CHARNIA

LEICESTER

LITERARY AND PHILOSOPHICAL

SOCIETY

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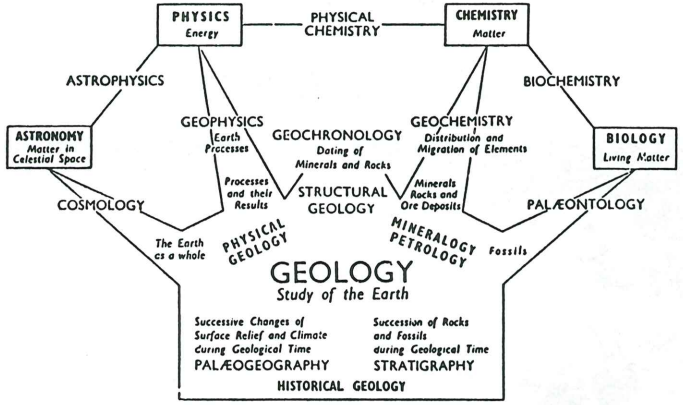
THE NEWSLETTER OF

SECTION C (GEOLOGY)

EDITORIAL

Do you sometimes wonder exactly where geology begins and ends? I certainly do and it is only when you sit down and try to define 'geology' on paper that the enormity of this field of study hits you. In its infancy geology was in danger of becoming a melange of unconnected philosophies occupying a region somewhere between the study of antiquities and the field of 'Natural Philosophy'. It wasn't until the son of Charles Lyell the botanist, that is, Charles Lyell Jnr. the geologist, published his 'Principles of Geology' in 1830 that what we now know as a science became such. Certainly by 1854 the subject had been established as a science, as shown in Professor David Page's preface to Lapworth's 'Introductory Text-Book of Geology'. Lapworth himself states (of the 'pure' sciences) '...but to each of these sciences Geology is indebted for information which it utilises for its own purpose; and the discoveries of geology become of value to all its sister sciences in return.' Those readers familiar with Arthur Holmes' 'Principles of Physical Geology' (1965 revised edn.) will be familiar with this diagram:-



Exactly when did geology mature? Certainly Lyell's 'Principles' had a dynamic influence on Darwin, culminating in the eventual publication of 'On the Origin of Species' in 1859. What in turn influenced Lyell? The Geological Society of London had been founded in 1807 and was already publishing quite sophisticated papers on stratigraphy. Hutton had certainly proposed a cyclical series of events involving repeated deposition, uplift and erosion which had become established ideas by this time. It may surprise some to know that Robert Bakewell published an 'Introduction to Geology' and it was this book, which Lyell Jnr. found in his father's library, that set him on his course. This was in 1816, when Lyell was nineteen years old. From this we can imply that, at the beginning of the C.19th., geology was the province of a loose federation of wealthy farmers, clerics, physicians, aristocrats and civil engineers.

As an eighteen year-old, Lyell attended lectures at Exeter College, Oxford, where he witnessed the Reverend William Buckland's lively and imaginative reconstructions of organisms long extinct. Buckland certainly adopted a scientific approach to using index fossils and lithostratigraphy for dating purposes - and even reconstructing organisms and palaeoenvironments from fossil evidence. Way ahead of his time, Lyell argued that since most of the pages of the book of fossil history had been destroyed, we should be prepared for seemingly anomalous discoveries. An example of this would be the discovery of mammalian forms in strata belonging to a time when the most advanced vertebrates were considered to be reptilian. In his 'Origin' Darwin said of the Earth's fossil record, '...with its imbedded remains must not be looked at as a well filled museum, but as a poor collection made at hazard and at rare intervals.'

