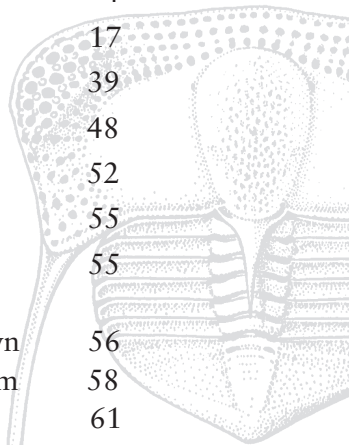


The Palaeontology Newsletter

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Reminder: The deadline for copy for Issue no. 93 is 17th October 2016.

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Editorial

For the last few months, many of us will have been following closely the evolution of the UK's referendum campaign on whether or not to remain within the EU, aka 'Brexit'. The referendum result to leave the EU has instigated a period of political and economic uncertainty that has the potential to impact not only on the UK but on a global scale. 'Brexit' has been greeted with dismay and concern by many scientists in the UK, not least because scientific research there is supported heavily by EU funds. It is not yet clear whether the UK will negotiate continued access to major EU funding schemes such as Horizon 2020, and if not (or if not successful), whether national funding programmes will make up the shortfall. Funding aside, the departure of the UK from the EU has ramifications for thousands of researchers of non-UK nationalities, both those who are currently working in the UK and those considering or seeking work there. Potential impediments to the future of scientific research in the UK relate to visa requirements and moves by the UK government to restrict the free flow of people. One particularly damaging result of the referendum, which has already been voiced by scientists via social and mainstream media, is the perception that non-UK nationals may not be welcome. At a broader level, the campaign has even sparked calls for similar referenda to be held in several other EU countries.

The true impact of 'Brexit' may not be obvious for years, but it may particularly affect research in disciplines or fields that are not seen as priorities for social and economic development, especially if there is a net tightening of the purse strings for research funding. Indeed similar 'refocusing' of national research agendas has already taken place in other EU countries (including the Republic of Ireland) and further afield. In this political climate, independent and stable sources of funding – such as the Palaeontological Association – may play an increasingly important role in facilitating access to research monies. Our comprehensive programme of research grants supports the research of members of the Association at all career stages and regardless of nationality. Details of these grants are provided in each issue of the Association Newsletter and we urge members to apply and to raise awareness of these funding sources among colleagues and students.

Maria McNamara

Newsletter Editor

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Association Business

Conversion to a Charitable Incorporated Organisation

Since 2013, charities in the UK have had the option to become incorporated by converting to a charitable incorporated organisation (CIO). The main benefits of this new structure are that the charity becomes a legal entity with the ability to conduct business in its own name, and has limited liability so that its members do not have to contribute in the event of financial loss. In early 2016, following discussion with a legal advisor from the Foundation of Science and Technology, Council agreed that the Palaeontological Association should convert to a Charitable Incorporated Organisation (CIO), and that this change should take place as soon as possible. Conversion to a CIO requires the adoption of a new constitution.

On 15th February 2016, the proposal to convert to a CIO and accept the new constitution was circulated to members. Members were asked to vote on Council's proposal to proceed with conversion to the CIO and adopt the new constitution.

An Extraordinary General Meeting was called for this purpose on Wednesday 16th March 2016 at 1:00pm, in the Royal School of Mines, Department of Earth Sciences and Engineering, Imperial College, London. Members were also able to vote electronically. The Minutes of this Extraordinary General Meeting and details of the proposed new Constitution are published below.

Members voted overwhelmingly in favour of Council's proposal that the Association should convert to a CIO and adopt the proposed new Constitution.

Formal documentation was submitted to the Charity Commission in April 2016 and it is anticipated that the process will be completed in the summer.

DRAFT EGM MINUTES 2016

Minutes of the Extraordinary General Meeting held on Wednesday, 16th March at 1:00pm in Room G39, Royal School of Mines, Department of Earth Sciences and Engineering, Imperial College, London.

- 1. Apologies for absence.** Ms G. Benevento, Dr T. J. Challands, Ms H. Drage, Ms T. Ford, Dr C. T. S. Little, Dr M. Munt, Ms R. Nathan, Dr I. Rahman, Dr A. R. T. Spencer.
- 2. Voting on Council's proposal that the Association should convert to a Charitable Incorporated Organisation.** The President, Professor D. A. T. Harper, outlined the background and rationale for Council's proposal, which had been circulated to the members via e-mail in February. Following an opportunity for questions, members present who had not already voted via e-mail were given the opportunity to vote on the proposal.
- 3. Results.** The Executive Officer, Dr J. Hellawell, confirmed the results of the ballot. Including votes received by e-mail, 504 members voted to support Council's proposal to convert to a Charitable Incorporated Organisation (CIO) and adopt the new constitution; three voted against;



and one abstained. Following this mandate from the membership, Prof. Harper announced that Council would move forward with the process of conversion to a CIO and would update the membership in due course.

4. **AOB.** There was no additional business, and the meeting was closed.

Constitution of The Palaeontological Association

Date of constitution (last amended): 16th March 2016.

1. Name

The name of the Charitable Incorporated Organisation (“the CIO”) is The Palaeontological Association.

2. National location of principal office

The CIO must have a principal office in England or Wales. The principal office of the CIO is in England.

3. Objects

The objects of the CIO are to advance education for the public benefit in Palaeontology and its allied sciences by:

- promoting research and publishing the useful results thereof;
- holding public meetings for the reading of original papers and the delivery of lectures;
- extending knowledge of the science through demonstration and publication;
- awarding grants and bursaries; and
- by such other means as the council of charity trustees may determine.

Nothing in this constitution shall authorise an application of the property of the CIO for the purposes which are not charitable in accordance with section 7 of the Charities and Trustee Investment (Scotland) Act 2005 and section 2 of the Charities Act (Northern Ireland) 2008.

4. Powers

The CIO has power to do anything which is calculated to further its objects or is conducive or incidental to doing so. In particular, the CIO’s powers include power to:

- (1) borrow money and to charge the whole or any part of its property as security for the repayment of the money borrowed. The CIO must comply as appropriate with sections 124 and 125 of the Charities Act 2011 if it wishes to mortgage land;
- (2) buy, take on lease or in exchange, hire or otherwise acquire any property and to maintain and equip it for use;
- (3) sell, lease or otherwise dispose of all or any part of the property belonging to the CIO.
In exercising this power, the CIO must comply as appropriate with sections 117 and 119-123 of the Charities Act 2011;
- (4) employ and remunerate such staff as are necessary for carrying out the work of the CIO. The CIO may employ or remunerate a charity trustee only to the extent that it is permitted to do so by clause 6 (Benefits and payments to charity trustees and connected persons) and provided it complies with the conditions of those clauses;
- (5) deposit or invest funds, employ a professional fund-manager, and arrange for the investments or other property of the CIO to be held in the name of a nominee, in the same manner and subject to the same conditions as the trustees of a trust are permitted to do by the Trustee Act 2000.

5. Application of income and property

- (1) The income and property of the CIO must be applied solely towards the promotion of the objects.
 - (a) A charity trustee is entitled to be reimbursed from the property of the CIO or may pay out of such property reasonable expenses properly incurred by him or her when acting on behalf of the CIO.



- (b) A charity trustee may benefit from trustee indemnity insurance cover purchased at the CIO's expense in accordance with, and subject to, the conditions in section 189 of the Charities Act 2011.
- (2) None of the income or property of the CIO may be paid or transferred directly or indirectly by way of dividend, bonus or otherwise by way of profit to any member of the CIO. This does not prevent a member who is not also a charity trustee receiving:
 - (a) a benefit from the CIO as a beneficiary of the CIO;
 - (b) reasonable and proper remuneration for any goods or services supplied to the CIO.
- (3) Nothing in this clause shall prevent a charity trustee or connected person receiving any benefit or payment which is authorised by Clause 6.

6. Benefits and payments to charity trustees and connected persons

(1) General provisions

No charity trustee or connected person may:

- (a) buy or receive any goods or services from the CIO on terms preferential to those applicable to members of the public;
- (b) sell goods, services, or any interest in land to the CIO;
- (c) be employed by, or receive any remuneration from, the CIO;
- (d) receive any other financial benefit from the CIO;

unless the payment or benefit is permitted by sub-clause (2) of this clause, or authorised by the court, or the prior written consent of the Charity Commission ("the Commission") has been obtained. In this clause, a "financial benefit" means a benefit, direct or indirect, which is either money or has a monetary value.

