on how this might be achieved are still under discussion in the OECD but could be completed by the end of 2004. The Government will not be in a position to take a firm view on those proposals until then.

1.3 We recommend that the Government develop and publish a clear, concise summary document regarding their policy on biodiversity conservation activity in the United Kingdom and on the international stage.

8. The UK is a party to all the major international agreements which aim to further biodiversity conservation, including the Convention on Biological Diversity, the Convention on the Conservation of Migratory Species of Wild Animals (also known as the Bonn Convention), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on Wetlands (also known as the Ramsar Convention). The UK has also signed the International Treaty on Plant Genetic Resources for Food and Agriculture which it hopes to ratify soon. The Government subscribes to the objectives of these conventions. It is an active supporter of their work programmes, as well as making substantial financial contributions to help developing countries participate in the work of these Conventions.

9. DEFRA has recently published a biodiversity strategy for England ("Working with the Grain of Nature", October 2002). The Scottish Executive will consult on a biodiversity strategy for Scotland in 2003. The Welsh Assembly Government will consult on the framework for biodiversity action in Wales later this year and the Northern Ireland Executive published its biodiversity strategy on 7 September 2002.

1.4 We recommend that the Higher Education Funding Councils should consider the role of the Research Assessment Exercise in the decline of systematic biology in universities and explore ways in which to support this subject, as they do with other minority disciplines.

10. The Funding Councils are currently reviewing research assessment in a process that is being led by Sir Gareth Roberts, Wolfson College, Oxford and managed by the HEFCE. The issue of minority subjects and how best to assess and support them will be considered as part of that review and more broadly in relation to the HEFCE's proposed funding for enhancing capability.

1.5 We recommend that the BBSRC should reconsider its decision not to award academic analogue status to Royal Botanic Gardens, Edinburgh and Kew.

11. At its July meeting, the BBSRC Council considered the background to, and procedures used by BBSRC in defining organisations as academic analogues eligible for responsive-mode funding from BBSRC. The Council agreed that the awarding of such status to organisations that enhance and extend the science base in biotechnology and the biological sciences should be the responsibility of Council, and that status should be reviewed biennially. Specifically, it agreed that the Royal Botanic Gardens Kew and Edinburgh should be eligible for responsive-mode funding when this was for a joint project in collaboration with an already eligible institution, such as a university or BBSRC institute. The Council regarded this as the appropriate way for the unique expertise in the institutions concerned to be made available to the existing wider science base.

1.6 We recommend that the systematic biology community, especially via the Systematics Association and the Linnaean Society, should continue to increase efforts to demonstrate the relevance and importance of systematic biology. This should have the effect both of improving its profile to funding bodies and of making it more

attractive to potential professional taxonomists and volunteers. We also hope that systematic biologists who are members of learned societies, such as the Institute of Biology and the Royal Society, will use their influence to promote the discipline.

12. The Government supports this recommendation.

1.7 We recommend that the United Kingdom should take the lead and propose to the Global Biodiversity Information Facility (GBIF) that GBIF run a pilot with some priority species to form the basis of a trial for Professor Godfray's suggestion of making taxonomy primarily digitised and web-based. A trial would demonstrate the benefits and pit-falls of this approach before implementing it more widely.

13. The Government supports the work of the Global Information Biodiversity Facility (GBIF). The UK has been involved in GBIF since its inception and became a full voting participant in September 2001. It is clear that the digitisation of taxonomy will be an important factor in achieving GBIF's goal of making the world's biodiversity data freely available, and resulting in the utilisation of the data by a wider range of disciplines. As such, GBIF has already identified the digitisation of biodiversity data, including taxonomic data, as one priority in achieving its goal. In support of this, GBIF's work programme includes initiating additional digitisation efforts, following a review of existing technologies and digitisation efforts. The "Catalogue of Life"; a joint initiative between the UK-based Species 2000 and North America's Integrated Taxonomic Information System will also contribute to the GBIF work programme. This aims to create a unified catalogue of the 1.75 million known species of living organisms on earth.

14. The Government agrees with the Committee that new approaches to digitising taxonomy to make it more accessible through the world wide web should be piloted. In the light of Professor Godfray's recommendation, the UK successfully promoted a pilot project at the recent Governing Board meeting to demonstrate GBIF's practical value and usage to the wider conservation community within a meaningful timeframe. We agree with Professor Godfray that this should be limited in scope, and believe that the pilot needs to be focussed on a restricted group of species or one ecosystem. The pilot now forms part of GBIF's two-year work programme. The digitisation of a particular group of species will be a core component of this pilot.

1.8 We recommend that DEFRA should take the lead in setting up a body with the express purpose of bringing together representatives from Government departments, ecologists and conservationists and the systematic biology community, including those based at museums, universities and other insitutions. DEFRA should provide funding for administrative support in the early stages, although we envisage that the body should eventually seek to become self-financing with all participants making a small contribution to running costs. The body's main remit would be to:

(a) identify priority areas of biodiversity for which taxonomic research is most needed by the conservation community, and for other national purposes, such as health and agriculture.

Additional remits would be to:

(b) assess the taxonomic impediment to conservation action – specifically to analyse the shortage of taxonomic specialists and gaps in taxonomic data;
(c) campaign for resources for taxonomists researching in those priority areas.

15. The Government broadly accepts this recommendation and will be working with interested organisations to take it forward. The Government believes that the initial task of such a body should be to develop an overall strategic view of priorities for UK systematics policy within a clearly defined timescale, perhaps eighteen months to two years. At that stage, it may be appropriate for Government to step back. Responsibility for articulating the needs of UK systematics should primarily be the responsibility of the systematics community itself. In any event, it is not appropriate for the Government to participate in campaigns for additional resources for taxonomists. Defra plans to convene a meeting with interested parties next year to decide the next steps.

1.9 We recommend that the current level of spending on the Darwin Initiative, approximately £3 million per annum, should be earmarked specifically for projects with a significant taxonomic component, to be used for conservation purposes. This would be used to help build taxonomic capacity in developing countries and should include projects to digitise UK systematics collections. Any additional funds to the Darwin Initiative beyond this core could have a wider remit to include projects with a major focus on development issues or poverty alleviation.

16. The Government welcomes the Committee's recognition of the role of the Darwin Initiative in furthering the conservation of biodiversity. The Initiative has done a great deal to help countries rich in biodiversity but poor in resources to meet their obligations under the Convention on Biological Diversity. A considerable proportion of the £27 million already committed to projects in nearly 100 countries has supported work on systematics. The Government is proud of the record of Darwin projects in delivering benefits beyond the resources put in and in leaving a lasting legacy in host countries after Darwin funding ceases. The Government therefore agrees with the Committee that an additional injection of funds for the Initiative is deserved. For this reason, the Prime Minister announced an increase in the Darwin budget to £7 million per year by 2005. The budget will rise next year from £3 million to £4 million. The additional money will double in each of the two successive years, bringing the budget for 2004/05 to £4 million and for 2005/06 to £7 million.

17. The Secretary of State for Environment Food and Rural Affairs is advised on awards to projects and on the development of the Darwin Initiative by the Darwin Advisory Committee. The Secretary of State accepts the Committee's advice that Darwin Initiative funds should not be earmarked for systematics work. Systematics is a significant component of many projects, and the increase in the budget will mean a proportionate increase in support for systematics work. But the Committee does not believe that earmarking will help sustain the pressure for excellence that the Darwin Initiative strives to achieve.

December 2002

COMMENTS BY THE LINNEAN SOCIETY OF LONDON ON THE GOVERNMENT RESPONSE TO THE SELECT COMMITTEE REPORT *WHAT ON EARTH? THE THREAT TO THE SCIENCE UNDERPINNING CONSERVATION*

1. Two key points underlie the Select Committee Report.

a) That part of systematic biology which is concerned with the identification and description of species continues to be in decline, despite the publication of the 'Dainton' Report in 1992.

b) It is also the part of systematic biology which is fundamental to any comprehensive programme of biodiversity conservation.

2. The Select Committee Report made nine recommendations to remedy this situation. The Government's brief Response to the Report is deeply disappointing, being not only brief but also both superficial and dismissive.

3. The Government Response states that grant-in-aid funding of three major systematics institutions is to be increased. This is somewhat misleading since the Government also comments that it will not be possible to increase funding to the level it would have been taking account of inflation since 1992, so that the 'increases' are really significant reductions in the level of reduction suffered over the last decade.

4. It is to be warmly welcomed that there will be a real increase in the level of funding for the Darwin Initiative, but it is to be regretted that no portion of this funding is to be earmarked for projects with a significant taxonomic component.

5. It is also to be regretted that in response to the Select Committee's recommendation that consideration be given to supporting systematics collections, the Government carefully avoids making any firm commitment.

6. The response to the remaining six recommendations suggest that the Government is largely content with the *status quo* and sees no need to take any other initiatives. For example, it seems content that the illogical situation should persist whereby NERC gives analogue status to the Natural History Museum (NHM), Kew and the Royal Botanic Gardens Edinburgh, but BBSRC gives such status only to the NHM. Again, while predictably expressing support for the work of the Global Biodiversity Information Facility (GBIF), the Government ignores the problem that 80% of the funding of a GBIF project still has to be found locally.

7. This leads to the depressing conclusion that the decline in this key area of systematic biology, highlighted by both the 'Dainton Report' of 1992 and the recent Select Committee Report, will continue.

8. In 2001 the Linnean Society wrote on behalf of 27 other Learned Societies to the Government Chief Scientist, Professor Sir David King, to express concern about the decline in systematic biology. In the course of this and subsequent correspondence, it was explained why it could no longer be left to the systematics community alone to

arrest this decline. We were therefore disappointed to read in para. 15 of the Government Response that it is still considered that the responsibility for remedying the situation lies with the dwindling community of systematic biologists.

9. Unfortunately, the Government Response will reinforce the widely held impression that this area of environmental concern is regarded as of low priority – apart from the dictates of political correctness which require all governments to be seen to make statements in support of international initiatives to conserve biodiversity.

10. In para. 2 of its response, the Government points out that at the World Summit on Sustainable Development in Johannesburg, more than 180 governments committed themselves to reducing the rate of biodiversity loss by 2010. However, because there is no reliable method of measuring the rate of biodiversity loss, there is no means of knowing whether this target will be fulfilled. Unless more action is taken to improve the current state of systematic biology, it is very unlikely that any reliable method of measuring the rate of biodiversity loss will be available by 2010.

11. The Linnean Society holds to its firm belief that the Select Committee Report *What on Earth?* is an excellent and realistic document deserving serious and detailed consideration. The Society's own positive response to its publication was to set up a working group under the chairmanship of Professor Richard Bateman of the Natural History Museum to explore how the Select Committee's recommendations could be further developed. The report of our working group outlined eight projects as examples of new initiatives that would both fulfil some of the recommendations and address some additional issues regarded as of high priority by systematists.

12. The eight projects are distributed among different disciplines, different groups of organisms, different ecosystems and different research organisations. The deliberate aim was to maximise linkages among organisms and to distribute the benefits of any increased resourcing of the systematics community. Each project was estimated to require a minimum of five years to complete, have an estimated cost of £5M each, and involve at least three different partner organisations.

13. Details of each of these projects are contained in the 20 page document which we sent earlier to the Select Committee as our response to their Report (and copied also to the Government Chief Scientist). The titles of the projects were:

lepidoptera "taxome" programme and related projects;
digitisation and dissemination exchanges with developing countries;
realising the potential of regional and local natural history collections;
urban biodiversity surveys in the UK;
monitoring changes of species distributions in the UK;
assessing the rigour of species identification by automated DNA sequence analysis;
determining how the remarkable diversity of tropical forests is maintained;
understanding the processes of speciation, extinction and invasion on oceanic islands.

14. Finally, the Linnean Society welcomes the work being done to produce biodiversity strategies for England, Wales, Scotland and Northern Ireland and many of its members are contributing to these processes. However, we wish to emphasise the important international contribution made by taxonomists and other biodiversity scientists in the UK and the need to develop and support strategies for this work.

Sir David Smith FRS FRSE
President, 31st March 2003

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COMMENTS BY THE ROYAL ENTOMOLOGICAL SOCIETY ON THE GOVERNMENT RESPONSE TO THE SELECT COMMITTEE REPORT *WHAT ON EARTH? THE THREAT TO THE SCIENCE UNDERPINNING CONSERVATION*

The Council of the Royal Entomological Society (RES) welcomes the opportunity to comment on the Government response to the House of Lords' Select Committee on Science and Technology Report "What on Earth? The Threat to the Science Underpinning Conservation."

The Government response is generally positive in tone, expressing broad support for the view of the Select Committee and the systematics community that the science of systematics provides essential and indispensable underpinning for the conservation of biodiversity. However, the details of the response suggest that the Government does not acknowledge the evidence – such as that concerning insect taxonomy, presented to the Committee by the RES in January 2002 – that UK investment and expertise in taxonomy and systematics have been in decline for many years. The response makes some generic commitments to increased resources for conservation and biodiversity, but it makes no specific commitments to the resources for taxonomy and systematics that were the focus of the Committee's Report. Thus, the response fails to address the issue of redressing the past decline in these resources and, indeed, full implementation of the commitments and actions proposed by the Government in its response may still allow further decline.

The RES, with a membership of about 1800 professional and amateur entomologists worldwide, concurs with the Government's view that biodiversity conservation and the underpinning science of systematics are global issues. We are also mindful that, historically, British naturalists – such as former RES Fellows Charles Darwin and Alfred Russel Wallace – have been world leaders in their field and that throughout the past century biologists in many countries, especially those of the Commonwealth, have looked to British taxonomists as key players in this global science. Unfortunately, the UK's former pre-eminence in this area has been greatly weakened over the past two decades, as the RES described in its earlier evidence to the Committee. The Government's argument that perfect knowledge of all as-yet-undescribed species may be unattainable is an irrelevant truism (though we would have said 'is', not 'may be'): the Committee's concern was not about perfect and complete taxonomic knowledge but about sufficient knowledge to support informed decisions and actions in the conservation of biodiversity.