It's a pity that genetics didn't really become established in science until the turn of this century, even though the idea of genes or 'genetic particles' had been established in 1866 when Gregor Mendel published the results of eight years of research. This research lay undiscovered and dormant until it was 'rediscovered' nearly one hundred years ago. There was a book (or, at least, a paper) Darwin should have read! Lyell was destined to be a literary bod of sorts, possibly a poet, until he read a particular book on geology. Darwin may possibly have been something else if Gilbert White's 'Natural History of Selbourne' hadn't created an impression on him at an early age... In Darwin's case, the book which truly set him thinking about natural selection was Malthus' 'Population'. Darwin wrote that he read this for amusement in October, 1838.

Returning to genetics: this is an area finding a bigger slice of geological interest as we approach the millennium. One talk given recently to Section C, by Dr. Robert Foley, focused on the role of studying genetic traits in piecing together the 'out of Africa' migration of humans over the past four million years or so. Prior to being able to analyse ancient DNA (aDNA) all that was available to piece together what seemed an impossible jigsaw was comparative anatomy and the study of artefacts and the deposits in which they were found. Now it is possible to follow the trail at a molecular level and for that reason I have included an article in this issue of 'Charnia' describing research being carried out in the Genetics Dept. of Leicester University. This project is not utilising sources of aDNA but samples taken from living Europeans. Very soon it will be possible to track the waves of migration that populated prehistoric Europe. I wonder how much further our knowledge of human evolution in particular and evolution in general would have advanced if Mendel's discoveries hadn't have been hidden away for nearly four decades?

So, we can now add genetics to Holmes' diagram. In 1911 Professor A.C.Seward of Cambridge University quoted something T.H.Huxley had written ten years earlier: 'From the period claimed by archaeologists we pass by gradual stages into the domain of the geologist. As Huxley wrote, 'when even the dim light of Archaeology fades, there yet remains Palaeontology, which... has brought to daylight once more the exuvia of ancient populations, whose world was not our world, who have been buried in river beds immemorially dry, or carried by the rush of waters into caves, inaccessible to inundation since the dawn of tradition.' ' More than ever now there is a huge overlap between archaeology and palaeontology. Television programmes such as 'Meet the Ancestors' and 'Time Team' very often bring this into the wider public arena. How much different attitudes are today: Murchison, wrote that it was quite wrong for students to 'imbibe like pap' Lyell's 'inconceivable nonsense.' As we know, many of these nineteenth century liberators of knowledge also fell foul of religious fundamentalism - something which sadly survives as a force to be reckoned with today. As one biographer

of these early scientific geologists asks, 'Who was to interpret the meaning of a science whose findings could so flagrantly be used to contradict the opening verses of the Bible?'

I can find no references to biblical contradiction brought about by anything which came to the notice of Section C one hundred and sixty years ago. This may be due in part to the fact that the LL&PS reported, in the 1875 Transactions, that 'The Minute Books and Papers relating to the first nine years of the Society's existence were unfortunately lost about twenty years ago...'. Incidentally, on the subject of missing records - if anyone knows of hitherto undiscovered archives relating to our Society, Paul Monk will very gratefully receive such information as he's putting together a special publication, due out in Autumn. (A potted history of the Society was published in 'Charnia' in the Autumn/Winter Edition of 1993-4.)

However, on the fiftieth anniversary of the formation of the LL&PS, George Shaw MD, stated the following in his Presidential Address, delivered on October 6th., 1884: 'Now, mighty as are the discoveries of the last half century, and mighty as are the results they may yet achieve, one new element has been introduced into the world of speculation whose future it is impossible to foretell or estimate. I allude to the doctrine of Evolution, which, first formulated in Darwin's ***Origin of Species*** about twenty five-years ago, has now gained almost universal acceptance... As a result of this doctrine of evolution another tone of thought, which is gaining ground, is the doctrine of Heredity, that is, of the overpowering influences of 'descent' or environment. It is a very grave question, especially if carried to its logical conclusions.' Remember, this was sixteen years before the rediscovery of Mendel's investigatory work, originally published in 1866. In 1904 'Mendelism' came before the LL&PS on the 8th. of January. The speaker, C.Hurst, FLS, stated, "What would have happened had Mendel's work come into the hands of Darwin, no one can say."