(2) Scope and powers permitting trustees' or connected persons' benefits

- (a) A charity trustee or connected person may receive a benefit from the CIO as a beneficiary provided that it is available generally to the beneficiaries of the CIO.
- (b) A charity trustee or connected person may enter into a contract for the supply of services, or of goods that are supplied in connection with the provision of services, to the CIO where that is permitted in accordance with, and subject to the conditions in, section 185 to 188 of the Charities Act 2011.
- (c) Subject to sub-clause (3) of this clause a charity trustee or connected person may provide the CIO with goods that are not supplied in connection with services provided to the CIO by the charity trustee or connected person.
- (d) A charity trustee or connected person may receive interest on money lent to the CIO at a reasonable and proper rate which must be not more than the Bank of England bank rate (also known as the base rate).
- (e) A charity trustee or connected person may receive rent for premises let by the trustee or connected person to the CIO. The amount of the rent and the other terms of the lease must be reasonable and proper. The charity trustee concerned must withdraw from any meeting at which such a proposal or the rent or other terms of the lease are under discussion.
- (f) A charity trustee or connected person may take part in the normal trading and fundraising activities of the CIO on the same terms as members of the public.

(3) Payment for supply of goods only – controls

The CIO and its charity trustees may only rely upon the authority provided by sub-clause (2)(c) of this clause if each of the following conditions is satisfied:

- (a) The amount or maximum amount of the payment for the goods is set out in a written agreement between the CIO and the charity trustee or connected person supplying the goods ("the supplier").
- (b) The amount or maximum amount of the payment for the goods does not exceed what is reasonable in the circumstances for the supply of the goods in question.
- (c) The other charity trustees are satisfied that it is in the best interests of the CIO to contract with the supplier rather than with someone who is not a charity trustee or connected person. In reaching that decision the charity trustees must balance the advantage of contracting with a charity trustee or connected person against the disadvantages of doing so.



- (d) The supplier is absent from the part of any meeting at which there is discussion of the proposal to enter into a contract or arrangement with him or her or it with regard to the supply of goods to the CIO.
- (e) The supplier does not vote on any such matter and is not to be counted when calculating whether a quorum of charity trustees is present at the meeting.
- (f) The reason for their decision is recorded by the charity trustees in the minute book.
- (g) A majority of the charity trustees then in office are not in receipt of remuneration or payments authorised by clause 6.

(4) In sub-clauses (2) and (3) of this clause:

- (a) “the CIO” includes any company in which the CIO:
 - (i) holds more than 50% of the shares; or
 - (ii) controls more than 50% of the voting rights attached to the shares; or
 - (iii) has the right to appoint one or more directors to the board of the company.
- (b) “connected person” includes any person within the definition set out in clause 30 (Interpretation).

7. Conflicts of interest and conflicts of loyalty

A charity trustee must:

- (1) declare the nature and extent of any interest, direct or indirect, which he or she has in a proposed transaction or arrangement with the CIO or in any transaction or arrangement entered into by the CIO which has not previously been declared; and
- (2) absent himself or herself from any discussions of the charity trustees in which it is possible that a conflict of interest will arise between his or her duty to act solely in the interests of the CIO and any personal interest (including but not limited to any financial interest).

Any charity trustee absenting himself or herself from any discussions in accordance with this clause must not vote or be counted as part of the quorum in any decision of the charity trustees on the matter.

8. Liability of members to contribute to the assets of the CIO if it is wound up

If the CIO is wound up, the members of the CIO have no liability to contribute to its assets and no personal responsibility for settling its debts and liabilities.

9. Membership of the CIO

(1) Admission of new members

(a) Eligibility

Membership of the CIO is open to anyone who is interested in furthering its purposes, and who, by applying for membership, has indicated their agreement to become a member and acceptance of the duty of members set out in sub-clause (3) of this clause.

A member may be an individual, a corporate body, or an organisation which is not incorporated.

(b) Admission procedure

The charity trustees:

- (i) may require applications for membership to be made in any reasonable way that they decide;
- (ii) may refuse an application for membership if they believe that it is in the best interests of the CIO for them to do so;
- (iii) shall, if they decide to refuse an application for membership, give the applicant their reasons for doing so, within 21 days of the decision being taken, and give the applicant the opportunity to appeal against the refusal; and
- (iv) shall give fair consideration to any such appeal, and shall inform the applicant of their decision, but any decision to confirm refusal of the application for membership shall be final.

(2) Transfer of membership

Membership of the CIO cannot be transferred to anyone else.

(3) Duty of members

It is the duty of each member of the CIO to exercise his or her powers as a member of the CIO in the way he or she decides in good faith would be most likely to further the purposes of the CIO.

(4) Termination of membership

- (a) Membership of the CIO comes to an end if:



- (i) the member dies, or, in the case of an organisation (or the representative of an organisation) that organisation ceases to exist; or
 - (ii) the member sends a notice of resignation to the charity trustees; or
 - (iii) any sum of money owed by the member to the CIO is not paid in full within six months of its falling due; or
 - (iv) the charity trustees decide that it is in the best interests of the CIO that the member in question should be removed from membership, and pass a resolution to that effect.
- (b) Before the charity trustees take any decision to remove someone from membership of the CIO they must:
- (i) inform the member of the reasons why it is proposed to remove him, her or it from membership;
 - (ii) give the member at least 21 clear days notice in which to make representations to the charity trustees as to why he, she or it should not be removed from membership;
 - (iii) at a duly constituted meeting of the charity trustees, consider whether or not the member should be removed from membership;
 - (iv) consider at that meeting any representations which the member makes as to why the member should not be removed; and
 - (v) allow the member, or the member's representative, to make those representations in person at that meeting, if the member so chooses.

(5) Membership fees

The CIO may require members to pay reasonable membership fees to the CIO, which may vary depending on the class of membership.

(6) Classes of Membership

- (a) The CIO has four classes of individual membership: Ordinary, Student, Retired and Honorary.
- (b) Ordinary, Student, Retired and Honorary members are considered to be full voting members of the CIO and eligible to take part in the government of the CIO as described in this constitution.
- (c) The rights and obligations of any such members (including payment of membership fees), conditions for admission to, and termination of, membership of any such class of members are determined by the charity trustees.

(7) Informal or associate (non-voting) membership

- (a) Corporate bodies or organisations which are not incorporated may only be admitted as non-voting Institutional Members of the CIO and are ineligible to take part in the government of the CIO.
- (b) The charity trustees may create associate or other classes of non-voting membership, and may determine the rights and obligations of any such members (including payment of membership fees), and the conditions for admission to, and termination of, membership of any such class of members.
- (c) Other references in this constitution to “members” and “membership” do not apply to non-voting members, and non-voting members do not qualify as members for any purpose under the Charities Acts, General Regulations or Dissolution Regulations.

10. Members' decisions

(1) General provisions

Except for those decisions that must be taken in a particular way as indicated in sub-clause (4) of this clause, decisions of the members of the CIO may be taken either by vote at a general meeting as provided in sub-clause (2) of this clause or by written resolution as provided in sub-clause (3) of this clause.

(2) Taking ordinary decisions by vote

Subject to sub-clause (4) of this clause, any decision of the members of the CIO may be taken by means of a resolution at a general meeting. Such a resolution may be passed by a simple majority of votes cast at the meeting (including votes cast by postal or email ballot).

(3) Taking ordinary decisions by written resolution without a general meeting

- (a) Subject to sub-clause (4) of this clause, a resolution in writing agreed by a simple majority of all the members who would have been entitled to vote upon it had it been proposed at a general meeting shall be effective, provided that:



- (i) a copy of the proposed resolution has been sent to all the members eligible to vote; and
 - (ii) a simple majority of members has signified its agreement to the resolution in a document or documents which are received at the principal office within the period of 28 days beginning with the circulation date. The document signifying a member's agreement must be authenticated by their signature (or in the case of an organisation which is a member, by execution according to its usual procedure), by a statement of their identity accompanying the document, or in such other manner as the CIO has specified.
- (b) The resolution in writing may comprise several copies to which one or more members has signified their agreement.
- (c) Eligibility to vote on the resolution is limited to members who are members of the CIO on the date when the proposal is first circulated in accordance with paragraph (a) above.
- (d) Not less than 10% of the members of the CIO may request the charity trustees to make a proposal for decision by the members.
- (e) The charity trustees must within 21 days of receiving such a request comply with it if:
- (i) The proposal is not frivolous or vexatious, and does not involve the publication of defamatory material;
 - (ii) The proposal is stated with sufficient clarity to enable effect to be given to it if it is agreed by the members; and
 - (iii) Effect can lawfully be given to the proposal if it is so agreed.
- (f) Sub-clauses (a) to (c) of this clause apply to a proposal made at the request of members.