We note the increased grant-in-aid to three of the UK's systematics institutions: the Natural History Museum, and the Royal Botanic Gardens at Kew and Edinburgh. We note, however, that there is no requirement from Government for these additional resources to be used to support the collections, which is what the Committee recommended. The focus of new resources on these three institutions is understandable, not least because of the size and importance of their existing collections. Nonetheless, we feel that the Government should be mindful of the resources needed by other institutions contributing to systematics: the national museums in Cardiff and Edinburgh, and small specialist centres of expertise in various research institutes and universities. The support of specialist centres is especially important for the newer multidisciplinary approaches to systematics, with small teams of systematists, ecologists and molecular geneticists (with concomitant capital resource needs) focusing on specific taxa or on particular habitats.

The Committee recommended that the Government should publish a clear concise summary of their policy on biodiversity conservation. The response lists five international conventions to which the Government subscribes, and refers to the four separate national biodiversity strategies for England, Scotland, Wales and Northern Ireland. This illustrates precisely why the Committee asked for a single clear summary document.

The request for the HEFCs to consider the role of the RAE in the decline of systematic biology has been answered by a non-specific reference to a review of minority subjects. There is a circularity of argument here, since the point was that systematics has become a *de facto* minority subject because of a progressive decline in public funding. The RES, representing scholarly and practical interests in insects, which are variously estimated as comprising 55% to 65% of all living species, would argue robustly that the Government cannot afford to view systematic biology – whether by morphological taxonomy or by molecular analysis – as a minority subject since it underpins most of biological science and is pivotal in addressing major issues such as conservation and exploitation of biodiversity, impacts of global environmental change, and integrated management of pests, vectors and diseases.

Since most insect species are herbivorous, and many of these feed on one or very few plant species, much entomology is also dependent on the state of botanical systematics. We cannot understand the argument for BBSRC not giving academic analogue status to the Royal Botanic Gardens. The encouragement of joint institutional projects is to be applauded when there is academic benefit to be gained by multidisciplinary partnerships. Where there is no such benefit, joint projects often increase transaction and administration costs and thus dilute the scientific effort.

We note the positive response to the recommendation that DEFRA should take the lead in developing a strategic view of priorities for UK systematics. We also note that the Government takes the view that DEFRA should step back after an initial period and that the responsibility for articulating the needs of UK systematics should lie with the systematics community itself. We might perhaps be forgiven for pointing out that the Committee's

2002 report, and the 1992 one prepared under Lord Dainton's chairmanship, are the result of precisely this process, whereby the systematics community through their institutions and learned societies gave evidence to the House of Lords' Select Committee.

Throughout the Government's response there is an unwillingness to reverse the decline in systematic biology by exercising any conditionalities or guidance on Government funds provided to the three major institutions named, or distributed via the HEFCs, the BBSRC or the Darwin Initiative. Without such conditionalities or guidance it seems probable that investment in systematic biology will continue to decline, since it is the funding priorities of these agencies over past years that has led to the threat to systematic science identified by the Select Committee in its Report. There has been a lack of 'joined-up thinking' between the Government departments and funding agencies that are either responsible for generating taxonomic knowledge or dependent on such knowledge, and there is no clear evidence in the Government's response to suggest that this situation will change.

The RES Council hopes that the Select Committee will continue to press the Government on those recommendations where the response has been somewhat equivocal. We take heart from the generally positive attitude of the Government response to the identified problems, and in spite of our misgivings that they may be 'too little, too late' we hope that the medium-term initiatives that are being pursued will slow or halt the decline in the UK's systematics science base.

On behalf of the Council of the Royal Entomological Society
Prof. Chris Haines, RES President,
11 April 2003

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Committee Structure of the Society

The Society's Council agreed to examine the roles of the Collections Curatorial Committee and the Library Committee of the Society at its meeting on 20th March 2003. The changes proposed and the reasons for them were endorsed by the Chairmen of both the Collections Curatorial Committee, Dr. Joysey, and the Library Committee, Mrs. Gove. There are three principal reasons for wishing to bring about these changes. First, if our aim of putting all our collections online by 2007 is to be met, then all our various collections – scientific specimens, books, manuscripts and archives, medals, pictures and portraits – need to be considered as an organised whole. Second, there is an urgent need for a coherent approach to raising the very significant funds we need, and that this must be associated with consideration of public access to these various collections. Third, it is increasingly difficult under the climate currently prevailing in public institutions to persuade appropriate experts from museums, botanic gardens and universities to give up the time to participate in our committee and curatorial work, yet such people are vital to our needs. Even so, our present structure leads to duplication of effort between the Collections Curatorial and Library Committees in areas such as the

Linnaeus Letters Conservation Project, as well as a lack of clarity as to responsibility for the Society's artefacts.

It was agreed that the Society develop an integrated approach to the responsibilities of the two committees by appointing a single Chairman, Mrs. Susan Gove, current Chairman of the Library Committee, who will oversee the development of a unified structure with responsibility for *all* the collections and associated integrated databases. This will also enable the scientific collections to benefit from the electronic expertise now available for the Library Collections. The President thanked Dr. Joysey for his long and tireless commitment to the Society and to the Chairmanship of the Collections Curatorial Committee in particular.

As an interim measure to maintain both continuity and the expertise and wealth of knowledge available to the Society from the two existing committees, the two committees will continue to meet both to oversee the management of the various collections and to participate in the review of how best they should restructure in the longer term.

* * * *

We offer our congratulations to two of our Fellows, **Professor Mark Chase** (Jodrell Laboratory, RBG, Kew) and **Professor Peter Holland** (Professor of Zoology, University of Oxford) on their election to Fellowship of the Royal Society. Both spoke at the recent International Conference on Polyploidy held jointly with the Royal Botanic Gardens, Kew and the Society; Mark also spoke in Leiden last November at the IAPT meeting which the Society supported.

* * * *

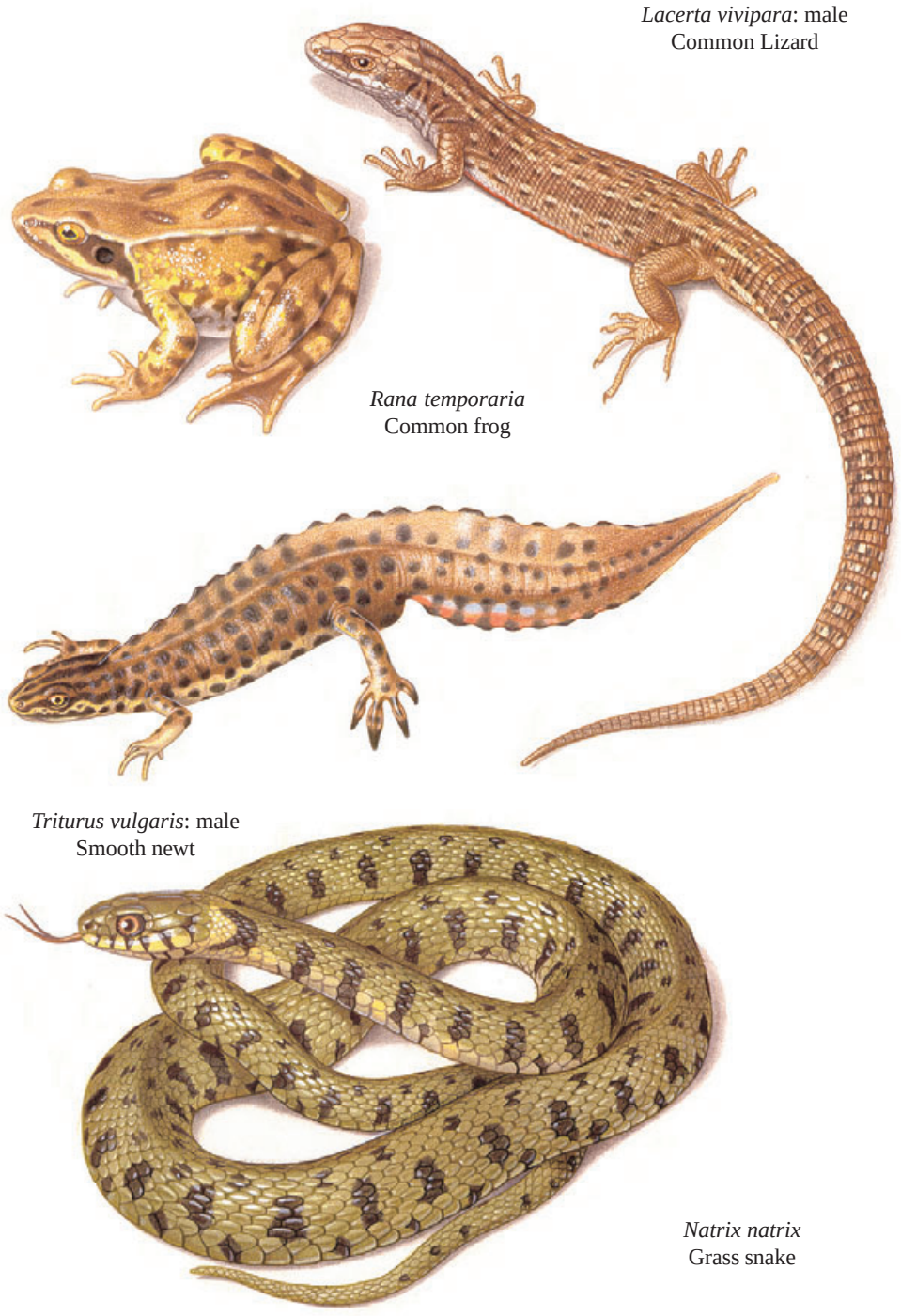
Dr Henry Gee has resigned from Council. Under Bye-Law 10.8, the Council must convene a Special General meeting (SGM) within six months to fill the vacancy as for the Anniversary Meeting. Council agreed earlier in the week (w/b 19 May) that the SGM should be on 16th October when there is an election of new Fellows and the annual Book Sale. Nominations from the Fellowship (Bye-Law 10.2) must be with the Executive Secretary by Thursday 24th July. Fellows will be notified of these and the Council's nomination in the October Linnean.

* * * *

Amphibians and Reptiles of North-west Europe by Ian Spellerberg FLS provides brief accounts of the natural history, ecology and conservation of some amphibian and reptile species from western Europe. It is beautifully illustrated by Peter Jack with support from the NERC Taxonomic Publications Grant. Some of the illustrations are shown opposite.

JOHN MARSDEN

* * * *



Amphibians and Reptiles of North-west Europe, by Ian F. Spellerberg, Illustrations by Peter Jack, Enfield, New Hampshire: Science Publishers, 2002. ISBN 1-57808-259-5
(See inside the back cover for more details and order form.).

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CORRECTION

Will members please note that an error was made in the Annual Report for 2002 on page 19 – New Fellows and Associates 2002. Anthony A CRAWFORD should read Anthony CRAWFORTH. The Membership Officer apologises for this mistake.

Library

This report covers Library activities from the beginning of 2003 to 12th May. The Library has been open for 89 days during which 171 UK visitors and 58 overseas visitors registered their attendance in the Library (total 229 = 2.57 visitors/day). Loans totalled 223 (2.5 books/day). Users of manuscripts numbered 15 and included visitors from Australia, Ireland, India, Mexico (via Spain) and the USA as well as from the UK. The showcases were used for displays for Society evening meetings and conferences and for special displays for visiting groups. These included students from Kingston University, Mississippi College and University College London, other groups being the Ephemera Society and a group of US visitors to the Mellon Digitisation meeting.

Donations and other accessions since the beginning of 2003 total 118, of which 94 were donations and 24 purchases. The computer entries for Linnaeus' copies of his own works have been edited, and work has started on other editions of his work held in the Library. When this is finished work will return to the rest of the Linnaean library (his copies of other people's books) and then the pre-1750 collection, progressing forward to the general library stock. The electronic catalogue, which will grow to include all the Society's collections, as well as the Library entries presently being edited, will be called CARLS (Computer Access to Records of the Linnean Society). The texts for the Library's website pages are being edited and the content is currently being checked before being added to the Society's web site in the near future. A pamphlet on the computerised catalogue was distributed to all members as an insert in the April issue of *The Linnean*. This will be amended in future to take the new name for the project. The Library working group has met twice and a number of policy issues, projects and recommendations were discussed. New collection development guidelines will be included in the October issue of the *Linnean.*

Library users over the summer are asked to remember that teams of students will be cleaning and moving the book stock in the Reading Room and elsewhere from mid July to the end of August. This may mean space is limited, books take longer to find and a likelihood of multi-lingual conversations intruding on the usual quiet.

GINA DOUGLAS

Donations to the Library: February – April 2003

Prof. R.J. Berry	Berry, Robert James & Busby, John, *God's book of works – the nature and theology of nature*. xvi, 286 pp., illustr., London T. & T. Clark Ltd, 2003.
Brooklyn Botanic Garden	Hanson, Beth, ed., *Spring blooming bulbs, an A–Z guide.*.. 111 pp., col. illustr., map, Brooklyn, Brooklyn Botanic Garden, 2002.
Sir John H. Burnett	Burnett, John, *Fungal populations and species.* 348 pp., illustr., maps, Oxford, OUP, 2003.
John Burton	Csoka, Gyorgy, *Gubasok/ Plant Galls.* Budapest, Forest Research Institute, 1997/6.