I wonder on what ground scientific and religious thinkers will meet two or three decades from now, once the human genome has been completely mapped and once we learn how and when populations and races developed 'out of Africa'?

G.Stocks

LEICESTER LITERARY & PHILOSOPHICAL SOCIETY - GEOLOGICAL SECTION

PROGRAMME OF FIELD OUTINGS FOR 1999

SUNDAY, MAY 23rd.	LINCOLNSHIRE LIMESTONE OF THE ANCASTER AREA. Two quarries in the area will be visited and lunch will be taken at a local hostelry. LEADER: JOHN ARAM
SATURDAY, JUNE 5th.	ASHFORD BLACK MARBLE MINES AND BAKEWELL CHERT MINE, DERBYSHIRE. Strong boots, helmet and head lamp are essential. These are walk-in mines and are not too strenuous. LEADER: Dr. TREVOR FORD
JUNE 18-20th.	WEEK-END EXCURSION TO THE ISLE OF WIGHT. LEADERS: Dr. MARTIN LUNT and Dr. DAVID MARTILL
SATURDAY JULY 10th.	VISIT TO HICKS LODGE OPENCAST COAL MINE. RJB Mining have very kindly allowed a small group of 16 to visit this interesting site where access is usually very restricted. Please book early. It is essential that you have <u>FULL</u> safety kit (helmet, strong boots, high visibility jacket). Meet at the mine entrance at 9.30 a.m. LEADER: PAUL MONK
SUNDAY AUGUST 8th.	SILURIAN ROCKS OF THE AREA AROUND WENLOCK EDGE. A shelf to basin transect. LEADER: Dr. PAUL SMITH
SUNDAY SEPT. 5th.	NORTHCOT QUARRY, BLOCKLEY, GLOUCESTERSHIRE. The Upper Lias clays of this pit are very fossiliferous with something for everyone. Meet at quarry entrance 10.30 a.m. Map ref. SP 183369 LEADER: PETE BLAKE
SATURDAY OCTOBER 2nd.	LAPWORTH MUSEUM, BIRMINGHAM UNIVERSITY. We finish the season with a visit to this excellent museum. HOST: Dr. PAUL SMITH

DETAILS OF TRAVELLING, TIMINGS AND GEOLOGY WILL BE SENT OUT TO THE MEMBERSHIP APPROXIMATELY ONE MONTH BEFORE EACH TRIP.

IF YOU REQUIRE MORE INFORMATION ABOUT ANY OF THE VISITS PLEASE CONTACT:

DENIS GAMBLE (FIELD SECRETARY)
2 ARCHDALE STREET,
SYSTON,
LEICESTER,
LE7 1NA.

CHAIRMAN'S REPORT TO THE AGM, YEAR 1998-99

All in all the Section had an excellent year, a year when we managed to shake off dull sloth and become re-invigorated. This in large measure is due to yourselves of course, the members, and the increased willingness of everybody to become involved in our activities. So give yourselves a pat on the back. Attendances on both the summer and winter programmes were up, in the case of the indoor meetings, quite dramatically so in certain cases. But first the summer programme. We had a full season of seven excursions, starting with Horsehay Quarry in Oxfordshire and the Lincolnshire Limestone and Oxford Clay around Peterborough in May, followed by a very enjoyable weekend in Watchet in June. In July Pete Blake opened his doors for the members to view his collections which was very successful, and then in August we chose just about the only decent summers day to see the Carboniferous Limestone at Ticknall. Blockley Quarry was our early September venue and finally we visited Oxford University Museum at the end of that month to round the season off nicely. Without the efforts of the leaders, Maurice Rogers, Alan Dawn, Paul Monk, Pete Blake and Derek Siveter, these trips would not have been possible, so our biggest thanks goes to them. At this point I would also take the opportunity to thank all the officers for their efforts over the year.