(4) Decisions that must be taken in a particular way

- (a) Any decision to remove a trustee must be taken in accordance with clause 15(2).
- (b) Any decision to amend this constitution must be taken in accordance with clause 28 of this constitution.
- (c) Any decision to wind up or dissolve the CIO must be taken in accordance with clause 29 of this constitution. Any decision to amalgamate or transfer the undertaking of the CIO to one or more other CIOs must be taken in accordance with the provisions of the Charities Act 2011.

11. General meetings of members

(1) Types of general meeting

There must be an annual general meeting (AGM) of the members of the CIO. The first AGM must be held within 18 months of the registration of the CIO, and subsequent AGMs must be held at intervals of not more than 15 months. The AGM must receive the annual statement of accounts (duly audited or examined where applicable) and the trustees' annual report, and must elect trustees as required under clause 13.

Other general meetings of the members of the CIO may be held at any time.

All general meetings must be held in accordance with the following provisions.

(2) Calling general meetings

- (a) The charity trustees:
 - (i) must call the annual general meeting of the members of the CIO in accordance with sub-clause (1) of this clause, and identify it as such in the notice of the meeting; and
 - (ii) may call any other general meeting of the members at any time.
- (b) The charity trustees must, within 21 days, call a general meeting of the members of the CIO if:
 - (i) they receive a request to do so from at least 10% of the members of the CIO; and
 - (ii) the request states the general nature of the business to be dealt with at the meeting, and is authenticated by the member(s) making the request.
- (c) If, at the time of any such request, there has not been any general meeting of the members of the CIO for more than 12 months, then sub-clause (b)(i) of this clause shall have effect as if 5% were substituted for 10%.
- (d) Any such request may include particulars of a resolution that may properly be proposed, and is intended to be proposed, at the meeting.
- (e) A resolution may only properly be proposed if it is lawful, and is not defamatory, frivolous or vexatious.



- (f) Any general meeting called by the charity trustees at the request of the members of the CIO must be held within 28 days from the date on which it is called.
- (g) If the charity trustees fail to comply with this obligation to call a general meeting at the request of its members, then the members who requested the meeting may themselves call a general meeting.
- (h) A general meeting called in this way must be held not more than three months after the date when the members first requested the meeting.
- (i) The CIO must reimburse any reasonable expenses incurred by the members calling a general meeting by reason of the failure of the charity trustees to duly call the meeting, but the CIO shall be entitled to be indemnified by the charity trustees who were responsible for such failure.

(3) Notice of general meetings

- (a) The charity trustees, or, as the case may be, the relevant members of the CIO, must give at least 14 clear days notice of any general meeting to all of the members, and to any charity trustee of the CIO who is not a member.
- (b) If it is agreed by not less than 90% of all members of the CIO, any resolution may be proposed and passed at the meeting even though the requirements of sub-clause (3)(a) of this clause have not been met. This sub-clause does not apply where a specified period of notice is strictly required by another clause in this constitution, by the Charities Act 2011 or by the General Regulations.
- (c) The notice of any general meeting must:
 - (i) state the time and date of the meeting;
 - (ii) give the address at which the meeting is to take place;
 - (iii) give particulars of any resolution which is to be moved at the meeting, and of the general nature of any other business to be dealt with at the meeting; and
 - (iv) if a proposal to alter the constitution of the CIO is to be considered at the meeting, include the text of the proposed alteration;
 - (v) include, with the notice for the AGM, the annual statement of accounts and trustees' annual report, details of persons standing for election or re-election as trustee, or where allowed under clause 22, details of where the information may be found on the CIO's website.
- (d) Proof that an envelope containing a notice was properly addressed, prepaid and posted; or that an electronic form of notice was properly addressed and sent, shall be conclusive evidence that the notice was given. Notice shall be deemed to be given 48 hours after it was posted or sent.
- (e) The proceedings of a meeting shall not be invalidated because a member who was entitled to receive notice of the meeting did not receive it because of accidental omission by the CIO.

(4) Chairing of general meetings

The person nominated as chair by the charity trustees under clause 19(2), shall, if present at the general meeting and willing to act, preside as chair of the meeting. Subject to that, the members of the CIO who are present at a general meeting shall elect a chair to preside at the meeting.

(5) Quorum at general meetings

- (a) No business may be transacted at any general meeting of the members of the CIO unless a quorum is present when the meeting starts.
- (b) Subject to the following provisions, the quorum for general meetings shall be the greater of 3% or 20 members.
- (c) If the meeting has been called by or at the request of the members and a quorum is not present within 15 minutes of the starting time specified in the notice of the meeting, the meeting is closed.
- (d) If the meeting has been called in any other way and a quorum is not present within 15 minutes of the starting time specified in the notice of the meeting, the chair must adjourn the meeting. The date, time and place at which the meeting will resume must either be announced by the chair or be notified to the CIO's members at least seven clear days before the date on which it will resume.
- (e) If a quorum is not present within 15 minutes of the start time of the adjourned meeting, the member or members present at the meeting constitute a quorum.



- (f) If at any time during the meeting a quorum ceases to be present, the meeting may discuss issues and make recommendations to the trustees but may not make any decisions. If decisions are required which must be made by a meeting of the members, the meeting must be adjourned.

(6) Voting at general meetings

- (a) Any decision other than one falling within clause 10(4) (Decisions that must be taken in a particular way) shall be taken by a simple majority of votes cast at the meeting (including postal votes if applicable). Every member has one vote.
- (b) A resolution put to the vote of a meeting shall be decided on a show of hands, unless (before or on the declaration of the result of the show of hands) a poll is duly demanded. A poll may be demanded by the chair or by at least 10% of the members present in person at the meeting.
- (c) A poll demanded on the election of a person to chair the meeting or on a question of adjournment must be taken immediately. A poll on any other matter shall be taken, and the result of the poll shall be announced, in such manner as the chair of the meeting shall decide, provided that the poll must be taken, and the result of the poll announced, within 30 days of the demand for the poll.
- (d) A poll may be taken:
 - (i) at the meeting at which it was demanded; or
 - (ii) at some other time and place specified by the chair; or
 - (iii) through the use of postal or electronic communications.
- (e) In the event of an equality of votes, whether on a show of hands or on a poll, the chair of the meeting shall have a second, or casting vote.
- (f) Any objection to the qualification of any voter must be raised at the meeting at which the vote is cast and the decision of the chair of the meeting shall be final.

(7) Postal Voting

- (a) The CIO may, if the charity trustees so decide, allow the members to vote by post or electronic mail ("email") to elect charity trustees or to make a decision on any matter that is being decided at a general meeting of the members.
- (b) The charity trustees must appoint at least two persons independent of the CIO to serve as scrutineers to supervise the conduct of the postal/email ballot and the counting of votes.
- (c) If postal and/or email voting is to be allowed on a matter, the CIO must send to members of the CIO not less than 21 days before the deadline for receipt of votes cast in this way:
 - (i) a notice by email, if the member has agreed to receive notices in this way under clause 22, including an explanation of the purpose of the vote and the voting procedure to be followed by the member, and a voting form capable of being returned by email or post to the CIO, containing details of the resolution being put to a vote, or of the candidates for election, as applicable;
 - (ii) a notice by post to all other members, including a written explanation of the purpose of the postal vote and the voting procedure to be followed by the member; and a postal voting form containing details of the resolution being put to a vote, or of the candidates for election, as applicable.
- (d) The voting procedure must require all forms returned by post to be in an envelope with the member's name and signature, and nothing else, on the outside, inside another envelope addressed to 'The Scrutineers for the Palaeontological Association', at the CIO's principal office or such other postal address as is specified in the voting procedure.
- (e) The voting procedure for votes cast by email must require the member's name to be at the top of the email, and the email must be authenticated in the manner specified in the voting procedure.
- (f) Email votes must be returned to an email address used only for this purpose and must be accessed only by a scrutineer.
- (g) The voting procedure must specify the closing date and time for receipt of votes, and must state that any votes received after the closing date or not complying with the voting procedure will be invalid and not be counted.
- (h) The scrutineers must make a list of names of members casting valid votes, and a separate list of members casting votes which were invalid. These lists must be provided to a charity trustee



or other person overseeing admission to, and voting at, the general meeting. A member who has cast a valid postal or email vote must not vote at the meeting, and must not be counted in the quorum for any part of the meeting on which he, she or it has already cast a valid vote. A member who has cast an invalid vote by post or email is allowed to vote at the meeting and counts towards the quorum.