	Slavik, Bohumil ed., *Kvetana Ceske Republicy Vol. IV.* Akad. ved Ceske Rep., Prague, 1995.
	Brito, Maria Carmen & Lucia, Vincente-Lope, *Espacios naturales de Tenerife, El bosque de Aqua Garcia.* 165 pp., illustr., some col. map. [Tenerife], Editorial Turquesa, [1995].
Drs Mark Chase Dr Michael Fay	Geller, Elizabeth, Ed. *McGraw- Hill Encyclopedia of Science & technology*. 20 vols., illustr., some col., maps, Maidenhead, McGraw-Hill, 2002.
Paolo Coccia	Coccia, Paolo., ed., *Un secolo di evoluzionismo in Italia: bibliografia 1859-1959.* 320pp., illustr., some col., Prato, Partnership, 2003.
John Collins	Hammarskiold, Hans & Lewenhaupt, Tony, *Nara Linne.* Hoganas, Forlags AB Wiken, 1993.
Dr David Cutler & Dr Mary Gregory	Keating, R.C., Gregory, Mary & Cutler, David, eds., *Anatomy of the monocotyledons, Acoraceae and Araceae*, Vol. IX. 327 pp., illustr., Oxford, Oxford University Press, 2003.
Field Studies Council	Redfern, Margaret & Shirley, Peter, *British plant galls, identification of galls on plants and fungi*. 207-531 pp., illustr., some col., Shrewsbury, Field Studies Council, 2002.
	Set of AIDGAP keys to fill gaps in holdings.
Richard Fitter	Galbraith C.A. (& others) eds., *The ecology and conservation of European Owls (proceedings of a conference…Edinburgh).* 110 pp., illustr., some col., map, Peterborough, J.N.C.C. 1992.
Dr David Frodin	Foucault, Michel, *The order of things.* 387pp., Vintage Books, New York, 1973.
Dr Arthur Hollman	Hunt, Tony, *Popular medicine in the 13th Century.* 466 pp., Cambridge, D.S. Brewer, 1996.
	Raimo, Harjula, *Mirau and his practise, a study of the ethnomedical repertoire of a Tanzanian herbalist.* 223 pp., illustr., map, London Tri-Med, 1980.
	Sanyal, P.K., *Medicine and pharmacy in India: medicine 200 years ago and after.* 224 pp., illustr., some col., Columbus, Ohio, privately, 1992.
Dr Stephen Jury	Valdes, Benito C., Rejali, Mohamed (& others), *Catalogue des plantes vasculaires du nord du Maroc: Checklist of vascular plants of North Morocco*, 2 vols. Madrid, C.S.I.C., 2002.
Sir Christopher Lever	Davies, Glyn ed., *African Forest Biodiversity, a field survey manual for vertebrates.* 161 pp., illustr., map, Oxford, Earthwatch Inst., 2002.
	Jaume Josa Llorca *Historia no tan naturales*, 149 pp., Barcelona, Ed. Alta Fula, 1987.
National Botanic Gdns, Glasnevin	Reynolds, Sylvia P., *Catalogue of alien plants of Ireland.* 414 pp., Glasnevin, National Botanic Gardens, 2002.

Prof Sir Ghillean Prance	Bernal, Rodrigo, ed. & Prance *G., Flora de Colombia Chrysobalanaceae*. 292 pp., illustr., map, Bogota Instituto de Ciencias Naturales, 2001.
	Bernal, Rodrigo, ed. & Prance *G., Flora de Colombia Dichapetalaceae*. 62 pp., illustr., map, Bogota Inst. de Ciencias Naturales, 2001.
Dr Elaine Robson	Wilson, Douglas P. & Davenport, Hester (Ed), *Sea Life in focus, a memoir.* 90 pp., illustr., some col., Old Windsor, Cell Mead Press, 2002.
Royal Botanic Gardens, Kew	Averyanov, Leonid & Cribb, Phillip eds., *Slipper Orchids of Vietnam – with an introduction to the flora of Vietnam.* 308 pp., illustr., some col., map, Kew, Royal Botanic Gardens, 2003.
Dr Tej Kumar Shrestha	Shrestha, Tej Kumar, *Birds of Nepal*, Vol. 2. 562 pp. + 88 pp., illustr., some col., maps, Kathmandu, Mrs B.Shrestha, 2001.
South African High Commission	King William's Town, Kaffrarian Musuem, *Mammals of the Cape Province*. Cape Town Dept of Nature Conservation, 1959.
	Clancey, P.A., *Birds of Natal and Zululand*, 511 pp., illustr., some col., map, Edinburgh, Oliver & Boyd, 1964.
	Steele, David & Perry John, *Game sanctuaries of Southern Africa*. 160 pp., illustr., some col., map, London, Robert Hale & Co., 1973.
Dr Ian F. Spellerberg	Spellerberg, I.F., *Amphibians and reptiles of North-west Europe – their natural history, ecology and conservation* xii, 203 pp., illustr., some col., map., Enfield, NH, Science Publishers Inc. 2002.
Hugh Synge	Clark, Mary E., *In search of human nature.* xix, 556 pp., illustr., map, London, Routledge, 2002.
	Gradstein, Stephan Robbert (& others), *Guide to the bryophytes of tropical America.* New York, New York Botanical Garden Press, 2002.
	Miller, A.G. & Cope, T.A., *Flora of the Arabian peninsula and Socotra, vol. 1*. 586pp., illust., maps, Edinburgh, Edinburgh University Press, 1996.
	Talbot, Stephen S. & Murray. David F. eds, *Proceedings of the first international conservation of the Arctic flora and fauna (CAFF) flora group workshop.* Akureyri, CAFF International Secretariat, 2002.
Dr S.I. Zeveloff	Zeveloff, S.I & Bolen, E. Anne ed., *Raccoons: a natural history.* 200pp., illustr., map, Washington, Smithsonian Inst. Press, 2002.

Correspondence

20 Pickwick Road
London SE21 7JW

30 January 2003

Dear Brian,

I must reply to comments in the latest *Linnean* (January 2003) pages 5 to 12. These are covering aspects of the House of Lords Select Committee report *What on Earth?,* and proposals and reflections thereon. I believe underlying these matters are some issues of concern for all interested in the future of taxonomy and our Society.

The most recently conceived purpose for our science is now as a support for conservation (q.v. *What on Earth?*); fifty years ago it was to support evolution, and we now know where that took systematics. Surely history should have taught us something of the value of our science, and that its value lies far beyond a supporting role for other disciplines. Systematics exists because it is necessary. Systematics can be sufficient for supporting other disciplines but this is just one of systematics many strengths. This sufficiency for others' goals is just a by-product of centuries of classificatory effort.

We now are in the tragic position of having two, or more likely three, generations of biologists with no significant exposure to intellectual taxonomy and historical biology. If I consider my own case, New Biology (already not so new in 1972) was all the rage at Glasgow when I was an undergraduate, and it was only encounters with Roy Crowson, and his book *Classification and Biology,* that opened other doors to biological knowledge. As an aside, that book, to my mind, is perhaps the only biology text of the last century which could be fairly listed under biology *and* literature.

Perhaps systematics by its nature has retained some of the arcane quirkiness of older ways of doing things, certainly the Linnean Society has up to now, coupled with an independence of spirit. Both of these attributes will need to be to the fore if we are to retain and develop our science.

We in the Society should all understand that systematics is not a support industry of anything, and taxonomy, in the sense of naming, allows entities to come into being *(q.v.* Ludwig Wittgenstein); without taxonomy we all remain silent. That alone is sufficient justification for taxonomy. To have a viable biology, taxonomy must be funded FULL STOP. Not because it supports some current whim of the zeitgeist, not because it provides an escape route for the follies of biodiversity measurements or the embarrassment of riches of molecular variety, neither is it a toy of the www generation, but because without it there can be no biology. I repeat, taxonomy brings biology into being, and phylogenetics can then reveal the order of life. That is the message we should be getting across. Once we correctly recognise the value of our discipline we can face the very real problems of its financial security and continued development in a world now demanding instant answers to eternal questions.

On this latter issue perhaps we at the Linnean Society, with the tercentenary in view, should look towards supporting independent positions at Universities and research institutions, which recognise some of the problems now facing our science. This I feel would be a much more positive response than suggesting that our survival depends on becoming camp followers of 'grander' sciences. Obviously the financial implications are considerable but so would be the intellectual merit.

I thank you for your time and I would ask you to bring this letter to the attention of any interested parties at the Society.

Yours sincerely
ROBIN BRUCE

Department of Earth Sciences, University College London
Gower Street London WCIE 6BT

17 February 2003

Dear Brian,

The picture on page 21 of the January *Linnean* is, of course, George Bellas Greenough (1778–1855), a founder member and first President of the Geological Society of London. Notwithstanding his 'Critical examination of the first principles of geology' he was not one of the great geologists of the early nineteenth century. His principal achievement, apart from being a founder of the Society, was organising the compilation and publication of the geological map of England and Wales in 1819, which drew accusations of plagiarism of William Smith's map of 1815. However, the 1819 map was actually compiled and drawn by Thomas Webster, a fine geologist who in his old age became, rather briefly, the first professor of geology at this College. In many areas Webster's map shows more detail than Smith's, because he used all available sources, whereas Smith used only his own work.

The portrait seems to show Greenough as a prematurely balding young man, self assured and pleased with himself. This is the only portrait so far as I know, but there are a couple of busts of him as an older man. One, by Nevil Northey Burnard (1818–1878) was posthumous, being dated 1859. We have a plaster cast of it here, the original is said to be in the Geological Museum, now perhaps in the geology library of the Natural History Museum. Woodward in his centenary history of the Geological Society (1907) mentions another, by Westmacott (but which? – there were several Westmacotts) in the Society's rooms.

Greenough left his geological collection to University College. We still have the catalogue, in several volumes, but not many of the specimens.

Yours sincerely
D T DONOVAN

5 February 2003 Ramapo College, Mahwah, NJ 07430 USA

The image shown on p. 21 of *The Linnean* 19(1) is George Bellas Greenough (1778–1855). He was born in London on 18 January 1778 and educated at Eton. He attended Pembroke College, Oxford, although he did not graduate. He studied law in Göttingen but was more interested in natural history, particularly mineralogy and chemistry. He was elected F.R.S. in 1807 and was a founder of the Geological Society of London serving as its first chairman and in 1811, its first president. He published *A Critical Examination of the First Principles of Geology* in 1819. He published his Geological Map of England and Wales in 1819, as well. In 1854 he published his geological Map of India. He died on 2 April 1855 in Naples.

EDWARD SAIFF

28.2.03 Claydon High School, Ipswich, Suffolk IP6 0EG

Dear Brian

Although I did not recognise the picture on p21 of The Linnean 19(1) of the balding gentleman from the early C19, your clue gave me the answer: it is George Bellas Greenough (1778–1855), FLS, geologist, geographer, archeologist and architect.

Born George Bellas, he inherited a fortune from his maternal grandfather who had had great success in selling Greenough's liver pills. This wealth funded the young lad's continued education at Peterhouse College and at the University of Göttingen. Between 1798 and 1801, he was influenced by Blumenbach and the Saxon neptunist Abraham Werner. Consequently his "A Critical Examination of the first principles of Geology" (1819) was chiefly anti-plutonist and his Presidential Addresses to the Geological Society were mainly theoretical in tone. Although criticized by some for his hands-off approach in the field, as a "perfumed flaneur" and the nemesis of William Smith, Greenough did eventually accept the merits of biostratigraphy over pure lithostratigraphy. Greenough accepted criticisms of his 1820 "Geological Map of the United Kingdom" not only for its great resemblance to that of 1815 published by Smith (some see Smith as the victim of Greenough's plagiarism) but also by correcting its second edition in 1839 in the light of subsequent fieldwork, such as that carried out by Sedgwick and Darwin on the supposed Old Red Sandstone of North Wales in 1831.

Another intriguing geological point where Greenough may have also "borrowed" an idea from an earlier publication concerns the source of the water for the biblical flood of Noah. Much as Edmund Halley had opined a century before him, Greenough considered that it was comets that brought ware-ice in their impacts with our planet. What interesting parallels that idea has with some twentieth-century theories of extra-terrestrial bodies and the Cretaceous extinctions.

Yours sincerely
HUGH PEARSON

5 March 2003 Kohn@u.washington.edu

Dear John

The January quiz photo (just received as I was in Australia for a month) must be of George Bellas Greenough (1778–1855). Greenough went to the University of Göttingen intending to study law, but was turned on to natural history by one of my heroes, Johann Friedrich Blumenbach (Kohn, 1992: p.56). Blumenbach started at Göttingen in 1776 as lecturer in medicine and curator of the natural history collection, and was promoted to full professor in the year of Greenough's birth. This was about the time that Göttingen became the first German university to require its faculty to do research as well as teach. Most famous for his contributions to physical anthropology and anatomy (Lenoir, 1981), Blumenbach wrote what may be the first textbook of natural history (*Handbuch der Naturgeschichte*, 1791) and taught the course in the subject that changed Greenough's life. He studied mineralogy and gradually switched to geology. Like Blumenbach, Greenough became a Fellow of the Royal Society. He was a founding member of the Geological Society of London, and he was an MP for five years. He published a geological map of England and Wales (1819) that updated William Smith's "map that changed the world", and also one of India (1854).

Yours sincerely
ALAN KOHN

KOHN, A.J. 1992. A chronological taxonomy of *Conus*, 1758-1840. Smithsonian Institution Press.
LENOIR, T.J. 1981. The Göttingen school and the development of transcendental Naturphilosophie in the romantic era. *Studies in History of Biology*, 5: 111-205.