Our Winter season of indoor lectures began on October 7th and again we enjoyed a full programme. I think I speak for us all when I say how marvellously high the standard of talks has been this time around, and this has been reflected in excellent attendances, up to sixty on occasions. It will take some doing to top this next season. It seems invidious to pick out highlights, but Chris Duffin's opening lecture and Robert Foley's hominid talk were indeed something special. Again a huge vote of thanks to all the speakers. The Parent Body meeting and our other two evenings in New Walk Museum for the Christmas and Member's meetings were also very successful and made a nice contrast with the lectures in the department here. The Saturday School on March 6th at Vaughan College also went extremely well, with a bumper attendance of over 70, and much of the success of this was down to Diana Sutherland who made such a good job of organising it.

And what of the rest of the year? Well, the other major event was the exhibition we held in New Walk Museum commemmorating 150 years of the section, and this too was a great success. Grateful thanks are due to Dennis Gamble and his team of Pete Blake, Gary Freestone and Mick Steele, and many thanks too to John Martin and Mark Evans at the museum. Whilst on the subject of our 150th, don't forget the dinner we are planning for later in the year in the museum. More on this later, but a date of sometime in November seems favourite at the moment. In keeping with the new optimism (if I may call it that), we have also made greater efforts with our newsletter Charnia under the editorship of Graham Stocks, which will now reach you three times a year. Contributions always welcome of course.

In concluding my chairman's report, let me wish you all good health and good geology for the forthcoming year as we enter the much anticipated Millennium.

Andrew Swift, Chairman, Section C

Open Day at Pete and Helen Blake's, 19/7/98

Many apologies to Pete and Helen Blake for neglecting to report their 'Open House' on July 19th last year, an account of which should have appeared in our December '98 Charnia. Pete's idea to open his famous shed for a day for members to view his splendid collection, and to see fossil preparation, proved an excellent one and was very successful, with members appearing throughout the day. Not least of the attractions were the fine refreshments that were laid on. The section is pleased to record its thanks to Pete and Helen for their generosity.

Section C Exhibition, New Walk Museum, 7/2/99 - 7/3/99

The benefits of having close ties with the museum at New Walk were demonstrated by our being able to mount a very successful exhibition there from February 7th to March 7th, chiefly to commemorating the first 150 years of the Section, but also to use the occasion to promote the section in the community and encourage new members. It was a nicely combined effort, with several members contributing to the overall success. The museum, through our good friends John Martin and Mark Evans, provided the venue, cabinets, and, most important, a large room in which to show the exhibits. Pete Blake donated many excellent specimens, Gary Freestone drew an original and amusing set of cartoons, and Mick Steele provided display boards. But without the guiding hand of Dennis Gamble, who not only did the display arrangement but also compiled most of the photographs and words, as well as providing several specimens and acting as attendant, it is true to say it the exhibition probably wouldn't have got off the ground. Elements of the exhibition are going to be used as the basis for a portable stand that we can take to appropriate events, something we've long needed. So many thanks to all concerned, all we need now is for the people who took away 100+ membership leaflets to fill them in!

THE RULES OF SECTION C (GEOLOGY) OF THE LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY

1. The objects of the section shall be to promote, record and extend the knowledge of the science of Geology in the County and district of Leicester by holding meetings for the delivery of lectures, for the reading of original papers and for discussion, and by holding meetings in the field, and by such other means as the Committee may from time to time determine.

2. Any Member or Associate of the Parent Body may join the Section by paying to the Treasurer a reduced Annual Subscription which will be determined from time to time by the Section at a General Meeting and after consultation with the Council.

3. Any other person, not being a member of the Society is eligible for election as a member of the section and may be elected to membership at any meeting of the Section. Such members shall pay to the Treasurer an Annual Subscription which will be determined from time to time by the Section at a General Meeting and after consultation with the Council except that persons pursuing a full-time course of study at an educational institution shall pay the reduced subscription as in Rule 2.