- (i) For postal votes, the scrutineers must retain the internal envelopes (with the member's name and signature). For email votes, the scrutineers must cut off and retain any part of the email that includes the member's name. In each case, a scrutineer must record on this evidence of the member's name that the vote has been counted, or if the vote has been declared invalid, the reason for such declaration.
- (j) Votes cast by post or email must be counted by all the scrutineers before the meeting at which the vote is to be taken. The scrutineers must provide to the person chairing the meeting written confirmation of the number of valid votes received by post and email and the number of votes received which were invalid.
- (k) The result of the postal/email ballot must not be disclosed until after votes taken by hand or by poll at the meeting, or by poll after the meeting, have been counted. Only at this point shall the scrutineers declare the result of the valid votes received, and these votes shall be included in the declaration of the result of the vote.
- (l) Following the final declaration of the result of the vote, the scrutineers must provide to a charity trustee or other authorised person bundles containing the evidence of members submitting valid postal votes; evidence of members submitting valid email votes; evidence of invalid votes; the valid votes; and the invalid votes.
- (m) Any dispute about the conduct of a postal or email ballot must be referred initially to a panel set up by the charity trustees, to consist of two trustees and two persons independent of the CIO. If the dispute cannot be satisfactorily resolved by the panel, it must be referred to the Electoral Reform Services.

(8) Adjournment of meetings

The chair may with the consent of a meeting at which a quorum is present (and shall if so directed by the meeting) adjourn the meeting to another time and/or place. No business may be transacted at an adjourned meeting except business which could properly have been transacted at the original meeting.

12. Charity trustees

(1) Functions and duties of charity trustees

The charity trustees shall manage the affairs of the CIO and may for that purpose exercise all the powers of the CIO. It is the duty of each charity trustee:

- (a) to exercise his or her powers and to perform his or her functions as a trustee of the CIO in the way he or she decides in good faith would be most likely to further the purposes of the CIO; and
- (b) to exercise, in the performance of those functions, such care and skill as is reasonable in the circumstances having regard in particular to:
 - (i) any special knowledge or experience that he or she has or holds himself or herself out as having; and
 - (ii) if he or she acts as a charity trustee of the CIO in the course of a business or profession, to any special knowledge or experience that it is reasonable to expect of a person acting in the course of that kind of business or profession.

(2) Eligibility for trusteeship

- (a) Every charity trustee must be a natural person.
- (b) No one may be appointed as a charity trustee:
 - if he or she is under the age of 16 years; or
 - if he or she would automatically cease to hold office under the provisions of clause 15(1)(f).
- (c) No one is entitled to act as a charity trustee whether on appointment or on any re-appointment until he or she has expressly acknowledged, in whatever way the charity trustees decide, his or her acceptance of the office of charity trustee.



(3) Number of charity trustees

- (a) There must be at least six charity trustees. If the number falls below this minimum, the remaining trustee or trustees may act only to call a meeting of the charity trustees, or appoint a new charity trustee.
- (b) The maximum number of charity trustees is 20. The charity trustees may not appoint any charity trustee if as a result the number of charity trustees would exceed the maximum.
- (c) The charity trustees shall form a Council that includes the following officers: a President, and, at least, two Vice-Presidents, a Treasurer, a Secretary, an Editor-in-Chief and such other officers as the Council may from time to time determine.
- (d) Terms of service for officers shall be flexible but should not exceed two years for President and Vice-Presidents, and five years for Secretary, Editor-in-Chief and Treasurer. Other members of the Council shall be elected for a term of three years.

(4) First charity trustees

The first charity trustees of the CIO are: Prof. D.A.T. Harper (President), Dr R.J. Butler, Dr C. Buttler, Dr T.J. Challands, Dr F.L. Gill, Dr L.G. Herringshaw, Dr C.T.S. Little, Dr M.E. McNamara, Dr M. Munt, Dr I.A. Rahman, Prof. E.J. Rayfield (Vice President), Dr M. Ruta, Dr A.B. Smith (Editor-in-Chief), Dr A.R.T. Spencer, Prof. R.J. Twitchett (Secretary), Prof. T.R.A. Vandenbroucke, Dr D.J. Ward (Vice President), Prof. C.H. Wellman and Dr P. Winrow (Treasurer).

13. Appointment of charity trustees

- (1) Charity trustees are appointed at the annual general meeting of members of the CIO for a term of two, three or five years in accordance with clause 12(3)(d), after which they retire.
- (2) Elections shall be held annually to fill any vacancies arising. Nominations from members of the CIO should be received by the Secretary not later than three calendar months before the annual general meeting.
- (3) Vacancies may be filled by the decision of the members at the annual general meeting. If nominations exceed vacancies a ballot shall be conducted at the annual general meeting and provision shall be made for a postal ballot for members unable to attend the meeting.
- (4) Any vacancies not filled at the annual general meeting may be filled as provided in sub-clause (5) of this clause.
- (5) The members or the charity trustees may at any time decide to appoint a new charity trustee, whether in place of a charity trustee who has retired or been removed in accordance with clause 15, or as an additional charity trustee, provided that the limit specified in clause 12(3) on the number of charity trustees would not as a result be exceeded;
- (6) A person so appointed by the members of the CIO shall retire in accordance with the provisions of sub-clauses (2) and (3) of this clause. A person so appointed by the charity trustees shall retire at the conclusion of the next annual general meeting after the date of his or her appointment, and shall not be counted for the purpose of determining which of the charity trustees is to retire by rotation at that meeting.

14. Information for new charity trustees

The charity trustees will make available to each new charity trustee, on or before his or her first appointment:

- (a) a copy of this constitution and any amendments made to it; and
- (b) a copy of the CIO's latest trustees' annual report and statement of accounts.

15. Retirement and removal of charity trustees

- (1) A charity trustee ceases to hold office if he or she:
 - (a) retires by notifying the CIO in writing (but only if enough charity trustees will remain in office when the notice of resignation takes effect to form a quorum for meetings);
 - (b) is absent without the permission of the charity trustees from three consecutive meetings and the trustees resolve that his or her office be vacated;
 - (c) dies;



- (d) in the written opinion, given to the CIO, of a registered medical practitioner treating that person, has become physically or mentally incapable of acting as a trustee and may remain so for more than three months;
 - (e) is removed by the members of the CIO in accordance with sub-clause (2) of this clause; or
 - (f) is disqualified from acting as a charity trustee by virtue of section 178-180 of the Charities Act 2011 (or any statutory re-enactment or modification of that provision).
- (2) A charity trustee shall be removed from office if a resolution to remove that trustee is proposed at a general meeting of the members called for that purpose and properly convened in accordance with clause 11, and the resolution is passed by a majority of votes cast at the meeting.
- (3) A resolution to remove a charity trustee in accordance with this clause shall not take effect unless the individual concerned has been given at least 14 clear days' notice in writing that the resolution is to be proposed, specifying the circumstances alleged to justify removal from office, and has been given a reasonable opportunity of making oral and/or written representations to the members of the CIO.

16. Reappointment of charity trustees

Any person who retires as a charity trustee by rotation or by giving notice to the CIO is eligible for reappointment. A charity trustee who has served for three consecutive terms may not be reappointed for a fourth consecutive term but may be reappointed after an interval of at least one year.

17. Taking of decisions by charity trustees

Any decision may be taken either:

- at a meeting of the charity trustees; or
- by resolution in writing or electronic form agreed by all of the charity trustees, which may comprise either a single document or several documents containing the text of the resolution in like form to each of which one or more charity trustees has signified their agreement.

18. Delegation by charity trustees

- (1) The charity trustees may delegate any of their powers or functions to a committee or committees, and, if they do, they must determine the terms and conditions on which the delegation is made. The charity trustees may at any time alter those terms and conditions, or revoke the delegation.
- (2) This power is in addition to the power of delegation in the General Regulations and any other power of delegation available to the charity trustees, but is subject to the following requirements:
- (a) a committee may consist of two or more persons, but at least one member of each committee must be a charity trustee;
 - (b) the acts and proceedings of any committee must be brought to the attention of the charity trustees as a whole as soon as is reasonably practicable; and
 - (c) the charity trustees shall from time to time review the arrangements which they have made for the delegation of their powers.

19. Meetings and proceedings of charity trustees

(1) Calling meetings

- (a) Any charity trustee may call a meeting of the charity trustees.
- (b) Subject to that, the charity trustees shall decide how their meetings are to be called, and what notice is required.

(2) Chairing of meetings

The charity trustees may appoint one of their number to chair their meetings and may at any time revoke such appointment. If no-one has been so appointed, or if the person appointed is unwilling to preside or is not present within 10 minutes after the time of the meeting, the charity trustees present may appoint one of their number to chair that meeting.

(3) Procedure at meetings

- (a) No decision shall be taken at a meeting unless a quorum is present at the time when the decision is taken. The quorum is six charity trustees. A charity trustee shall not be counted in the quorum present when any decision is made about a matter upon which he or she is not entitled to vote.