Commentary
Arts *versus* Science

Upon reading *The Linnean* for January 2003 (Vol. 19, Part 1, Society News, pp. 4–12) and seeing the quotation of the first stanza of Robert Herrick's (1591–1674) famous poem 'To the Virgins, To Make Much of Time', put me in mind of the apparent dichotomy between the so-called arts and science. The fact that many scientists do not feel that poetry does, or should, impinge on their studies, or if it does, it has little or no relevance. Whether or not the latter is true of course is related to perception by the individual, which would therefore be difficult to expound on at length, although I do have some views on this as presented below.

As a professional scientist (entomologist), I have gained much joy from both reading and writing poetry, mainly on natural history themes, including insects, but some of my colleagues find this a rather odd outlet for my recreational and creative needs. Yet so, a number of scientists, some extremely famous, have spanned both scientific and artistic camps, and have proved accomplished in both, e.g. Alexander Borodin, 1833–87 (musical composer), Albert Einstein, 1879–1955 and Sir Ernst Chain, 1906–79 (musicians), C.G. Johnson, 1906–94; Head of Entomology at Rothamsted, 1961–72 (water colour and oil

painter), John E. Treherne, 1929–89, Cambridge zoologist (novelist) and Erasmus Darwin, 1731–1802; Sir Humphry Davy, 1778–1829; and Ernst Schrödinger, 1887–1961 (poets), to name but a few. The great anatomist and artist, George Stubbs (1724–1806), renowned for his paintings of animals, particularly of horses and dogs, people and landscapes, clearly straddles the divide between the disciplines. If there is a difference between art and science, may be as K.G. Davies (2003) implies, it is illusory, – "It is a common perception today that scientists are seen to be cool, thinking, rational and insensitive, while artists are seen as emotional, intuitive and sensitive!" But one has only to read the biographies of scientists to realise that they can be just as emotional, intuitive and sensitive as the artist (Millar *et al.*, 1989; Dodson, 2002). And that their creativity is very much determined by their personality as well as upbringing and conditioning and the circumstances under which they find themselves (i.e. historical context and opportunity along with the necessary creative genius), some or all of which can be instrumental in scientific discovery and application. In contrast, there are artists who seem to fit the bill of being "cool, thinking, rational and insensitive", yet even so, are exceptionally creative e.g. the landscape painter, Joseph Mallord William Turner (1775–1851).

Leaving out personality, if it is possible to do so, I believe that Art and Science show the same traits of imagination, deduction, and description, and often involve mathematics and/or physics (e.g. musical notation, geometry and perspective and colour theory in painting). Both can be purely observational i.e. non-Popperian. In astronomy and evolutionary science, hypothesis testing is almost impossible. No one has ever seen a 'black hole' in space, although there is now good evidence that such exists (see web addresses below). Nor has anyone seen an animal or plant evolve from one species to another, although they may have witnessed over time, even a relatively short period of time (decades), changes of population allele and genotype frequency, or perhaps of behaviour/physiology, suggestive of an evolutionary event having taken place, e.g. sympatric speciation of insects in relation to adaptation to novel host plants (see Feder *et al*., 1998, in the case of Tethritid fruit flies, *Rhagoletis pomonella* (Walsh) and Claridge, 2003, concerning the Brown plant hopper, *Nilaparvata lugens* (Stål) (Homoptera: Delphacidae)). Evolutionary changes may perhaps also be related to other factors such as karyotype, hybridisation or even herbicide or insecticide resistance, the last having developed rapidly over the past 50 years or so in the agro-ecosystem in a large number of insect species as a result of intense chemical selection. For instance, the peach-potato aphid, *Myzus persicae* (Sulzer) (Hemiptera: Aphididae) has evolved multiple cross-resistant mechanisms in the UK. These include, in the highly resistant strains, R_2 and R_3, chromosomal translocation (autosomes 1 and 3), amplification of carboxylesterase-4 (E4) genes and their regulation by epigenetic processes (DNA methylation), as well as other mechanisms of resistance (knockdown resistance to pyrethroids, *kdr*, and modified acetylcholinesterase, MACE) (Foster *et al.*, 2000). The aforementioned changes resulting from selection are seen as the beginnings of evolutionary divergence leading to levels of speciation, – strains, biotypes, races, ethospecies, cryptic species, sibling species, etc.

The sciences, except in terms of their Greek derivation, mostly arose via alchemy (based on mysticism perhaps) and theology e.g. Gilbert White (1720–93), Charles Darwin (1809–82) and Sir Isaac Newton (1642–1727), as important examples. Some scientific fields probably had a technological or even entertainment origin (e.g. fireworks in China, perhaps invented around a 1000 years ago). The oldest universities in Britain, Oxford and Cambridge believe that there are no fundamental differences between the arts and sciences and award scientists a Bachelor of Arts (BA) degree! The oldest scientific journal in the world (founded 1665) is the *Philosophical Transactions of the Royal Society*. The *Biological Reviews* are published by the Cambridge Philosophical Society. Here, science and art merge and become one – either as philosophy or ultimately, in the case of physics, metaphysical (e.g. the position and momentum of an elementary particle cannot be determined exactly as described by the 'Uncertainty Principal' of Heisenberg; (Werner K. Heisenberg, 1901–76; see Millar *et al*., 1989). M.C. Escher's (1898–1972) paintings combine art and science in terms of numbers, morphology and design, almost like atoms in a crystal lattice (see also Dodson, 2002 in this respect). Poetry straddles both arts and sciences. A scientist can describe the distribution of daffodils besides a lake in the Lake District in a detached and factual way, but the description as such lacks the 'third dimension' as supplied by the arts, e.g. William Wordsworth's (1770–1850) poetic depiction (1804) of daffodils 'fluttering and dancing in the breeze'. Each element is essential for our fuller appreciation of the phenomenon in question and probably on the larger scale, of life and our earthly existence in relation to the natural world. If so, perhaps the differences between art and science are indeed more apparent than real. Certainly in former times, poetic descriptions of the natural world were tolerated. The nineteenth century Berwickshire naturalist James Hardy's (1815–98) description (1850a) of the take off of the grain aphid, *Sitobion avenae* (F.) during its summer aerial migration from senescing wheat to wild grasses is apposite in this respect: "In the field they seem to go off gradually one by one in the heat of the day, heedless of a destination, and like a packet vessel freighted with passengers for different ports; touching and discharging the cargo at intervals, and then anew buoyantly resuming the voyage. *Poa annua*, *Glyceria fluitans*, *Agrostis vulgaris*, *Dactylis glomerata*, *Holcus mollis*, *H. lanatus*, and *Triticum repens* are some of the grasses it selects, whence it may be inferred that it can never be at a loss, however devious its wanderings". In another paper (1850b) in which he describes host alternation of the rose grain aphid, *Metopolophium dirhodum* (Walker) and its aerial migration between Gramineae (cereals and grasses) and *Rosa* sp., he states "It thus appears to be impelled through a circuit, and to be ever striving to regain the source whence first it drew the vital stream; like a bird, that, with uncertain aim, has wandered from its home at day-dawn, but directs its way back unerringly, when the tempest lowers, and the shadows of evening thicken." (see Ferguson, 1898 and Bolam, 1899 for biographies of Hardy). But would such flowery prose survive the referee's red pen, let alone the Editor's, these days?

In terms of our own lives and wanderings, family legends may sometimes transform into written accounts of genealogy, which may collectively evolve into social history,

thence into national history and ultimately, given enough time, perhaps into archaeology. The last merges into scientific enquiry in terms of artefacts and their dating, including of written records such as the Dead Sea Scrolls. In terms of animals and plants, into population genetics, evolution and systematics. In terms of the human species itself, into the evolution of language and other cultural aspects, including housing, weapons, speech/dialect, clothing, and beliefs (ethnology).

It truly does seem that art and science are merely aspects of the same spectrum. That a daffodil or sunflower drawn by an artist or described by a writer or poet, or the sound of reeds in the wind captured in musical notation, are just as beautiful as the fact that a thin sheet of platinum allows only one in 8000 alpha particles to be deflected from it, whilst the rest pass through it, showing that matter is mostly empty space and that the atom comprises a dense nucleus (see under 'Sir Ernest Rutherford, 1871–1937' in Millar *et al*., 1989). And thus that God's design, if he has one, is beyond our wildest imaginings. Or if it is not his design and due merely to random, stochastic processes of nature, is lost somewhere in the darkest folds of time and space and may never be wholly understood by deduction, the delight of the scientist. If this is true, then the artist too has his rightful place in any description of the natural world, if only to fill the vacuum with regard to our philosophical lack of understanding of its complex workings. In essence, to provide that other dimension that scientific data collection, collation and interpretation cannot alone yield.

HUGH D. LOXDALE

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On an unknown letter from Revd T.R.R. Stebbing to Revd Canon A.M. Norman

Having for many years nurtured an interest in the history of carcinology (amphipodology in particular), on 9 June 1993, I acquired on the open market the presentation copy of Revd T.R.R. Stebbing's *History of Crustacea* (1893), that the author gave to Revd Canon A.M. Norman. It is inscribed "To the Rev. Canon Norman, F.R.S., with kindest regards from the author". On the inside front cover, the book bears Canon Norman's bookplate with his armorial bearings surmounting the caption Alfred Merle Norman M.A., D.C.L., F.R.S., etc. Stuck inside the first blank page was an autograph letter (plus envelope addressed to The Rev. Canon Norman, F.R.S., Burnmoor Rectory, Fence Houses, Co. Durham and stamped with a Victoria penny purple stamp), that Stebbing had sent either to accompany, or to follow, the volume almost exactly a century earlier. On recently re-reading Mills' biography of Stebbing (Mills, 1976), during the course of other historical researches, I came forcibly to realise the paucity of Stebbing's known personal papers and, therefore, the particular significance of the one in my possession.

According to Mills (1976), King's College, London received a bequest through Mrs Stebbing's will of her husband's bound offprints and books (mostly by other authors), but he was unable to locate any private papers or manuscript material, with the exception of two typescripts in King's College, many letters to W.T. Calman in the files of the Crustacea section of the British Museum (Natural History), and 28 letters to Alfred Merle Norman now with the Alder-Norman Letters in the General Library of the British Museum (Natural History). Most of Stebbing's private papers must have been lost or destroyed after his death. Mills (*loc. cit.*) reported that there is no trace of their fate in the wills of Thomas Stebbing or his wife or through family sources.

Since Stebbing and Norman loom as colossi in the history of British amphipodology (for a contemporary's view; see Walker, 1911) I thought it desirable to publicise the contents of this letter to add to the sum total of the known correspondence between them. Though couched in the conventional formalities of the time, this significant note testifies to the warmth of their friendship, not least in the way the sender 'pulls the leg'

of the recipient regarding theological allusions and geographical relativities. They were clearly in routine correspondence and closely aware of each other's movements. It is a great tragedy to historians of the subject that so little of Stebbing's letters and manuscripts survive; most especially regarding the companion volume on the Amphipoda foretold in his *History of Crustacea*. The letter reads as follows:

Ephraim Lodge,
The Common,
Tunbridge Wells,

June 13. 1893

My dear Norman,

I always intended to send you a copy of 'The Crustacea'. With the general principle you communicate I quite agree, as also with your remarks upon the book itself. It was begun on popular principles, but they were soon crowded out by the extent of the subject. Consequently it became one of those books which has been described as an invaluable resource in case of another flood, spots sure to be dry, even if all the rest of the world is under water.

You don't mention on what day you are starting out for Norway, so that perhaps this will not find you still at home. It is merely sent to remind you once more that Tunbridge Wells lies on the direct route between Fence Houses and Trondhjeim Fjord. On your return journey I fear we maybe away from home.

Mrs Stebbing joins in wishing you a pleasant holiday and successful dredgings.

Sincerely Yours
Thomas R.R. Stebbing

Norman's Norwegian excursion was written-up in his well known papers *A month on the Trondheim fjord* (Norman, 1893 *et seq*.).

GEOFF MOORE
University Marine Biological Station, Millport
pmoore@millport.gla.ac.uk

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Picture Quiz

Joseph Paxton (1801–1865)

Joseph Paxton was born on the 3rd August 1801, at the village of Milton Bryant in Bedfordshire, where his father owned a smallholding. He was educated at the nearby Woburn Grammar school and at the age of fifteen placed under the tutelage of his elder brother John who was the gardener to Sir Gregory Page-Turner at Battlesden Park, Woburn. Two years later he was apprenticed to William Griffin an eminent horticulturist and fruit grower, who was head gardener to Samuel Smith of Woodhall Park, Watton, Hertfordshire. Then, in 1821, he returned as a gardener to Battlesden Park, Woburn, where he undertook the construction of a large lake.

In 1823 he was for a brief period in the service of the Duke of Somerset at Wimbledon. At about this time the Horticultural Society commenced the formation of their garden at Chiswick. On the recommendation of Mr Sabine, the Honorary Secretary, the young Paxton was given employment in the new gardens and the following year (1824) was appointed foreman of the Arboretum (18/- shillings per week). In this capacity he soon attracted the attention of the President of the Horticultural Society, the Duke of Devonshire, who appointed him superintendent of his gardens at Chatsworth. Here he erected orchid houses and greenhouses, and a great conservatory over three hundred feet in length, said to be the model for the Great Exhibition building of 1851. In 1838 he accompanied the Duke on a 'grand tour' during which they traversed Switzerland, Italy, Greece, Turkey, Asia Minor, Malta, Spain and Portugal. On his return home, Paxton remodelled the gardens of Edensor, a village near Chatsworth, incorporating huge fountains up to 270 feet in height. Meanwhile, at Chatsworth, with its vast range of hothouses he induced the Amazonian water lily *Victoria amazonica* to blossom for the first time in Europe. The following year his name became a household word, in consequence of the unexampled success of his daring plans for the erection of the Great Exhibitions Building in Hyde Park.