4. The management of the section shall be vested in a Committee consisting of a Chairman, A Vice-Chairman, a Secretary, a Field Meetings Secretary, a Treasurer, a Publicity Officer, an Editor, a Student Representative, and not less than two or more than four other Members. The Committee shall have the power to co-opt up to three additional members.

5. The Officers and Members of the Committee (other than the Student Representative) shall be nominated by any two members of the Section. Such nominations shall reach the Secretary at least one week before the time arranged for the Annual General Meeting. The Student Representative shall be nominated by the Students' Union Geological Society of the University of Leicester.

6. The Chairman and Vice-Chairman shall be elected for one year and shall not hold the same office for more than two successive years. All other officers shall be elected for one year, and may offer themselves for re-election. The Student Representative shall serve for one year. Other Members of Committee shall be elected to serve for two years, and, with the exception of those members with special responsibilities, shall not normally be available for immediate re-election as Members at the end of their two years. As a whole, the new Committee should normally contain at least two members who were not members of the Committee during the preceding year. The Chairman shall be a Member of the Society or approved by the Council of the Society. The Committee shall elect one of its members to the Council of the Society.

7. The Committee shall have the power to fill casual vacancies as they occur.

Contd.

8. The Committee of whom half shall form a quorum, shall meet when summoned by either the Chairman, the Secretary or the Treasurer or any three members of the Committee, one week's notice in writing being given.

9. The Committee may create Sub-committees for special purposes and may co-opt members to serve on such Sub-committees. The Chairman and Secretary shall be ex-officio members of such Sub-committees.

10. The Annual General Meeting (of which ten shall form a quorum) shall be held in due time to receive and approve the Annual report and balance Sheet for presentation to the Council in accordance with its Rules. Notice of the Annual General Meeting shall not be held within 28 days of the request and 14 days notice of the meeting shall be given by post to all members.

11. Special General Meetings of the whole membership may be called by the Committee or on the signed request of six members of the Section sent to the Secretary. Such Special General Meetings shall not be held within 28 days of the request and 14 days notice of the meeting shall be given by post to all members.

12. Any member of the Section who has rendered conspicuous service to the Section may, on the recommendation of the Committee to the Annual General Meeting or to a Special General Meeting, be elected as the Honorary Life President or an Honorary Life Vice-President of the Section.

13. The Section is subject to the Rules of the parent body and of those set out herein, which can be changed by simple majority at any General Meeting, all members having the power to vote.

Approved at the Annual General Meeting of the Section held on March 24th., 1999.

Cool Peterborough

An Ice Age Spectacular

May 29th to November 27th 1999

An exhibition about the Ice Ages in the Peterborough area, centred on a specimen of the straight-tusked elephant Palaeoloxodon antiquus excavated from a gravelpit in the summer of 1996 by Stamford and District Geological Society.

The exhibition will feature three stages of the ice age. The oldest at 117,000 years will be the Ipswichian warm stage which yielded the elephant skeleton from a silted river channel below the cold stage gravels. About one-third of the skeleton was recovered and will be on display with a life-size cut-out model.

The cold stage will be represented by bones of Mammoth and other animals, together with more life-size cut-out models of Wild Ox, Horse, Reindeer, Woolly Rhinoceras and Bison.

The post-glacial warm stage will be represented by a near complete skeleton of a wild ox dated at around 4,000 years, excavated from the peat beds near Peterborough in 1996.

The whole exhibition will be backed by a number of large illustrations and liberally supported by explanatory texts.

A booklet about ice ages is being prepared.

The exhibition is supported by grants from Lafarge Redland and the COPUS fund. The work of preparation is being carried out by members of Stamford and District Geological Society on a voluntary, unpaid basis.

The society has raised funding to purchase most of the materials used in preparing the exhibition, which is expected to attract a large attendance.

There is no charge for admission and the exhibition is open from 10 am to 5 pm, Tuesday to Saturday inclusive.