- (b) Questions arising at a meeting shall be decided by a majority of those eligible to vote.
- (c) In the case of an equality of votes, the chair shall have a second or casting vote.

(4) Participation in meetings by electronic means

- (a) A meeting may be held by suitable electronic means agreed by the charity trustees in which each participant may communicate with all the other participants.
- (b) Any charity trustee participating at a meeting by suitable electronic means agreed by the charity trustees in which a participant or participants may communicate with all the other participants shall qualify as being present at the meeting.
- (c) Meetings held by electronic means must comply with rules for meetings, including chairing and the taking of minutes.

20. Saving provisions

- (1) Subject to sub-clause (2) of this clause, all decisions of the charity trustees, or of a committee of charity trustees, shall be valid notwithstanding the participation in any vote of a charity trustee:
 - who was disqualified from holding office;
 - who had previously retired or who had been obliged by the constitution to vacate office;
 - who was not entitled to vote on the matter, whether by reason of a conflict of interest or otherwise;

if, without the vote of that charity trustee and that charity trustee being counted in the quorum, the decision has been made by a majority of the charity trustees at a quorate meeting.

- (2) Sub-clause (1) of this clause does not permit a charity trustee to keep any benefit that may be conferred upon him or her by a resolution of the charity trustees or of a committee of charity trustees if, but for clause (1), the resolution would have been void, or if the charity trustee has not complied with clause 7.

21. Execution of documents

- (1) The CIO shall execute documents by signature.
- (2) A document is validly executed by signature if it is signed by two of the senior officers of Council as listed in clause 12(3)(c), namely the President, Vice-Presidents, Treasurer, Secretary or Editor-in-Chief, or if it is signed by the Executive Officer and one of the senior officers of Council.

22. Use of electronic communications

(1) General

The CIO will comply with the requirements of the Communications Provisions in the General Regulations and in particular:

- (a) the requirement to provide within 21 days to any member on request a hard copy of any document or information sent to the member otherwise than in hard copy form;
- (b) any requirements to provide information to the Commission in a particular form or manner.

(2) To the CIO

Any member or charity trustee of the CIO may communicate electronically with the CIO to an address specified by the CIO for the purpose, so long as the communication is authenticated in a manner which is satisfactory to the CIO.

(3) By the CIO

- (a) Any member or charity trustee of the CIO, by providing the CIO with his or her email address or similar, is taken to have agreed to receive communications from the CIO in electronic form at that address, unless the member has indicated to the CIO his or her unwillingness to receive such communications in that form.
- (b) The charity trustees may, subject to compliance with any legal requirements, by means of publication on its website:
 - (i) provide the members with the notice referred to in clause 11(3) (Notice of general meetings);
 - (ii) give charity trustees notice of their meetings in accordance with clause 19(1); and
 - (iii) submit any proposal to the members or charity trustees for decision by written resolution or postal vote in accordance with the CIO's powers under clause 10 or clause 11(7).
- (c) The charity trustees must:
 - (i) take reasonable steps to ensure that members and charity trustees are promptly notified of the publication of any such notice or proposal;



- (ii) send any such notice or proposal in hard copy form to any member or charity trustee who has not consented to receive communications in electronic form.

23. Keeping of Registers

The CIO must comply with its obligations under the General Regulations in relation to the keeping of, and provision of access to, registers of its members and charity trustees.

24. Minutes

The charity trustees must keep minutes of all:

- (1) appointments of officers made by the charity trustees;
- (2) proceedings at general meetings of the CIO;
- (3) meetings of the charity trustees and committees of charity trustees including:
 - the names of the trustees present at the meeting;
 - the decisions made at the meetings; and
 - where appropriate the reasons for the decisions;
- (4) decisions made by the charity trustees otherwise than in meetings.

25. Accounting records, accounts, annual reports and returns, register maintenance

- (1) The charity trustees must comply with the requirements of the Charities Act 2011 with regard to the keeping of accounting records, to the preparation and scrutiny of statements of accounts, and to the preparation of annual reports and returns. The statements of accounts, reports and returns must be sent to the Charity Commission, regardless of the income of the CIO, within 10 months of the financial year end.
- (2) The charity trustees must comply with their obligation to inform the Commission within 28 days of any change in the particulars of the CIO entered on the Central Register of Charities.

26. Rules

The charity trustees may from time to time make such reasonable and proper rules or bye laws as they may deem necessary or expedient for the proper conduct and management of the CIO, but such rules or bye laws must not be inconsistent with any provision of this constitution. Copies of any such rules or bye laws currently in force must be made available to any member of the CIO on request.

27. Disputes

If a dispute arises between members of the CIO about the validity or propriety of anything done by the members under this constitution, and the dispute cannot be resolved by agreement, the parties to the dispute must first try in good faith to settle the dispute by mediation before resorting to litigation.

28. Amendment of constitution

As provided by clauses 224-227 of the Charities Act 2011:

- (1) This constitution can only be amended:
 - (a) by resolution agreed in writing by all members of the CIO; or
 - (b) by a resolution passed by a majority of votes cast at a general meeting of the members of the CIO.
- (2) Any alteration of clause 3, clause 29, this clause, or of any provision where the alteration would provide authorisation for any benefit to be obtained by charity trustees or members of the CIO or persons connected with them, requires the prior written consent of the Charity Commission.
- (3) No amendment that is inconsistent with the provisions of the Charities Act 2011 or the General Regulations shall be valid.
- (4) A copy of any resolution altering the constitution, together with a copy of the CIO's constitution as amended, must be sent to the Commission within 15 days from the date on which the resolution is passed. The amendment does not take effect until it has been recorded in the Register of Charities.

29. Voluntary winding up or dissolution

- (1) As provided by the Dissolution Regulations, the CIO may be dissolved by resolution of its members. Any decision by the members to wind up or dissolve the CIO can only be made:
 - (a) at a general meeting of the members of the CIO called in accordance with clause 11, of which not less than 14 days' notice has been given to those eligible to attend and vote:
 - (i) by a resolution passed by a 75% majority of those voting, or



- (ii) by a resolution passed by decision taken without a vote and without any expression of dissent in response to the question put to the general meeting; or
 - (b) by a resolution agreed in writing by all members of the CIO.
- (2) Subject to the payment of all the CIO's debts:
 - (a) Any resolution for the winding up of the CIO, or for the dissolution of the CIO without winding up, may contain a provision directing how any remaining assets of the CIO shall be applied.
 - (b) If the resolution does not contain such a provision, the charity trustees must decide how any remaining assets of the CIO shall be applied.
 - (c) In either case the remaining assets must be disposed of by gift to one or more other charitable Societies or Associations which have for their objects the furtherance of palaeontology or its allied sciences.
- (3) The CIO must observe the requirements of the Dissolution Regulations in applying to the Commission for the CIO to be removed from the Register of Charities, and in particular:
 - (a) the charity trustees must send with their application to the Commission:
 - (i) a copy of the resolution passed by the members of the CIO;
 - (ii) a declaration by the charity trustees that any debts and other liabilities of the CIO have been settled or otherwise provided for in full; and
 - (iii) a statement by the charity trustees setting out the way in which any property of the CIO has been or is to be applied prior to its dissolution in accordance with this constitution;
 - (b) the charity trustees must ensure that a copy of the application is sent within seven days to every member and employee of the CIO, and to any charity trustee of the CIO who was not privy to the application.
- (4) If the CIO is to be wound up or dissolved in any other circumstances, the provisions of the Dissolution Regulations must be followed.

30. Interpretation

In this constitution:

“**connected person**” means:

- (a) a child, parent, grandchild, grandparent, brother or sister of the charity trustee;
- (b) the spouse or civil partner of the charity trustee or of any person falling within sub-clause (a) above;
- (c) a person carrying on business in partnership with the charity trustee or with any person falling within sub-clause (a) or (b) above;
- (d) an institution which is controlled:
 - (i) by the charity trustee or any connected person falling within sub-clause (a), (b), or (c) above; or
 - (ii) by two or more persons falling within sub-clause (d)(i), when taken together.
- (e) a body corporate in which:
 - (i) the charity trustee or any connected person falling within sub-clauses (a) to (c) has a substantial interest; or
 - (ii) two or more persons falling within sub-clause (e)(i) who, when taken together, have a substantial interest.

Section 118 of the Charities Act 2011 applies for the purposes of interpreting the terms used in this constitution.

“**General Regulations**” means the Charitable Incorporated Organisations (General) Regulations 2012.

“**Dissolution Regulations**” means the Charitable Incorporated Organisations (Insolvency and Dissolution) Regulations 2012.

The “**Communications Provisions**” means the Communications Provisions in [Part 10, Chapter 4] of the General Regulations.