Later, between 1853–54 he superintended the re-erection of the Crystal Palace at Sydenham. However, he now made the building far larger. With the new wings included it measured 3,476 feet in length, or about three quarters of a mile from end to end, being thus 1,628 feet longer than the old palace in Hyde Park. It had a surface area on the

A bust of Joseph Paxton in the Crystal Palace Park, Sydenham. Photo by Matty Pye.

ground floor and galleries of 843,656 square feet. The glass roof covered some 25 acres and the panes which gave the entire structure its crystal title would, if placed end to end, extend 242 miles! Paxton also created the terraced gardens and park on a scale of magnificence worthy of the palace with a system of fountains and waterworks said to have surpassed anything the world had yet witnessed. No less than two hundred acres were appropriated for park scenery, pleasure grounds, ornamental gardens, basins, lakes and terraces.

The lowest of all was a huge lake, overshadowed with primeval palms and ferns. The garden around it he created with islands on which resided 26 extinct animals including *Hylaeosaurus*, *Megalosaurus* and *Iguanodon*. These three life-sized sculptures of dinosaurs were made under the direction of Richard Owen. As the sculptures were nearing completion, they had a party in the *Iguanodon* (see *The Linnean*, **7**(1):8) on New Year's Eve 1853 which Paxton attended together with Owen.

Elsewhere, Paxton had already laid out Prince's Park, Liverpool in 1842, Birkenhead Park in 1844, Coventry Cemetery in 1845, as well as public parks in Dundee, Dunfermline, Glasgow and Halifax.

Clue: One of the leading conchologists of the 19th Century.

Paxton was one of the founders of the *Gardener's Chronicle*. He was also responsible for the editing and publication of many other botanical treatises. He edited the *Horticultural Register and General Magazine* (5 vols, 1831–34); *The Magazine of Botany and Register of Flowering Plants* (15 vols, 1834–1848*); A Practical Treatise on the Cultivation of the Dahlia* (1838); *Paxton's Magazine of Gardening and Botany* (8 vols, 1849) and, with Lindley's help, *A Botanical Pocket Dictionary* (8 vols, 1840).

Paxton was elected a Fellow of the Linnean Society in 1833. The genus *Paxtonia* Lindley was named in his honour. In 1854 he was returned as a member of Parliament for Coventry in the Liberal interest, which borough he continued to represent up to his death on 8th June 1865.

BRIAN GARDINER

C.A. Clarke, a modern Aurelian

In the introduction to a recent reprint of Moses Harris's book (Harris, 1766), Robert May points out that it was a pleasant conceit of the members of the worthy and ingenious Society of Aurelians to take their name from the golden chrysalis of some of the butterfly species they sought. It seems an equally happy choice for Sir Cyril Clarke, Professor of Medicine and distinguished contributor to many aspects of genetics of the Lepidoptera.

Cyril Clarke was brought up in Leicester, where his father was a physician at Leicester Royal Infirmary. During the First World War Cyril was evacuated a few miles into the country, for fear of zeppelin attacks. There he had a 16 year old governess who interested him in butterflies and moths, so that, in his words, he became an obsessive collector (Clarke, 1995). That experience had a major influence on his future work. Another, and most important one, was marriage to his wife Frieda (Féo) in 1934, who shared his enthusiasm for both Lepidoptera and dinghy racing.

After studying Natural Science in Cambridge and medicine at Guy's Hospital Medical School Clarke followed a medical career. During the Second World War he was a Surgeon Lieutenant in the Royal Navy. In 1946 he became a consultant physician in a Liverpool hospital and subsequently Reader in Medical Genetics and Professor of Medicine at Liverpool University. In 1963 he was instrumental in persuading the Nuffield Foundation to establish a Unit of Medical Genetics in Liverpool University Department of Medicine to promote research and teaching. He became its Director, and in this period his skills as a facilitator did much to promote the development of medical genetics throughout the country. He was knighted in 1974. He retired in 1972 but continued actively working from his home on the Wirral until his death.

One piece of work in which he and Féo were engaged for several decades concerned melanism in the peppered moth. This was a continuation of a theme in evolutionary studies in Britain which was already being discussed before Cyril was born. It can serve as a link, which puts into context his biological perspective and the way his work developed.

The peppered moth had been known as such at least since the mid-18th century, when Moses Harris described variation in colour of the larvae, but not of adults. By the 1860s, however, people noticed that many common species of moths in Britain, including this one, had black or dark brown (melanic or melanochroic) variants. Previously these were not familiar to collectors here or on the continent. Sometimes they were given names, to draw attention to them (the darkest peppered moth melanic was *doubledayaria* Millière 1872, or *carbonaria* Jordan 1869, the intermediates were *insularia* Thierry-Mieg 1886).

The records started as incidental notes in journals by amateur entomologists and lepidopterists, of whom there were many in northern industrial towns. Later there were comments on how and why the changes took place. The subject was of interest in scientific

circles in the late 19th century because it had a bearing on two issues – the nature of heredity and the nature of species. So far as heredity was concerned, it was evident before Mendel was rediscovered that inherited traits had to be transmitted in discrete packets, otherwise their effects would become diluted. However, most useful characters, such as stature and fertility, showed no sign of a discrete nature but appeared to be continuous in phenotype.

With regard to species, Darwinian theory suggested that one species developed into another by continuous and imperceptible changes. But species appeared to be discrete and distinct from each other; in Francis Galton's words evolution seemed to proceed by jerks.

There are many cases where one is very variable while a close relative is invariant – suggesting some sort of constraint in the one which is absent in the other. Examples from the British Lepidoptera were quoted by Bateson (1913, from lectures delivered in 1907). Thus, the Lychnis *Hadena bicrurus* is invariate but the Tawny Shears *H. perplexa* is highly variable; the Large Yellow Underwing *Noctua pronuba* is polymorphic while the Lesser Broad Bordered Yellow Underwing *N. janthina* is not. The simple Darwinian argument would be that selection favours constancy in one case and variability in the other. But Bateson found this hard to believe in species with such similar habits, concluding that variation is tolerated (that is, neutral) and that extreme fixity indicates intrinsic (in his words, physiological) stability. Sometimes variants of large effect would appear, which could possibly be important in the transition from one species to another.

These themes were discussed with much acrimony by Karl Pearson and W.F.R. Weldon on the one hand and William Bateson on the other, with Francis Galton holding the ring. In 1893 he set up a Royal Society committee to investigate gradual evolution of continuous differences by natural selection (*Committee for Conducting Statistical Inquiries into the Measurable Characteristics of Plants and Animals*). In1897 Bateson became its secretary and it was renamed the *Evolution Committee*. On its behalf he sought information on the advance of melanism in moths in the *Entomologist's Record* (Bateson, 1900). The results appeared in Barrett (1901) and Doncaster (1906), and were discussed by Bateson (1913). The melanics appeared to originate in northern cities and to spread progressively further south, suggesting a single location of origin. The next step was to find out why. Was the variation genetic? It was soon shown to be (Bowater, 1914). Was its spread due to some kind of thermal or innate hardiness factors? Were the melanic moths better camouflaged than typicals in the changing industrial environment?

The dispute between biometry and Mendelian genetics was effectively resolved by R.A. Fisher in a famous paper in 1918. He showed that the patterns and inheritance of continuous variation could be explained as the consequence of many segregating loci of similar, small effect. An interesting corollary was that variation in *expression* of major segregating genes may arise in the same way, through change in allele frequency at other loci in the genome. Thus, not only the frequency of a phenotype in a polymorphism, but also its expression may be selected. Weldon noted this when discussing the Mendelian

condition *wrinkled* vs. *round* peas. He pointed out that the appearance of the wrinkled pea depended on the strain in which it was present. The major gene segregated but did not completely define the phenotype. The theoretical implications were examined by Fisher (1930), E.B. Ford (1964) and by Philip Sheppard (1958), a student and later the most important intellectual colleague of Ford. They form a basis for the work in which Cyril Clarke was involved.

He was in Liverpool when he met Philip Sheppard, as a result of a common interest in butterflies. After war service in the RAF Sheppard worked with E.B. Ford in Oxford on the Scarlet Tiger Moth *Panaxia dominula*. He wanted to start experimental studies on butterfly mimicry. Clarke was an expert at breeding the species concerned, including hand pairing which allowed particular crosses to be made (Clarke, 1952). Sheppard put a note in one of the entomological journals asking for swallowtail pupae. Clarke responded and their friendship took off. Later Sheppard became Professor of Genetics in Liverpool and there followed a couple of decades of close cooperation.

At the time they started to work together H.B.D. Kettlewell was looking at some of the questions posed by the peppered moth (reviewed in Kettlewell, 1973). He showed that birds did attack resting moths and that they detected the morphs differentially on different backgrounds. For a general survey of the pattern of distribution over the country his approach echoed Bateson's in that he collected the existing results and stimulated others to produce additional data. Clarke and Sheppard realized that they were well placed to monitor a region from Cheshire to north Wales in which there was a very steep cline in morph frequency. Surveys in the 1960s established the pattern (Clarke & Sheppard, 1966), allowing analyses of selection/migration balance and subsequent measurements of change to be made (Bishop, 1972; May *et al.*, 1975; Mani, 1980). J.A. Bishop extended and strengthened this work and the survey area was later enlarged (Bishop *et al.*, 1978) to provide a detailed picture of two contrasting areas.

The Clarkes also recorded morph frequencies in the vicinity of their house through the subsequent drop in atmospheric pollution and in morph frequency, to produce the most complete record of change available for the species, unbroken from 1959 to the present day (Clarke *et al.*, 1994). This allows models of selective patterns to be analysed in detail (Clarke *et al.*, 1985; Grant *et al.*, 1996) and has been used to examine the effect of the moon on catch success (Clarke *et al.*, 1990) and variation in morph frequency over the flight season (Grant & Clarke, 1999).

Clarke & Sheppard (1966) also extended the selective predation experiments introduced by Kettlewell. Using dead moths they could vary the background on which the insects were placed so as to examine effects of local variation in trees. Putting melanic and typical moths on light and dark patches of bark in all combinations, their results showed an advantage to melanics overall at the industrial Liverpool sites, although there was a non-significant advantage to typicals when both types were placed on pale backgrounds. Since much unjustified criticism of these experiments has been made (Coyne 1998; Wells, 2000; Hooper, 2002), it is worth emphasising that over two dozen

such tests have been carried out by several investigators, giving generally consistent results (Cook, 2000). There is a significant association between selective value obtained and frequency of typicals in the region where the experiment was conducted. Typicals were at an advantage in unpolluted regions, while a melanic advantage was characteristic of highly polluted sites.

The Clarkes also had an interest in Sheppard's Oxford moth, *Panaxia dominula*. He had been studying gene frequency and selection in a natural colony containing a rare gene. He also started a number of artificial colonies with known gene frequencies, one of which was about 1km from the Clarkes' home. It fell to very low numbers, the last sample made by Sheppard being in 1976, the year of his death. In 1988 the Clarkes captured a single specimen in their light trap while sampling peppered moths. This was unusual in two respects; the moth is normally day-flying and the one caught was homozygous for the variant gene. After that, they sampled the colony, collecting both larvae and adults, until it again became very rare (Clarke *et al.*, 1993). The results may show no more than effects of random fluctuation, but they brought this moth into active discussion once again (Cook & Jones, 1996).

The mimicry work had an altogether more ambitious objective, namely to deconstruct the genetic system which controlled mimicry patterns and determine whether these could have been built up as a result of progressive accumulation of improvements. Butterfly mimicry had been an early subject of dispute. Some people thought it could evolve by progressive improvement (Poulton, 1890; Eltringham, 1910). Others argued that the similarities must have been fully formed and represent common ancestral features (Punnett, 1915; Goldschmidt, 1945). Once again, progress in understanding was to come from further field observation (e.g. of predation and of frequencies in random samples), analysis of physiological differences (e.g. in the distribution of poisons between species) and genetic analysis of pattern variation.

The material used was mostly swallowtail butterfly species polymorphic for mimetic female forms. Specimens of a range of forms had to be obtained from a variety of tropical countries. Clarke used his network of contacts to achieve this, and they used to send adult butterflies through the post. These were bred, often hand-paired by Féo and Cyril at their home. I think Sheppard provided most of the analytic input, but without the breeding skills of the Clarkes there would have been nothing to analyse. Later, when the Nuffield Unit was established (1963) a butterfly house on the roof allowed the animals to fly and breed under almost natural conditions.

The question was, could edible (Batesian) mimics have evolved by progressive accumulation of features which increased their resemblance to distasteful models? From the genetic point of view there are two components. Is the mimetic pattern determined by a single gene or by several (perhaps with different functions) operating together? Is the expression completely fixed or can it be modified by changes in genetic background (alleles present at other parts of the genome)? If several genes are involved and their expression is plastic then there is evidence compatible with progressive improvement

of resemblance. If the evidence indicates a single fixed gene, and substitution of one allele for another simply swaps to another fixed pattern, then a deep ancestral embedding of these patterns becomes more likely.

One of the species they looked at was *Papilio dardanus* (Clarke & Sheppard, 1960 and elsewhere). This has cream and black tailed non-mimetic males and several different female forms resembling distasteful models in the family Danaeidae (Figure 1). Female mimics resemble the models by being tailless, having brown or white patches instead of cream colour on the wings, and different amounts of black around the edges. Some races, in Madagascar and Somalia, have non-mimetic male-like females. Clarke and Sheppard were able to show that where models are abundant the mimetic patterns behave as a multiple allelic Mendelian series with dominance, but that in individuals from regions where models are rare, or when there are crosses between races, the dominance

Figure 1. Batesian mimicry in *Papilio dardanus*. The female in Madagascar is similar to the non-mimetic male (1). In various parts of Africa tailless female forms (2, 4 & 6) resemble distasteful danaid models 3, 5 & 7. This figure was produced by A. Weismann in 1904 and reproduced by Maynard Smith (1989).