The museum is closed Sunday and Monday.

Stamford & District Geological Society

LAFARGE REDLAND AGGREGATES

COPUS

PETERBOROUGH CITY COUNCIL COMMUNITY SERVICES

The end-Cretaceous catastrophe

John Hudson

Andrew Swift has asked me to write a summary of my remarks on this subject, following a talk I gave to Section C in January. As on that occasion, I shall not try to give a comprehensive account, which would be impossible in any case in the time and space available. These are merely some personal reflections. As I can't remember at all precisely what I said, these may not be the same reflections you received in January.

Everybody must be aware by now of the hypothesis that the impact of an asteroid with the earth caused a mass extinction at the end of the Cretaceous period, and in particular killed off the dinosaurs. The rapid faunal change at that time has been used ever since John Phillips' work in the mid 19th century to separate the Mesozoic (middle life) from the Cenozoic (recent life) periods of earth history. The asteroid impact theory stems from the discovery by Alvarez and others, in 1980, of a layer of clay bearing the rare metal iridium, precisely at the boundary, at several localities. Iridium is rare on earth but comparatively abundant in meteorites, and thus presumably in asteroids, which are essentially big meteorites that haven't fallen into one of the planets yet. To deliver the amount of iridium implied by their analyses, Alvarez and others estimated a size of 10km for the impacting body; big enough to deal the earth a heavy blow. Especially since the discovery of the probable impact crater in Mexico, as described to section C last year by Peter Maguire, most people now acccept that there was an impact. Whether it caused the extinctions is more controversial. Obviously, if it did so, one needs to establish that the extinctions took place simultaneously with the impact, or very shortly afterwards, and as the result of its effects.

It helps first to remove some misconceptions that are prevalent in the public mind, so lets start with the dinosaurs where misconceptions are rife.. Firstly, most dinosaur species were extinct long before the end of the Cretaceous, including for instance the giant *Diplodoccus* of the Jurassic. It was not "the dinosaurs" that died at the end of the Cretaceous but the last dinosaurs, which however still included such famous forms as

Tyrannosaurus, *Triceratops*, and hadrosaurs (duck-billed dinosaurs). Secondly, they did not die out because they were bad at being animals and "refused to evolve" (as though any animal group holds a meeting of its parliament to decide whether to evolve or not), although this seems to be an ineradicable metaphor in the popular and the broadsheet press. They were extremely good at their jobs, and of diverse ecology and mode of life. The late Cretaceous ones were not racial degenerates (look at *T. rex*). And they weren't out-competed by our ancestors the mammals either; these were small and rather insignificant at the time. There is some evidence that dinosaurs were declining in numbers in North America, the only area in which the record is any good, for much of the last part of the Cretaceous, but there is also evidence that their final demise was sudden; a hadrosaur footprint has been found only 37 cm below the iridium layer, in the kind of sediment that is deposited rapidly. A footprint, unlike a bone, cannot be a derived fossil.. But really, dinosaurs are much too rare to test the hypothesis conclusively. How can you tell that the last one you found was the last one that lived? This question in fact clouds the whole issue of the sudden-ness of extinctions (and originations) and has been dignified by a special title in the scientific literature: the Signor-Lipps Effect, and investigated by mathematical modelling. Good for impressing your friends.

Another thing that clouds the issue is the lack of distinction between an extinction and a catastrophe. An extinction need not be catastrophic, except of course to the creature concerned. The death of the dodo needs no special explanation, and had no effects beyond the island it inhabited. A (global) catastrophe can, but need not, cause particular extinctions: that at the end of the Cretaceous was real enough as I shall try to show, but it didn't extinguish all life or we wouldn't be here wondering about it. I think it is easy to show that there was a catastrophe at the end of the Cretaceous. There is a sudden dying-out of most marine plankton, as revealed especially in cores taken as part of the Ocean Drilling Project (see the latest issue of "Geology Today"). As these are the basis of the marine food chain, it is explicable that many other marine creatures suffered too. And this happens precisely at the base of the iridium clay. Carbon isotope ratios provide an index of the bulk of life in the surface waters of the sea (not just diversity of species); it collapses at the same boundary and remains suppressed for perhaps a million years.. On land, the North American forests abruptly died back, and the trees were replaced by ferns, much as modern forests are invaded by herbs such as rosebay after a fire. Not everything died, but recovery was slow. The survivors probably owed their success more to good luck than good genes.