“**charity trustee**” means a charity trustee of the CIO.

A “**poll**” means a counted vote or ballot, usually (but not necessarily) in writing.



Annual Meeting 2016

Notification is given of the 60th Annual General Meeting

This will be held at Université Claude Bernard Lyon 1, France, on 15th December 2016, following the scientific sessions.

AGENDA

1. Apologies for absence
2. Minutes of the 59th AGM, University of Leeds
3. Trustees Annual Report for 2015
4. Accounts and Balance Sheet for 2015
5. Election of Council and vote of thanks to retiring members
6. Report on Council Awards
7. Annual address

DRAFT AGM MINUTES 2015

Minutes of the Annual General Meeting held on Wednesday, 15th December 2015 at Cardiff University, UK.

- 1. Apologies for absence.** Dr P. Winrow, Dr L. G. Herringshaw, Dr M. E. McNamara, Dr R. J. Butler.
- 2. Minutes.** Proposed by Dr C.T.S. Little and seconded by Dr M. D. Sutton, the minutes of the 2014 AGM were agreed a true record by unanimous vote.
- 3. Trustees Annual Report for 2014.** Proposed by Prof. G. D. Sevastopolu and seconded by Prof. J. C. W. Cope, the report was agreed by unanimous vote of the meeting.
- 4. Accounts and Balance Sheet for 2014.** Proposed by Dr C. J. Buttler and seconded by Prof. P. C. J. Donoghue, the accounts were agreed by unanimous vote of the meeting.
- 5. Election of Council and vote of thanks to retiring members.**
 - 5.1** Prof. D. A. T. Harper extended a vote of thanks to the following members of Council who were retiring from their positions this year: Dr M. D. Sutton and Dr J. Hellowell. Prof. Harper also thanked Dr T. J. Palmer for his service as Executive Officer and announced that Dr J. Hellowell would be replacing him as the Association's new Executive Officer from January 2016.
 - 5.2** The following members were elected to serve on Council: President: Prof. D. A. T Harper; President Elect: Prof. M. P. Smith; Vice Presidents: Prof. E. J. Rayfield and Dr D. J. Ward; Treasurer: Dr P. Winrow; Secretary: Prof. R. J. Twitchett; Editor-in-Chief: Dr A. B. Smith; Editor Trustees: Prof. C. H. Wellman, Dr M. Ruta; Newsletter Editor: vacant; Book Review Editor: Dr T. J. Challands; Publicity Officer: Dr L. G. Herringshaw; Education Officer: Dr C. J. Buttler; Outreach Officer: Dr F. Gill; Internet Officer: Dr A. R. T. Spencer; Meetings



Coordinator: Dr T. R. A. Vandenbroucke; Ordinary Members: Dr R. J. Butler, Dr C. T. S. Little, Dr M. E. McNamara, Dr M. Munt, and Dr I. Rahman.

- 5.3 Prof. G. Cuny and colleagues will organize the Annual Meeting in 2016 at the Université Claude Bernard Lyon 1, France.

6. Association Awards. The following awards were announced:

- 6.1 The Lapworth Medal was awarded to Prof. J. A. Clack FRS (University of Cambridge, UK).
- 6.2 The President's Medal was awarded to Prof. G. E. Budd (Uppsala University, Sweden).
- 6.3 The Hodson Award was presented to Dr R. B. J. Benson (University of Oxford, UK).
- 6.4 The Mary Anning award was presented to Mr L. Koch (Ennepetal, Germany).
- 6.5 Undergraduate Research Bursaries were awarded to: Mr G. A. Coleman, University of Bristol, supervised by Prof. M. J. Benton, *Dissecting the rise of the archosaurs*; Mr W. Jessop, University of Oxford, supervised by Dr A. C. Daley, *Were co-existing archaeocyathids partitioning suspended food matter by having different pore sizes, in order to reduce competition for resources?*; Mr L. E. Meade, University of Birmingham, supervised by Dr R. J. Butler, *3D photogrammetric imaging and re-analysis of a unique Late Carboniferous footprint assemblage from Shropshire*; Ms N. Meyer, University of St. Andrews, supervised by Dr A. Zerkle, *Multiple sulphur isotope studies of pyritised microbially induced sedimentary structures, Neoproterozoic Ghaap Group, South Africa*; Mr C. Nedza, University of Leicester, supervised by Prof. M. A. Purnell, *3D textural analysis of tooth wear in insectivores, and its application to fossil mammals*; Ms K. Norden, University of Bristol, supervised by Dr J. Vinther, *Effects of diagenetic processes on melanosome morphology in iridescent feathers*; Mr J. O'Shea, University of Bristol, supervised by Dr I. Rahman, *Testing functional hypotheses in Cambrian cinctan echinoderms using computational fluid dynamics*; Mr G. Samarawickrama, Plymouth University, supervised by Dr U. Balthasar, *Shell thickness distribution in Ordovician and Silurian rhynchonelliformean brachiopods*.
- 6.6 Research Grants were awarded to: Dr J. F. Hoyal Cuthill (University of Cambridge), *Resolving the evolutionary relationships of the Ediacaran biota with new quantitative methods*; Dr B. Metcalfe (VU University Amsterdam), *The Lilliput effect: growth rate or longevity?*; Dr J. Ortega-Hernández (University of Cambridge), *The origins of aerial breathing in terrestrial ecosystems: insights from virtual fossil reconstruction*.
- 6.7 Under the Small Grants Scheme, the following awards were announced: Sylvester-Bradley Awards to Ms C. M. Bullar (University of Bristol), *Braincase anatomy, phylogeny and the success of Neoceratopsia*; Mr D. J. Marshall (University of Bristol), *Insights into chelicerate evolution through comparative cuticular analysis*; Mr S. Pates (University of Oxford), *Diversity and ecology of the anomalocaridids of the Great Basin, USA*; The Callomon Award to Mr N. F. Adams (Royal Holloway, University of London), *Early Pleistocene Palaeontology of Westbury Cave, Somerset*; Stan Wood Awards to Ms C. Colleary (Virginia Tech), *Biomolecule preservation through time: mapping bone degradation in fossil Proboscideans from different depositional environments*; Mr M. Marzola (Copenhagen University), *The Late Triassic amphibian and reptilian fauna of the Jameson Land Basin (East Greenland) and its comparison with coeval European faunas*; and The Whittington Award to Dr M. R. Smith (Durham University), *Vetulicolian affinities reconsidered through the lens of ecdysozoan anterior organization*.



- 6.8 The President's Award was presented to Mr J. W. Oyston (University of Bath).
- 6.9 The Council Poster Prize was presented to Mr C. Nedza (University of Leicester).
- 6.10 The 2015 best paper prizes were awarded to Prof. S. M. Holland and Prof. M. E. Patzkowsky for their paper entitled "The stratigraphy of mass extinction" (*Palaeontology*) and to Prof. L. E. Popov and colleagues for "Himalayan Cambrian brachiopods" (*Papers in Palaeontology*).
7. **Annual Address.** The Annual Address entitled "Computer modelling and simulation of extinct organisms: its utility and limitations for reconstructing the evolution of locomotor behaviour" was given by Prof. J. R. Hutchinson (The Royal Veterinary College).

Trustees Annual Report 2015

The Trustees present their report with the financial statements of the charity for the year ended 31 December 2015. The Trustees have adopted the provisions of *Accounting and Reporting by Charities: Statement of Recommended Practice* applicable to charities preparing their accounts in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (FRS 102) (effective 1 January 2015).

1. Objectives and Activities

The Trustees confirm that they have referred to the Charity Commission's guidance on public benefit when reviewing the charity's aims and objectives, in planning future activities and setting the grant-making policy for the year.

1.1 Aims and objectives: The aim of the Association is to promote research in Palaeontology and its allied sciences by (a) holding public meetings for the reading of original papers and the delivery of lectures, (b) demonstration and publication, and (c) by such other means as the Council may determine. In order to meet these objectives, the Association continues to increase its range and investment in public outreach and other charitable activities, whilst continuing to support research, publications, and student and speaker attendance at national and international meetings including our flagship Annual Meeting.

1.2 Grants-in-aid for meetings and workshops: The Association provided funds to support the following meetings and workshops: 'Evolution and Development of Vertebrate Dentition: a Festschrift in honour of Moya Meredith Smith' (Dr Z. Johanson, Natural History Museum, London); 5th Polar Marine Diatom Workshop (Dr M. A. Barcena, University of Salamanca); 'Rooted in deep time: palaeontological contributions to systematics', 2015 Systematic Association Biennial Meeting Symposium (Dr R. B. J. Benson, University of Oxford); 'Rise of Animal Life: Cambrian and Ordovician biodiversification events' (Prof. K. El Hariri, Cadi-Ayyad University); 63rd SVP Meeting (Dr G. J. Dyke, University of Southampton); 'Co-evolution of life and the planet: broad-scale controls on biodiversity', GSA Annual Meeting Topical Symposium T149 (Prof. R. J. Twitchett, Natural History Museum, London); and 'Experimental solutions to deep time problems in palaeontology', IGCP591 closing meeting (Dr T. R. A. Vandenbroucke, Ghent University).