Figure 2. The *Papilio polytes* mimetic forms *polytes*, *romulus* and *theseus* (lower row) and their models (upper row). Forms *theseus* and *polytes* differ only as a result of the presence of a modifier system. Modified from Clarke & Sheppard (1972).

breaks down, indicating the action of modifiers. Presumably there has been selection to adjust the expression where adjustment is needed. Improvement in mimicry therefore appears to have proceeded by small stages.

In the SE Asian species *Papilio polytes* there are also mimetic females with different geographic races (Figure 2). There is a non-mimetic male-like type and four mimetic forms segregating as a single autosomal locus. Again, these show complete dominance where two sympatric forms are crossed, but dominance breaks down in allopatric crosses. Two of the forms (*polytes* and *theseus*) differ from each other only because of the different modifiers present in different geographical locations where they occur. Similarly in *P. dardanus* the two forms *hippocoon* and *hippocoonides* which mimic geographical races of their model *Amauris niavius*, have the same major allele but different modifiers. The redness on the wings of *P. polytes* form *romulus* has been shown to be chemically different from the red in the same places on the wings of its model, another indication of progressive selection as distinct from retention of an ancestral character.

Papilio memnon, another SE Asian species with many female mimetic forms (Figure 3), provides further evidence for the slow accretion hypothesis (Clarke *et al.*, 1968). Some forms have red patches at the base of the wings mimicking a red spot on the

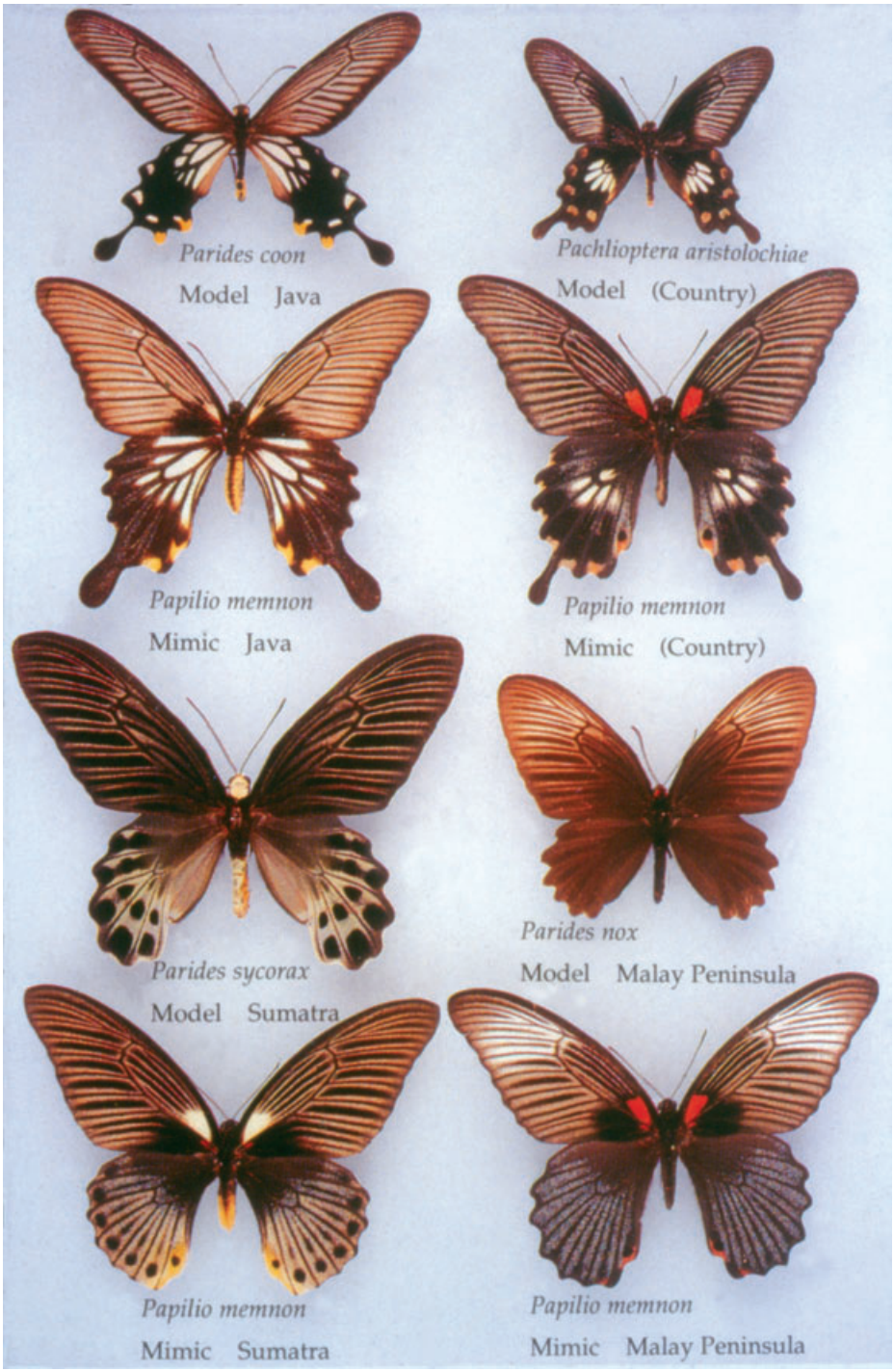

Figure 3. Some *Papilio memnon* mimics and their models. From Cook & Callow (1999).

thorax of the model. Some have tailed, rather than tailless, models and are themselves tailed, so that the tailed condition varies between mimics. The abdomen may be yellow or black to suit the model and again there are white or coloured wing patches which copy features of particular models. Again dominance breakdown can be seen in geographically distant crosses. Again the major features (tails, red patch, yellow abdomen etc.) segregate as if controlled by a single major locus with multiple alleles switching from one form to another. But these features have very different metabolic or ontogenetic origins and might be expected to be controlled by different loci. Clarke and Sheppard had sufficient bred material and field observations to be able to interpret rare odd forms from the wild as products of crossing-over between several closely linked loci. On the basis of the likelihood of single versus double crossovers, they were able to postulate an order for these loci making up a super-gene (consisting of tails, hindwing pattern, forewing pattern, colour of basal triangle, abdomen colour in that order). It is plausible that separate closely-linked loci controlling wing colour pattern could have arisen by duplication, but abdomen colour and tails are something else. The close linkage is therefore consistent with the suggestion that linkage itself has evolved to produce a coalescent bundle of loci determining a major feature under strong and long-term selection.

This is a cursory sketch of a much more complex story. Of course, some of the conclusions have been criticised. There have been reservations about the super-gene evolution hypothesis on grounds of the time and selection required. There has also been disagreement based on phylogenetic analysis and concerning whether non-mimetic males are really ancestral types, as Clarke and Sheppard assumed (Bernardi *et al.*, 1985; Vane-Wright & Smith, 1991). The important point here, however, is that the work opened up the subject in two respects.

First, it supplied solid genetic evidence where previously there had only been speculation. Secondly, it was based on a tradition of thinking of the genome as a reactive and readily evolving system, the study of which would shed light on major questions of evolution and speciation. In his medical work, Clarke is, of course, best known for studies of Rhesus incompatibility which led to a method for avoiding haemolytic disease of the new-born. These were based on study of a super-gene in some ways analogous to those studied in butterflies. Clarke's book *Genetics for the Clinician* was first published in 1962, not long after discovery of the first human trisomic in 1959. It was famous for presenting butterflies to doctors. Reading it now it can be seen to be advanced in the rounded view it adopts of the study of human genetics and in its emphasis on the importance of gene interaction and genomic balance.

This approach counteracts a tendency to take an atomistic view of evolutionary genetics. *The neutral theory of molecular evolution* (Kimura, 1983) has been enormously influential over the last few decades. It is important to emphasise just how different are the assumptions it makes from those discussed here. Genetic variants at a locus are taken to have negligible effects in themselves and to be totally independent of those at any other locus, so that evolution can be understood in terms of mutation rate and effective

population size alone. Perhaps this is true of one part of the genome, while purifying selection prevails and super-genes develop in another part, as Kimura suggested. But we know from the globin molecule, for example, that replacement of a single base by another in a sequence can have an effect varying from the imperceptible to near lethality. Not only may some alleles be selected but those at different loci may interact. Over long periods there may sometimes be periods of selection which is random in magnitude and direction and is invisible in the *ensemble* treatment of patterns of allele frequency. If so, the apparent rate of divergence or the apparent population size would be altered, which would affect the molecular phylogenies now so commonly produced.

More spectacular developments are the Human Genome Project and sequencing projects for other organisms. It is essential to remember that when we know the sequence we do not have all the answers. How and why did the arrangements of sequences arise? How does the information contained unfold into a phenotype? Why are there introns? Is junk DNA junk? Why are chromosomes the length and number they are, and why do they differ the way they do between related species? Why is the amount of DNA so variable between species? Why is one species variable when a closely related one, almost identical in sequence, is invariant? How does a 2 per cent difference in sequence convert a chimpanzee into a human being? Clarke was a pioneer long before the present phase of genetics could be imagined, using his experience in the field of insect evolutionary genetics to inform the way he thought about human genetics and its applications.

This article is based on a talk given at the Linnean Society meeting at the Athanaeum, Liverpool, 7 September 2002. There is a list of Clarke's papers on peppered moths and scarlet tiger moths and of those with Sheppard on butterfly mimicry in *The Linnean* 17(2): 41-45 (2001). Obituaries were published in the *British Medical Journal* 322,367, 2001; *The Daily Telegraph* 20,11,2000; *The Guardian* 1.12.2000; *The Independent* 1.12.2000; *The New York Times* 5.12.2000; *The Times* 8.12.2000. I am grateful to Teresa Sutton for biographical information from *Munk's Roll*, Royal College of Physicians. Behind the work discussed here can be seen the genius of Cyril Clarke's friend and colleague Philip Sheppard, who died at the early age of 55 (see Clarke, 1977).

LAURENCE COOK

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Reptilian Parental Behaviour

In a recent issue of *The Linnean* Gardiner (2002) states that among amniotes parental care "only occurs in crocodiles, birds and mammals". His statement implies that parental behaviour is unknown in other reptilian taxa such as turtles, lizards, and snakes. As reptilian parental behaviour has been the subject of my research for several years, I will herein set about correcting this common, understandable misperception by briefly reviewing the literature covering this aspect of reptilian reproduction and by providing a few examples of the breadth of parenting behaviours exhibited by lepidosaurs (tuatara, lizards, and snakes) and even a few turtles. The literature that I cite is intended to give readers of *The Linnean* a better understanding of this little-known and understudied aspect of reptilian reproduction.

The fact that parental behaviour, in various forms, has been documented for a diverse number of oviparous and viviparous, non-crocodilian reptiles (with the exception of amphisbaenians) has been reviewed by several authors (Fitch, 1970; Shine, 1988; Somma, 1990, 2003a,b; Blackburn, 1999; Shine & Lee, 1999). While parental behaviour does not appear to be a dominant form of reproductive behaviour, reliable documentation exists for one species of tuatara (Rhynchocephalia), more than 133 species of lizards, 102 species of snakes, and 6 species of turtles (Somma, 2003a,b).

Parental behaviour in turtles is exceedingly rare (occurring in only 3 families) and entirely maternal (Iverson, 1990; Somma, 2003a). Of the six species definitively known to exhibit parenting behaviours of some form, the best examples are the nest-defending behaviours seen in the tortoises *Gopherus agassizii* (Barrett & Humphrey, 1986; Henen, 2000), *G. flavomarginatus* (Janulaw & Appleton *in* Morafka, 1981; Turner, 1998), and *Manouria emys* (Louwman, 1982; McKeown, 1993, 1999). More interestingly, there is an observation of female *Trachemys stejnegeri malonei*, an emydid, digging and loosening the soil around their nests just prior to hatchling emergence (Hodsdon & Pearson, 1943).

Among lepidosaurians parental behaviour is quite diverse. Of the two known tuatara, defensive nest-guarding behaviour is exhibited by maternal *Sphenodon punctatus*, while no such behaviour is seen in *S. guntheri* which simply abandons its nest (Guillette, Cree & Gross, 1990; Cree *et al.*, 1991; Somma, 2003a). Parental behaviour occurs in at least 14 lizard families and may have a variety of functions (Shine, 1988; Somma, 2003a). At least 12 species of large iguanids (*sensu stricto*) exhibit maternal nest-guarding for varying lengths of time (Shine, 1988; Alberts, 2000; Somma, 2003a). Lizards that commonly brood their eggs include most species in the scincid genus *Eumeces*, most oviparous anguids, and a variety of gekkonid genera (Somma, 2003a). The functions of egg-brooding in lizards may include nest-cleansing, hydroregulation, thermoregulation, and defense of the clutch (Groves, 1982; Hasegawa, 1985; Shine, 1988; Somma & Fawcett, 1989; Lang, 1990). Several oviparous and viviparous lizards (agamids, cordylids, geckos, skinks, varanids, xantusiids, xenosaurids) care for their neonates (Somma, 1990, 2003a). Often this involves aggressive defense of young as seen in some geckos and skinks (Somma, 1987, 2003a). A few species of monitor lizards (Varanidae) release their hatchlings from nest cavities in a manner similar to crocodiles (Bauer, 1998; Carter, 1999). Aggressive protection of eggs and hatchlings is displayed by both male and female parents in *Gekko gecko* (Zaworski, 1987, 1988; van der Hulst, 2001). Maternal crocodile skinks, *Tribolonotus gracilis*, aggressively guard their eggs and hatchlings (Hartdegen *et al.*, 2001; Reams & Urbanek, 2001). Mothers in the scincid species *Eumeces obsoletus* and *E. septentrionalis* may assist in the hatching process and groom their young (Evans, 1959; Somma, 1987). In captivity, maternal *E. obsoletus* will avoid taking food items for herself, giving priority toward allowing her young to feed (Evans, 1959). There are even tenuous reports indicating mother prehensile-tailed skinks, *Corucia zebrata*, will nudge their young toward food (Groves, 1994), while maternal *Cordylus cataphractus*, a cordylid, actually feed their young (Branch, 1998). These last two species are viviparous and may remain with their young for weeks or months.