Despite all this, some scientists remain unconvinced that the catastrophe caused the bulk of the extinctions. They maintain that extinctions were happening at an accelerated rate before the iridium layer was deposited, and continued afterwards. To some extent this is to be expected, because extinctions happen all the time and nobody supposes that all extinctions are caused by extra-terrestrial impacts. Views have become polarised, and it may be a while before consensus is reached. Meanwhile, I shall base my own views on the common-sense proposition that if a major impact battered the earth at the end of the Cretaceous, and if many things became extinct at that time, the two are likely to be related. It might not stand up in a court of law or in strict formal logic, but in geology we are used to dealing with probabilities.

So what was the killing mechanism? darkness? sudden cooling? greenhouse warming from CO2 emitted? wildfires? poisoning by acid rain? All have their proponents, and all have their critics. To discuss them would be another story, and at this stage an inconclusive one. So also would be the question of whether all mass -extinctions have a common cause, whether volcanism contributes too, and much else. The end Cretaceous catastrophe, by itself, is enough to be going on with. And of course if it really did cause the extinctions we are still living with its effects: indeed we are one of its effects.

Y chromosome diversity and the origins of the modern European populations

Zoë Rosser and Dr. Mark Jobling
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The Y chromosome is paternally inherited, and, for most of its length, escapes from recombination. Thus, unlike other chromosomes, which are continually being reshuffled by recombination, Ys are passed down from father to son virtually unchanged, except for the accumulation of mutations. We can draw a single tree relating together all modern Y chromosomes. Measurement of the frequencies of different Y chromosome types ('haplotypes') defined by these polymorphisms in different populations, will allow deductions to be made about migrations, admixture and mating practices in particular regions of the world (1, 2). The fact that the Y has a phenotype - maleness - means that patterns of Y haplotypes are likely to be different from those of maternally and biparentally inherited markers. A particular advantage of the Y chromosome is that it carries many different polymorphic marker systems with different mutation rates, and these different loci allow us to look at evolutionary events on different timescales.

Two models, demic and cultural diffusion, have been proposed to explain the early expansion of farming in Europe, starting about 10,000 years ago. Demic diffusion is the movement of people from the Near East (3), whereas cultural diffusion is the movement of ideas and not people (4). Previous research has shown relatively low variation in the maternally inherited mitochondrial DNA in Europe compared to the rest of the world, but higher variation has been observed in preliminary studies on the Y chromosome. This is why analysis of Y chromosome diversity within European populations should be more informative; preliminary results from Y data suggets that the history of Europe is more complex than is proposed by the two simple models.

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(2) Hammer, M. F. Spurdle, A. B. Karafet, T. Bonner, M. R. Wood, E. T. Novolletto, A. Malaspina, P. Mitchell, R. J. Horai, S. Jenkins, T. Zegura, S. L. (1997) The geographic distribution of human Y chromosome variation. Genetics **145**, 787-805.
(3) Ammerman, A. J. and Cavalli-Sforza, L. L. (1984) Neolithic transition and the genetics of populations in Europe (Princeton University Press, Princeton, NJ).
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UPDATE ON TRACE FOSSILS FROM THE CHARNIAN