1.3 Public meetings: Four public meetings were held in 2015, and the Association extends its thanks to the organizers and host institutions of these meetings.

59th Annual Meeting. The Association's Annual Meeting is its flagship meeting and this year was held on 14th – 17th December at Cardiff University and Amgueddfa Cymru – National Museum Wales, UK. Dr C. J. Buttler, Dr L. Cherns and Dr L. M. E. McCobb, with local support from colleagues and PhD students, organized the meeting, which included a symposium on 'Palaeobiotic interactions' and comprised a programme of internationally recognized speakers. There were 274 attendees. The Annual Address was entitled 'Computer modelling and simulation of extinct organisms: its utility and limitations for reconstructing the evolution of locomotor behaviour' and was given by Prof. J. R. Hutchinson (The Royal Veterinary College). The President's Prize for best oral presentation by an early-career researcher was made to Mr J. W. Oyston (University of Bath). The Council Poster Prize for best poster presentation by an early-career researcher was presented to Mr C. Nedza (University of Leicester).

Progressive Palaeontology. This is an annual, open meeting for research students in palaeontology and allied sciences to present their work to an audience of their peers. The 2015 meeting was organized by Mr J. N. Keating and a team of other students, and was held at the University of Bristol in April.

Lyell Meeting. The Association was one of the joint co-organizers of this annual meeting. The 2015 Lyell Meeting was held in March at Burlington House, London, on the topic of 'Mud, glorious mud, and why it is important for the fossil record' organized by Dr A. L. Coe (The Open University) and Prof. A. R. Lord (Senckenberg Research Institute).

British Science Festival. This is an annual forum for presentations to the public and general scientists. The Association sponsored its 2014 President's Prize winner, Mr D. J. Button (University of Bristol), to give a public talk on 'Dinosaur Behaviour: Recreating Lost Worlds' at the 2015 Festival in Bradford, which drew a large audience.

1.4 Publications: Publication of the journals *Palaeontology* and *Papers in Palaeontology* is managed by Wiley. During 2015, the following volumes were published: *Palaeontology* volume 58, comprising six issues; and *Papers in Palaeontology* volume 1, comprising four issues. The Association is grateful to Amgueddfa Cymru – National Museum Wales and The Lapworth Museum of Geology (University of Birmingham) for providing storage facilities for publication back-stock and archives. Council thanks Mr N. Stroud for assistance with the typesetting and production of the *Palaeontology Newsletter*.

1.5 Research Grants: Eleven applications for Palaeontological Association Research Grants were received. Three were recommended for funding in 2015, totalling £15,084, and were awarded to: Dr J. F. Hoyal Cuthill, University of Cambridge, 'Resolving the evolutionary relationships of the Ediacaran biota with new quantitative methods'; Dr B. Metcalfe, VU University Amsterdam, 'The Lilliput effect: growth rate or longevity?'; and Dr J. Ortega-Hernández, University of Cambridge, 'The origins of aerial breathing in terrestrial ecosystems: insights from virtual fossil reconstruction'.

1.6 Small Grants Scheme: The scheme received 19 applications. Seven were recommended for funding in 2016, totalling £9,491. Small grants were awarded as follows: Dr M. R. Smith (Durham University) received the Whittington Award; Mr N. F. Adams (Royal Holloway, University of London) received the Callomon Award; Ms C. Colleary (Virginia Tech) and Mr M. Marzola (Copenhagen



University) received Stan Wood awards; Ms C. M. Bullar (University of Bristol), Mr D. J. Marshall (University of Bristol) and Mr S. Pates (University of Oxford) received Sylvester-Bradley awards.

1.7 Undergraduate Research Bursary Scheme: The scheme attracted ten applications. Eight were recommended for funding in 2015, totalling £11,600, as follows: Mr G. A. Coleman, University of Bristol, supervised by Prof. M. J. Benton; Mr W. Jessop, University of Oxford, supervised by Dr A. C. Daley; Mr L. E. Meade, University of Birmingham, supervised by Dr R. J. Butler; Ms N. Meyer, University of St. Andrews, supervised by Dr A. L. Zerkle; Mr C. Nedza, University of Leicester, supervised by Prof. M. A. Purnell; Ms K. Norden, University of Bristol, supervised by Dr J. Vinther; Mr J. O'Shea, University of Bristol, supervised by Dr I. A. Rahman; and Mr G. Samarawickrama, Plymouth University, supervised by Dr U. Balthasar.

1.8 Publicity, outreach and engagement: The Association continues to promote palaeontology and its allied sciences to the national media, radio and television. The Association is a major financial supporter of the Lyme Regis Fossil Festival and the Yorkshire Fossil Festival (held in Scarborough in 2015). At both festivals, the Association had displays and activities for the public, which were organized and staffed by members of Council, the Executive Officer and volunteers.

1.9 Outreach and Engagement Grants: The scheme received a total of eight applications in 2015. Three were recommended for funding, totalling £15,724, and were awarded to: Dr R. J. Butler (University of Birmingham), 'Gesture control technologies and palaeontology: exploring innovative outreach and education approaches using 3D fossil models'; Ms S. Butterworth (Emerald Ant CIC), 'The Iguanodon Restaurant – Inspiring Communities in Earth Sciences through Art'; Dr S. Montanari (University of Edinburgh), 'Fossils For Everyone: Palaeontology Outreach in Children's Hospitals'.

1.10 Online activities: The online activities of the Association continue to expand with greater emphasis on social media (Facebook; Twitter). The Association continues to be the sole host for the online-only journal *Palaeontologia Electronica*, as well as continuing to host websites for other societies (The Palaeontographical Society; International Organisation of Palaeobotany), palaeontological online resources (EDNA fossil insect database; the Kent Fossil Database), and online outreach projects (Palaeontology [Online]). The Association Twitter account, @ThePalAss, had 2,119 followers at the end of 2015, an increase of 969 on the numbers at the end of 2014. Towards the end of 2015 the Association launched a re-designed website (<www.palass.org>) with the aim of making our online assets easier to navigate and find for our membership and the wider general public.

1.11 Awards: The Lapworth Medal, awarded to people who have made a significant contribution to the science by means of a substantial body of research, was presented to Prof. J. A. Clack (University of Cambridge). The President's Medal, awarded to a palaeontologist within 15 to 25 years of their PhD in recognition of outstanding contributions in their earlier career, coupled with an expectation that they will continue to contribute significantly to the subject in their further work, was presented to Prof. G. E. Budd (Uppsala University). The Hodson Award, for a palaeontologist within ten years of award of their PhD who has made an outstanding contribution to the science through a portfolio of original published research, was awarded to Dr R. B. J. Benson (University of Oxford). The Mary Anning award, for an outstanding contribution by an amateur palaeontologist, was made to Mr L. Koch (Ennepetal, Germany). Council also awards undergraduate prizes to outstanding students in university departments where palaeontology is taught beyond Level 1.



1.12 Forthcoming plans: The Association will continue to make substantial donations from General and Designated funds to promote the charitable aims of the Association. Resources will be made available to continue a similar programme of grants, meetings, outreach and public engagement activities. A donation will be made to the Biodiversity Heritage Library in order to scan back issues of all of the Association's publications so that they become freely available online. A new website was launched at the 2015 Annual Meeting and development will continue through 2016. Volume 59 of *Palaeontology* and volume 2 of *Papers in Palaeontology* will be published. The 60th Annual Meeting will be held in December 2016 at the Université Claude Bernard Lyon 1, France. The 2016 Progressive Palaeontology conference will be held at the University of Oxford. In late 2015, Council decided to investigate whether incorporation would be beneficial to the Association and help further its aims and objectives. Subsequently, in early 2016, Council's proposal to convert to a Charitable Incorporated Organisation (CIO) was agreed by the membership at an Extraordinary General Meeting held on 16th March 2016. It is anticipated that the process of converting to a CIO will be completed in 2016.

2. Achievements and Performance

2.1 Meetings support: During 2015, the Association agreed to support a total of ten palaeontological meetings, symposia or workshops worldwide (in the UK, USA, Spain and Morocco). In addition, our Postgraduate Travel Grant scheme supported six postgraduate students to present their work at national and international conferences. The Association's support enabled the worldwide dissemination of research to the benefit of the global palaeontological community.