Parental behaviour occurs in at least five families of snakes and is particularly common in oviparous boids, viperids, oviparous elapids, and diverse lineages of colubrids, such as the genera *Farancia* and *Psammophylx* (Shine, 1988; Somma, 1990, 2003a; Greene *et al.*, 2002). Brooding behaviour in oviparous snakes can have functions relating to defense, nest-cleansing, nest camouflage, thermoregulation, and hydroregulation (Hopley, 1882; Hutchison, Dowling & Vinegar, 1966; Vinegar, Hutchison & Dowling, 1970; Harlow & Grigg, 1984; Shine, 1988; York & Burghardt, 1988; Shine *et al.*, 1997; Somma, 2003a). Although ophidian maternal behaviour (and biparental care in the case of some cobras) may not show the diversity and complexity seen in some lizards, short-term care of neonates occurs in a variety of viviparous vipers (Somma, 2003a,b; Greene *et al.*, 2002).

Parental behaviour in non-archosaurian reptiles remains largely understudied despite the array of behaviours seen in various lineages. Given their overall secretive habits, it may be no surprise that so little is known about these enigmatic creatures. Perhaps it can be said that the level of sophistication of behaviours found in turtles and lepidosaurs normally does not quite compare to crocodilians (Lang, 1987; Shine, 1988) and other

amniotes. The fact that crocodilians share both the same reproductive mode (exclusively oviparous) and similar parenting behaviours with birds and non-avian dinosaurs (Horner, 1982; Varricchio *et al.*, 1997; Clark, Norell & Chiappe, 1999) may be a line of evidence for recognizing the clade Archosauria (*sensu* Parrish, 1997). Indeed, several researchers other than Gardiner have applied parental behaviour to cladistic or phylogenetic analyses (Gans, 1996; Clark *et al.*, 1999; Shine & Lee, 1999). However, both the considerable diversity of behaviours exhibited and the variety of apparent "evolutionary trajectories" (Zug, Vitt & Caldwell, 2001) among reptilian lineages makes such analysis problematic. I suspect that the few easily discernible patterns seen at the generic and familial levels (Somma, 1990, 2003a; Greene *et al.*, 2002) will provide little content for analysis among more inclusive lineages.

LOUIS A. SOMMA
Department of Zoology, PO Box 118525, 223 Bartram Hall,
University of Florida, Gainesville, FL 32611-8525, USA
e-mail: las@zoo.ufl.edu

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On Sweating

Thermoregulatory evaporation of water takes place in mammals by way of the sweat glands (Brück, 1990), as everyone knows. It is surprising that the subject was not mentioned by Charles Darwin in *The Descent of Man* (1871), although he did discuss the absence of hair from the human body. A couple of years later, in *The Expression of the Emotions in Man and Animals*, however, he wrote: 'When a man suffers from an agony of pain, the perspiration often trickles down his face; and I have been assured by a veterinary surgeon that he has frequently seen drops falling from the belly and running down the inside of the thighs of horses, and from the bodies of cattle, when thus suffering'. He added that there had been no struggling to account for the perspiration, and that the whole body of a female hippopotamus 'was covered with red-coloured perspiration whilst giving birth to her young. So it is with extreme fear.....'. The origins and functions of sweating were not discussed, nor was the distribution of sweat glands on the body.

By sweating and thus cooling the body a human being can for a while withstand a temperature at which water would boil. As early as 1775, C. Blagden (*Philos. Trans.*, 65 (1): 484) reported to the Royal Society that he and a colleague had exposed themselves in a room heated to 125°C. His observations emphasised the separate effects on physiological strain of the air temperature, radiant heat from a stove, and the humidity. 'The air heated to these degrees felt unbearably hot, but was very bearable', Blagden

wrote, adding: 'Whenever we breathed on the thermometer, the quick-silver sank several degrees. Every expiration gave a very pleasant impression of coolness to our nostrils'. For the benefit of sceptics, they 'overdid' a beefsteak in one of the environments which they tolerated.

Two morphological types of sweat glands occur in mammals, atrichial (without hair) and epitrichial (associated with hair). Atrichial sweat glands are confined to certain primates and reach their highest development in human beings while, in other species, the epitrichial glands may produce large quantities of sweat. Very high rates of evaporation can be achieved by the atrichial glands of humans (Belding, 1967), the epitrichial glands of horses, camels and, to a much lesser extent, of cattle, bears, some carnivores, and large rodents. In other mammals, sweating is only weakly developed and either needs to be supplemented by panting or does not take place at all. Pigs, for instance, do not sweat and, consequently, are very sensitive to heat. In some varieties of goats and sheep, intermittent sweating may occur, but there is little evidence of any correlation between this and the body temperature. Rhinos sweat, but elephants do not. Instead, the blood vessels dilate in their large ears from which heat is lost by radiation and convection. This is increased when they flap their ears.

Sweat glands are present all over the bodies of humans, horses, camels and bears but, in cattle, sheep, dogs and cats, they are active only around the lips and hooves, and on the pads of the paws. Like birds, such mammals have to cool themselves by panting. This is much less effective, although more economical of water, than is sweating – which explains why tropical temperatures are so much more debilitating to dogs than to their owners. Dogs can only lose water by evaporation from the moist tongue and the mucous membranes of the mouth and upper respiratory tract. Furthermore, panting involves physical energy while sweating does not. In addition, it is difficult to imagine how an animal that thermoregulated by panting could have evolved the power of speech.

The camel does not pant, but sweat is produced in moderate quantities which evaporate on the surface of the skin, beneath the coarse hair, rather than from the surface of the hair as in horses – an important factor in water economy. Moreover, sweating does not begin until the body temperature has risen considerably. In the North African summer, a camel may have a morning temperature of 34°C and an afternoon maximum of 40.7°C. To raise some 450 Kg through 7 deg C takes up a great deal of heat which is dissipated during the night. Only after the higher temperature has been reached does sweating commence. In contrast, when exposed to a hot environment, human beings maintain, by sweating, an almost constant temperature of about 37°C. Camels allow their body temperature to vary over a thermal range greater than does that of any other mammal. Not only are they able to store heat during the day and lose it at night without expense of water, but there is a further advantage in the high body temperature. The difference between the hot environment and the body is smaller and, since the transfer of heat is proportional to this thermal difference, less heat reaches the body and less water is required to prevent a further increase in body temperature (Schmidt-Neilsen, 1964).

Most rodents and other small mammals cannot afford the luxury of sweating. This is because heat loss is proportional to body surface area and available water is proportional to body mass. The smaller an object is, the larger is its surface area in relation to its weight. In order to maintain a constant, normal body temperature when the air temperature is around 40˚C, a kangaroo-rat or jerboa would have to lose water at about 20 per cent of its body weight per hour. In emergencies, however, when the body approaches the lethal level of 42˚C, copious salivation occurs which wets the fur of the chin and throat. The cooling effect of this may keep experimental animals alive for up to half an hour at temperatures fatal to other small rodents, but the time limit on the mechanism is severe. Possibly an animal driven from its burrow by a predator may have a better chance of survival with such a mechanism than without. Thermoregulatory salivation and frothing at the mouth when the body temperature rises, likewise takes place in tortoises. These animals also urinate on their back legs when suffering from thermal stress. When water is not available, elephants collect saliva from their mouths with their trunks, and spray it onto their backs.

It is interesting to speculate as to why human beings and horses have evolved such exceptionally high rates of water loss through sweating. The answer in the case of horses must surely be that sweating, although inefficient in an animal with dense hair, nevertheless evolved as an emergency antipredator device. The defence of the Pliocene ancestors of horses and other single-hoofed ungulates was undoubtedly to flee from enemies, as they and their relations – zebras, the kiang of Mongolia and Turkestan, and wild asses – do today.

The total number of sweat glands on the human skin has been estimated to be in the region of 2.4 million. The palms of the hands, the soles of the feet, and the head are most abundantly supplied. Moistening the surfaces of the hands and feet improves the ability to grasp branches and other objects. This would have been invaluable to our arboreal ancestors, while the head especially needs to be kept cool because the activity of the brain engenders a considerable amount of heat. Sweating onto a naked skin not only cools it but also increases the thermal gradient between the body surface and the ambient air (Lee, 1964). The ability to sweat could presumably have served our anthropoid ancestors not only to escape from predators but also to keep up with their prey. At the same time, it necessitated access to abundant supplies of water.

So far, we have been considering eccrine sweat glands. In humans, these are atrichial and are controlled by cholinergic fibres from the sympathetic nervous system whereas the apocrine glands, which are associated with hair follicles, are not supplied by nerves but do respond to adrenaline in the blood stream. The secretion of apocrine glands is apparently produced by the disintegration of the cells of the glands themselves. This does not take place with eccritic sweat glands which consequently are said to be merocrine Apocrine glands are distributed chiefly under the arms and in the genital region: their secretions are almost certainly pheromones (Comfort, 1974). Scent glands, mammary glands and the wax glands of the ear canal in mammals are probably derived from them.

Phylogenetically, apocrine glands are probably older than eccrine glands, as the latter have a widespread distribution only in simian primates. The distinction between the two types is, however, somewhat doubtful. Both are present in the platypus, but the main criterion for considering glands to be apocrine, as explained above, is that they display necrobiotic secretion, the evidence for which is equivocal. At the same time, the terms, epitrichial and atrichial do not indicate the functional difference between the two (Whittow, 1973).

Human hairlessness and pigmentation have recently been reviewed in some detail (Cloudsley-Thompson, 1999), but the question I would have liked to ask Darwin, were he still around is why, in his opinion, human beings should have evolved such marked development of the sweat glands. Why should we be able to sweat more than any other animal? Perhaps no-one will ever know.

J. L. CLOUDSLEY-THOMPSON

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Book review

Keeping it up

The Descent of Men, by Steve Jones, London: Little, Brown, 2002.
ISBN 0 316 85615 0, Price £14.99.

This book is about the biological basis of human masculinity, and how our perceptions and knowledge have changed since Darwin's publication of *The Descent of Man* in 1871. It is Steve Jones' second foray into Darwinism after *Almost Like A Whale*'s updating of *Origin of Species. The Descent of Man* is to an extent the history and functions of the Y chromosome, unknown to Darwin, which has been sequenced as part of the Human

Genome Project, and which uniquely passes down the male line without recombination. DNA sequencing does open new doors, but there is a lot of it (60 million base pairs) in the Y-chromosome and an interpreter is required. This is, for me, where Steve Jones scores. Within a book dealing with the male role in the reproductive process, with male genital physiology and endocrinology, with castration, and with inborn errors of metabolism, he has teased out the limited DNA messages carried by those 60 million base pairs (and a few others), and which provide an unedifying story for males. Much of the Y sequence is redundant, a lot is plain junk and only a very small fraction seems biologically active. But redundant sequences carry traces of past glories and so we know that the Y chromosome tells a history of decline for males, indeed the main masculine feature of the Y chromosome is a small sequence called the Sex-determining Region of the Y (SRY) which subverts the normal development of embryos to females to males. In Darwin's day just the idea was heresy.

The Human Genome Project (acronym HUGO) has been criticised in the past as an irrelevant luxury. This book makes significant use of the results of HUGO to provide lucid explanations and elaborations of a number of biological concepts. The book is well-referenced and could usefully serve as a modern biology primer for sixth formers and undergraduates. Steve Jones is altogether too modest about his literary talents, with his dry humour and, particularly, the clarity of his arguments. The examples are excellently chosen and suggest much detailed research; some are hilarious, like Charlie Chaplin being found guilty of failing to support an infant which scientific evidence (blood groupings) established could not be his. The jury decided otherwise because the child *looked* like Charlie. Complete with moustache and funny walk, doubtless.

Why sexual differentiation occurred in the first place remains a mystery, since there are plenty of examples of successful parthenogenesis; indeed, the Royal Entomological Society and the Linnean Society recently held a three-day meeting on clones, which will be published in its *Biological Journal*[1]. Having read this book, I am much more inclined to the Haldane-Oparin of the origin of life – that a cell-like structure (coacervate) preceded any genetic material – and maybe genetic material was the original parasite. Maleness came later, and may also have had a parasitic origin. And in another reversal of perceived wisdom, maleness is expensive to maintain. Some day we might not feel able to afford it, or it may become just too politically incorrect.

JOHN MARSDEN

1. *Intraclonal Genetic Variation: Ecological and Evolutionary Aspects*: 11-12th April 2002, due out as the May 2003 issue of the Society's *Biological Journal*.

KUNTH – Obituary

Taken from *Humboldt, Bonpland, Kunth and Tropical American Botany*
Editor William T. Stearn. Verlag Von J. Cramer 1968.

Nekrolog

Von Alexander von Humboldt

The following obituary was first published by Humboldt in *the Beilage zum Preußischen Staats-Anzeiger* (no.128:611) of 9 May 1851, then reprinted in *Botanische Zeitung* 9:427-432 (June 1851).