by Ben Bland

The discovery of intense burrowing, including the trace fossil ***Teichichnus***, in the Brand group in 1992 was completely unexpected and has forced a major rethink of English geological history for the period 600 to 400 Ma (million years) ago. A description of the traces and sediments was published in 1995 (B.Bland & R. Goldring, Neues Jahrbuch fur Palaeontology, vol 195, pp 5-23) as a contribution to a festschrift volume marking the seventieth birthday of Dolf Seilacher, who chose the name ***Teichichnus*** back in 1955 for the distinctive vertical stacks of concave laminae left in sediment when animals move their burrows. Such burrows have never been found in rocks older than the Cambrian, so it was realised that the Brand Group must be Cambrian or younger, and comparison with local rocks at Nuneaton and more widely with Newfoundland, which is thought to have been very close at that time, shows that the Brand Group is almost certainly Cambrian. It is very rare for a rock sequence to be re-dated on the basis of trace fossils alone.

Although I had been interested in geology as a child, my interest in Pre-Cambrian life dates to 1963 when I was an undergraduate taking physics at Leicester. Young Roger Mason had discovered a strange frond fossil in the green turbidites of the golf course quarry in 1957, named ***Charnia*** by Trevor Ford in 1958, and I had purchased 'Genetics, Palaeontology and Evolution', edited by Jepsen, Simpson & Mayr. I visited Bradgate Park and Swithland Wood, but did not then have the experience to recognise traces. After graduation, my amateur energies were devoted to the Pre-Cambrian in Shropshire and France, and later in Newfoundland and the USA, with geological holidays in Scandinavia, Australia and Spain. For me, the Pre-Cambrian is an exciting time in evolution, when animals first appear in the fossil record, and rocks can be dated on the basis of the type and extent of tracks, trails and burrows, because the rate of evolution is so rapid. For example, with hindsight, the position of the Pre-Cambrian/Cambrian boundary in the Charnian lies between the rocks where bedding parting surfaces are rare (generally destroyed by bioturbation) and the Brand Group and the beds below, where they are abundant despite the cleavage.

I first tried to find Pre-Cambrian traces in the Charnian in 1992, on the way home from a visit to trace-fossil expert Peter Crimes in Liverpool. I stopped at Groby to look at stone walls and thought I could see faint mottling, suggesting burrows. That year I found abundant traces on many of the thousands of beautifully carved 17th to 20th century slate gravestones from the quarries in Swithland and Groby. It gradually dawned on me that these traces showed much to deep and intensive burrowing to be Pre-Cambrian, and the identification of ***Teichichnus*** confirmed that the Brand Group had to be much younger than everyone had previously thought - more like 515 Ma than 603 Ma.

This discovery undermined the accepted picture, which was that the whole of the Charnian was older than the Markfieldite intruding it at Cliffe Hill quarry, thought to be the same age as the markfieldite intrusion near Nuneaton, dated at 603 Ma. The whole of the Charnian had been heated and cleaved before the Cambrian - i.e. before 540 Ma, as the Midlands Craton collided with and became part of England. Since the Brand Group slate is Cambrian, probably 515 Ma, the cleavage and the join with England

must be younger (now thought to be Acadian (Siluro-Devonian - BGS work in progress). Also,the Charnian in Newfoundland has been dated at 565 Ma, again much younger than 565 Ma.

My belief is that the solution to this apparent conflict is just like the explanation of *Teichichnus*: the Charnian spans a long time interval, so that the top slice - the Brand Group - is Cambrian deposited between c. 520 to 546 Ma. These deposits in turn rest, after a gap of 36 Ma, on much older sediments deposited between c. 610 to 604 Ma and subsequently intruded by markfieldite aged 603 Ma. The markfieldite in Cliffe Hill quarry intrudes sediments that are quite different from the turbidites in which *Charnia* is found, and more closely resemble beds well below *Charnia*. For me, the best supporting evidence for this picture is that some fossils at Cliffe Hill quarry differ from those seen with *Charnia* and *Cyclomedusa*, and more closely resemble those seen in sediments much deeper elsewhere in the Charnian at Longcliffe and at Nuneaton. If this is not the explanation, then the markfieldite must be much younger than 603 Ma.