Translation by Ray Buxton
Edited by Steve Manning

A full year has now passed since the botanical world (the term taken in its widest scientific sense) has lost one of the most famous, untiringly active as well as most discerning researchers. This so unexpected loss has not only been felt in the German fatherland; the uninterrupted 17 year stay of Professor Kunth in Paris, his journey to England, his correspondence with the greatest botanists of the two continents have made the loss even more widespread than is customary in a contented working life of a scholar. But who could have been shaken by his early death more deeply than I, who, due to a long-lasting community of ideas and effects has to thank him for a large part of the favour and attention which the public has paid to mine and Bonpland's botanical researches in the equinoctial zone in such a profuse and lasting manner. The majority of Kunth's great published works which achieved a rare distinction in France and have long been counted among the classics, do not need renewed praise; but in the case of such a diligent all-embracing botanist, the treasures of the unpublished knowledge is, so to speak, buried in the foundations of the herbaria, which are arranged in natural families and in critically evaluated groupings and genera. The sole inheritance, which Kunth has bequeathed to his caring and devoted "sacrificial" widow, is the collection of dry plants which is one of the most comprehensive and numerous ever possessed by a private individual**.** Professor Kunth was presented with the personal good wishes of the Monarch, who like his noble deceased father before him encouraged culture to blossom (Natural Sciences as well as the products of creative imagination), and by whose munificence has saved the collection from destruction or transfer across the Atlantic.

It contains a considerable part of the rare plants which were collected in the seldom visited but constantly changing world of South America, from the high plains of Mexico to the snow-covered Cordillera of New Grenada, and from Quito and Peru during our expedition; they thus complete the set which has already come into the royal collection by the purchase of the Willdenow herbarium of mine and Bonpland's plants. Generous governmental assistance has been forthcoming through the active scientific zeal of the then Education Minister von Ladenberg and the friendly support of the Finance Minister

von Rabe despite difficult circumstances, yet speedily and in a cordial manner. Thus the warm-hearted and patriotic wish of my dying friend has been completely fulfilled.

Carl Sigismund Kunth was born on the 18 June 1788 in Leipzig. His father, a scientifically educated man was a Reader in the English language and whilst employed at Leipzig University translated several historical works into German. Owing to the family's limited financial circumstances, he was unable to complete the academic education of his son, although the latter as a diligent pupil of the Leipzig Law School had already attracted the attention of Rosenmüller owing to an early inclination towards the natural sciences. It was Rosenmüller who provided him with the opportunity to complete his education as a draughtsman. He was also the nephew of the excellent and universally respected Ober-Regierungsrathes (Senior State Official) Kunth, a truly modest man, to whom my brother and I owed our education, and who called the young man to Berlin in 1806, where he kindly supported him and employed him at the Mercantile Institute. His non-demanding job and the patronage of his superior enabled him to make use of the scientific aids available in the Capital. His passion for botany was nurtured by his contact with the excellent Willdenow who soon acknowledged him as his outstanding scholar. The *Flora Berolinensis,* arranged according to the Linnean sexual system, was Kunth's first literary attempt. Through the early promise of the young man and Willdenow's warm recommendation, I owe the good fortune and benefits of a long-lasting and cordial relationship.

After the enjoyment and hard work of a five year journey, Bonpland and I had a serious duty to fulfil – to make generally available in a scientific manner all the specimens we had collected, together with the observations we had noted in descriptions and diagrams in various scientific disciplines. Journeys to the interior of a continent reveal the marvellous forms of organic nature, almost in layers, from the plain to the snow region, with climates appearing to be superimposed one on the other, and offering a far greater richness of material than so-called circumnavigations, which usually keep to the barren coasts, and hardly permit the exploration of island groups. The round-the-world sailor misses so much of the pleasure and perspective of the diversity of life. The compensations offered by the changing expanses of space and the various types of cosmic phenomena to be seen when travelling through latitudes and longitudes are to a large extent unnoticed.

In spite of the enduring and most congenial activity of my friend and travelling companion, it was clear to Aimé Bonpland and simultaneously to myself that we were in need of outside help in order to master the accumulated material and to progress so many publications simultaneously begun. The decision by Bonpland (caused by political events) to return to South America[1] after the loss of his post as Curator of the beautiful botanical gardens of Malmaison and Navarre, made me realise in a double sense how much I owed to the friendly co-operation of my travel companion in formulating the

1. Bonpland emigrated to an area of northern Argentina near the border with Paraguay. – S.M.

outline publication plans. He had not only assembled this but had completed five folio volumes of botanical descriptions on the spot during the expedition. My first attempt to enlist outside help **(**which by the way, interrupted Bonpland's publication of three important works of our Equinoctial plants, the Melastomae and the Rhexia), was the invitation to my previous teacher Willdenow. He came to Paris and for several months worked in our herbaria, which at that time contained over 5,000 species from the American tropical zone alone; however, for family reasons it became necessary for him to return to Berlin rather earlier than I had hoped, but I was even less able to achieve my purpose because, despite pointed advice, this exceptionally discriminating man distanced himself from general observations as a result of the practice he employed in his previous scientific activity (a system of natural family 'affinities').

Youthful receptivity and more comprehensive views of organic development were to be found with Willdenow's outstanding pupil, the young Kunth, whom I invited to Paris in 1813 and who was soon highly regarded by Antoine Laurent de Jussieu, the most renowned botanist in the country, by Richard and Desfontaines; he lived in Paris for 17 years, working diligently gaining an ever increasing and justified reputation. During this period, the large collections of the Jardin des Plantes and of von Benjamin Delessert were opened to him as if they were his own. Already in 1816 he was appointed a corresponding member of the Academy of Sciences in Paris. A journey to England and the favour of Robert Brown, the greatest botanist of our time, opened up for him the treasures of England. In order to get some idea of his boundless activity it is sufficient to mention that from 1815 to 1825, he published in 7 folio volumes over 4,500 descriptions of plant species collected by Bonpland and myself including 3,600 new ones. The copper plates which accompany this work (*Nova Genera et Species Plantarum in peregrinatione ad plagam aequinoctialem Orbis Novi collecta*) for which he himself made all the analyses of the flower parts, amount to 700. After Bonpland had emigrated to "la PlataStrome"[1] , Kunth published the *Révision des Graminées*, as well as the monumental work of the Mimosacées and 5 new books of our Melastomen. Parts of 4 octavo volumes followed the completion of the 7 folio volumes of the *Nova Genera*, and in the latter is detailed all individual genera according to the provisional 4,500 height records showing the individual species in the results of my Geography of Plants (*Synopsis Plantarum aequinoctialium Orbis Novi*).

Of the 1,425 copper plates included in the 29 volumes of the larger edition in folio and in quarto of the American travel work, 1,240 belong to the botanical section (the publication of this work has become possible only through the lasting favour of the public); of the remainder, some are based on astronomical observations and height measurements mostly from maps drawn by me, others are illustrations of zoological and anatomical objects, plus picturesque views and detailed drawings of the original peoples of Peru and Mexico. Concerning the numerical data, I must point out how great a part my friend has played in this long and onerous undertaking. When once more I transferred my home after the 20 year stay in France, 2 years later – in August 1829 – Kunth followed me in order to take up the position of Professor of Botany and as Vice-Director

of the botanical garden. At that time I was on an expedition for the Russian King in the Siberian Altai. Kunth's efforts to make himself useful to the students at the Herbarium and with the collections was due to his noble sense of duty and a never diminishing zeal for science. In Germany he published his *Handbuch der Botanik*, (two-thirds of which is devoted to the compilation of the natural families), a useful introduction to the *Anleitung zur Kenntißoffzineller Gewächse*, and 6 volumes of a general *Enumeratio Plantarum omnium hucusque cognitarum*; as well as his Botany Primer (*Lehrbuch der Botanik*) which deals with Organography and Physiology, all requiring much hard work in the light of the most recent discoveries.

In a very magnanimous way, the East India Company knows how to support studies in all fields, studies which relate to the formation of countries, natural products and ancient cultures. In 1830 they made the laudable decision to produce a number of Indian herbaria containing many plants, and allowed them, through the distinguished botanist Dr. Wallich, to be distributed to famous museums. Our Government appointed Kunth the laudable task of accepting the collection destined for Berlin – his extensive knowledge of species characteristics had made him especially skilled thanks to his sharp insight and long experience in correcting the determination of great numbers of plants; because of his help with this distribution, he was presented with a considerable number of duplicates as his own private property. Lack of research and dubiously described plants, mean that duplicates are of the greatest importance in the sound determination of species, and this treasure-house of the flora of the Alps and of the Himalayan ranges can now be found in the large royal herbarium at Schöneberg; fortunately under the ordered supervision of a scholar, Dr. Klotzsch, who has accumulated a most extensive systematic knowledge of flora thanks to an insight based on his own observations into the affinities of the natural families, as well as a long co-operation with my old friend Sir William Hooker (now Director of the Royal Botanic Garden in Kew).

Professor Kunth enjoyed a long-lasting health in blissful domesticity by virtue of much hard work, and a retiring disposition; he kept his distance from literary conflicts which often have a shattering effect in the pleasant kingdom of the flora. In 1837 he visited Paris for the last time, seeing his botanical friends of whom the witty Adrien de Jussieu was foremost. A few months earlier, supported by a knowledgeable pupil and relative, Wladt von Schönefeld, Kunth had published with much depth of feeling the *Notice sur la vie et les ouvrages de Mr. Kunth*. Two years after Kunth's last journey to Paris, rheumatic pain set in which was probably caused a shoulder problem as a result of an unfortunate fall in the Berlin Tiergarten, and this accompanied by a decline in hearing, suppressed his cheerful nature. In 1845, in order to get stronger through the mountain air, he set off for the attractive Alps of Upper Bavaria and Salzburg; but before he reached the mountains he stopped in Munich for several weeks, being confined to his bed for most of the time, owing to a dangerous nerve-weakening illness, until his wife could join him and was able to revive him through her own efforts. Physically he seemed to become a little stronger. Through endurance, he continued his scientific works,

and in 1849 he published the last volume of his primer of botany and was able to complete the 5th of the *Ennumerato Plantarum*. As before, he enjoyed the thriving culture in the botanical garden under the intelligent and careful supervision of Direktor Bouché. But the old joy and peace of mind did not return to any extent after 1849. The loving care of his dear wife and the attentive medical treatment were not able to soothe the sufferings of a sad and melancholy disposition. After a four-month illness he was taken from us on the 22nd March 1850. The memory of my friend will be celebrated for a long time; not merely where his outstanding scientific contributions and influence on the descriptive part of Botany in general, which was both analytical and systematic can be recognised, but also with those who know how to value his human side – a character of solid simplicity and a grace of manner which embellished life itself.

The Library Reading Room in the Society's rooms at Burlington House.

Robert Hooke Tercentenary Commemoration, Oxford, 2nd October 2003

Programme

Meetings in the Examination Schools in the High Street

Morning:	Chair *Sir David Smith, Former President of the Linnean Society*
10.25	Welcome *Professor Sir Henry Harris,* *formerly Regius Professor of Medicine, Oxford*
10.30	Hooke: The Man *Dr Allan Chapman, authority on the life of Hooke*
11.00	Robert Hooke as Fellow and Secretary of the Royal Society *Professor John Enderby, Physical Secretary of the Royal Society*
11.30	Hooke's Legacy to Science *Sir Roger Penrose, Rouse Ball Professor of Mathematics, Oxford*
12.00	Hooke the Mathematician *Sir Christopher Zeeman*

Luncheon in Christ Church Hall (1.00 – 2.15 pm)

Afternoon	Chair *Sir Arnold Wolfendale,* *formerly Astronomer Royal, Professor Emeritus, Durham*
2.30	Hooke's Concepts of the Earth in Space and Polar Wanderings on the Terrestrial Surface *Dr Ellen Tan Drake, Scientific Historian, Oregon State University*
3.00	Hooke's Contributions to Astronomy *Sir Martin Rees, Astronomer Royal*
3.30	Hooke's Civic Observations and Measurements *Professor M.A.R. Cooper,* *Emeritus Professor of Engineering Surveying, City University*
4.00	Concluding Summary *Sir Arnold Wolfendale*

Contact: *margaret.molloy@chch.ox.ac.uk*
or Development Office, Christ Church, Oxford OX1 1DP
for tickets costing £25 including lunch.

The Linnean Society
Programme

2003

18th–22nd Aug.	Systematics Association 4th Biennial Meeting † Prof. Chris Humphries FLS & Gordon Curry
22nd–29th Aug.	*Species Plantarum 1753* – meeting in Uppsala
25th Sept.	6 pm HUXLEY & THE RATTLESNAKE Jordan Goodman
2nd Oct.	ROBERT HOOKE (1635–1703) COMMEMORATION † Paul Kent with and at Christ Church, Oxford
9th Oct. 6pm	IN THE BLINK OF AN EYE: THE CAUSE OF THE MOST DRAMATIC EVENT IN THE HISTORY OF LIFE Andrew Parker, Dept. of Zoology, University of Oxford
16th Oct.* **Book Sale****	6 pm NATURALIZED SPECIES: THE ECOLOGY OF SUCCESSFULLY INTRODUCED SPECIES Sir Christopher Lever FLS
23rd–24th Oct.	LONG TERM DATABASES AND ECOLOGICAL CHANGE † Terence Langford FLS, University of Southampton
8th Nov.	THE MYSTERIOUS ORIGINS OF THE ENGLISH APPLE The Brogdale Lecture Barrie Juniper, Plant Sciences, University of Oxford.
21st–22nd Nov.	COLOUR (with Inst. Mech. Eng. and others) † Michael Collins, University of South Bank and † David Cutler FLS, RBG, Kew
11th–12th Dec.	ALEXANDER VON HUMBOLDT † Walter Lack FMLS, Botanischer Garten u Botanisches Museum Berlin-Dahlem.

Unless stated otherwise, all meetings are held in the Society's Rooms.
For further details please contact the Society office or consult the website – address inside the front cover. * Election of Fellows † Organisers
** All books gratefully received, preferably before the day of sale please

Typesetting and layout by Mary J Morris, West Mains, London Road, Ascot SL5 7DG