2.2 Publications: During 2015, 119 papers were submitted to *Palaeontology*. Of these, 88 (74%) were considered suitable by the Editorial Board and 74 (62%) were subsequently accepted following peer review. The average time from acceptance to production was reduced for the second year running, to 46 days for papers published in volume 59 of *Palaeontology* (some of which had been published online in 2014). The same interval for papers in volume 1 of *Papers in Palaeontology* was higher (at 76 days), but this was due in part to a small number of initial papers that were held before online publication in 2014. The Association also sponsored the online publication of 34 Dryad data records associated with papers in volumes 59 and 1.

2.3 Support for research: In 2015 the Association agreed to fund the research activities of 18 early-career researchers based in four countries (the UK, USA, The Netherlands, Portugal). Two of this year's Undergraduate Research Bursary awardees presented their work at the 2015 Annual Meeting. Apart from directly benefiting the career development of the individuals concerned, the Association's funds enabled more palaeontological research to be undertaken worldwide than would otherwise have been the case. Overall, fewer grants were funded in 2015 compared to the previous year. Compared to 2014, applications for Research Grants increased (from six to 11) and success rates consequently fell (from 50% to 27%). For the Small Grants Scheme, applications remained the same (19) but success rates fell (from 47% to 37%) as fewer were awarded. The number of applications to the Undergraduate Research Bursary Scheme fell substantially (from 20 to ten) compared to 2014, and success rates consequently increased (from 50% to 80%). Each grant is now assigned a unique identifying number which authors are encouraged to use when acknowledging the Association's financial support in order to better track the individual outputs associated with each award.



2.4 Outreach, education and public engagement: During 2015, the Association supported the two major UK fossil festivals, at Lyme Regis and Scarborough, which attracted respectively an estimated 12,000 and 4,000 members of the general public of all ages. Secondary school students were particular beneficiaries of the Association's outreach and education activities, with a dedicated event associated with the Lyme Regis Fossil Festival. During 2015, we awarded three Outreach and Engagement grants to fund diverse projects led by Dr R. J. Butler, Ms S. Butterworth and Dr S. Montanari. Continued use of social media, in particular the Association's Twitter account, has enabled the rapid and regular dissemination of research news, including of new publications, meetings and other information, to a growing audience.

3. Financial Review

3.1 Reserves: As of 31st December, The Association holds reserves of £737,043 in General Funds, which enable the Association to generate additional revenue through investments, and thus to keep subscriptions to individuals at a low level, whilst still permitting a full programme of meetings to be held, publications to be produced, and the award of research grants and grants-in-aid. They also act as a buffer to enable the normal programme to be followed in years in which expenditure exceeds income, and allow new initiatives to be pursued. The Association holds £142,930 in Designated Funds which contribute interest towards the funding of the Sylvester-Bradley, Hodson, Callomon, Whittington and Stan Wood awards and towards the Jones-Fenleigh Fund. Total funds carried forward to 2016 totalled £879,973.

3.2 Summary of expenditure: Total charitable expenditure, through grants to support research, scientific meetings and workshops in 2015, was £340,324. Governance costs were £20,989. Total resources expended were £393,980. The Association continues its membership of the International Palaeontological Association and remains a Tier 1 sponsor of *Palaeontologia Electronica*, and the *Treatise on Invertebrate Paleontology*.

4. Structure, Governance and Management

4.1 Nature of the governing document: The governing document of the Palaeontological Association is the Constitution adopted on 27th February 1957, amended on subsequent occasions as recorded in the Council and AGM Minutes.

4.2 Management: The Association is managed by a Council of up to 20 Trustees, which is led by the President. The Association employs an Executive Officer and a Publications Officer. The Trustees are elected by vote of the Membership at the Annual General Meeting, following guidelines laid down in the Constitution.

4.3 Trustees: The following members were elected at the AGM on 17th December 2014 to serve as trustees in 2015: *President:* Prof. D. A. T. Harper; *Vice Presidents:* Mr D. J. Ward and Dr M. D. Sutton; *Treasurer:* Mr P. Winrow; *Secretary:* Prof. R. J. Twitchett; *Editor-in-Chief:* Dr A. B. Smith; *Editor Trustees:* Dr M. Ruta, Prof. C. H. Wellman; *Newsletter Editor:* Dr J. Hellawell; *Book Review Editor:* Dr T. J. Challands; *Internet Officer:* Mr A. R. T. Spencer; *Publicity Officer:* Dr L. G. Herringshaw; *Education Officer:* Dr C. J. Buttler; *Outreach Officer:* Dr F. Gill; *Meetings Coordinator:* Dr T. R. A. Vandenbroucke; *Ordinary Members:* Dr R. J. Butler, Dr C. T. S. Little, Dr M. E. McNamara, Dr M. C. Munt, Dr I. A. Rahman. *The Executive Officer* Dr T. J. Palmer and the *Publications Officer* Dr S. L. Thomas serve on Council but are not Trustees. Dr M. D. Sutton and Prof. R. J. Twitchett represented the Association on the Joint Committee for Palaeontology.



4.4 Membership: Membership on 31st December 2015 totalled 1,086 (1,071 at end 2014). Of these, 592 were Ordinary Members, 164 Retired Members, 19 Honorary Members, 274 Student Members and 37 Institutional Members. There were 43 institutional subscribers to *Papers in Palaeontology*. Wiley also separately manage further Institutional subscribers and arrange online access to publications for those Institutional Members on behalf of the Association.

4.5 Risk: The Association is in a sound financial position. Potential financial risks were discussed as part of a Council Away Day held in October 2015. Succession planning for the Executive Officer was considered by Council as part of the Annual Review of Officers during 2015 and was implemented later in the year. Following advertisement of a revised, full-time position and a thorough interview process led by the President, a new Executive Officer has been appointed for 2016 and the Association is confident of a smooth transition.

5. Reference and Administration

5.1 Name and Charity Number: The Palaeontological Association is a Charity registered in England and Wales, Charity Number 276369.

5.2 Address: The contact address of the Association is The Palaeontological Association, c/o IGES Llandinam Building, Aberystwyth University, Aberystwyth, SY23 3DB, UK.

5.3 Professional services: The Association's Bankers are NatWest, 42 High Street, Sheffield, S1 2GE. The Association's Independent Examiner is Ms M.R. Corfield ACA ACMA, Corfield Accountancy Ltd., Myrick House, Hendomen, Montgomery, Powys, SY15 6EZ. The Association's investment portfolio was managed by Quilter Cheviot Investment Management, 1 Kingsway, London WC2B 6XD.



REFERENCE AND ADMINISTRATIVE DETAILS

Principal address

c/o IGES, Llandinam Building,
Aberystwyth University,
Aberystwyth
SY23 3DB

Trustees

Prof. D.A.T. Harper	President	
Dr M.D. Sutton	Vice President	
Dr D.J. Ward	Vice President	
Prof. R.J. Twitchett	Secretary	
Dr P. Winrow	Treasurer	
Dr A.B. Smith	Editor-in-Chief	
Dr M. Ruta	Editor Trustee	
Prof. C.H. Wellman	Editor Trustee	
Dr A.R.T. Spencer	Internet Officer	
Dr J. Hellowell	Newsletter Editor	Resigned 31st December 2015
Dr T.J. Challands	Book Review Editor	
Dr L.G. Herringshaw	Publicity Officer	
Dr F.L. Gill	Outreach Officer	
Dr C.J. Buttler	Education Officer	
Dr T.R.A. Vandenbroucke	Meetings Coordinator	
Dr R.J. Butler	Ordinary Member	
Dr C.T.S. Little	Ordinary Member	
Dr M.E. McNamara	Ordinary Member	
Dr M. Munt	Ordinary Member	
Dr I.A. Rahman	Ordinary Member	

Independent examiner

Corfield Accountancy Limited
Chartered Accountants
Myrick House
Hendomen
Montgomery
Powys
SY15 6EZ

Bankers

NatWest
Sheffield City Centre
42 High Street
Sheffield
S1 2GE

Approved by order of the board of trustees on 6 June 2016 and signed on its behalf by:

Dr P. Winrow – Trustee



Independent Examiner's Report to the Trustees of The Palaeontological Association

I report on the accounts for the year ended 31 December 2015 set out on the following eight pages.

Respective responsibilities of trustees and examiner

The charity's trustees are responsible for the preparation of the accounts. The charity's trustees consider that an audit is not required for this year (under Section 144(2) of the Charities Act 2011 (the 2011 Act)) and that an independent examination is required. The charity's gross income exceeded £250,000 and I am qualified to undertake the examination by being a qualified member of ACA ACMA.

It is my responsibility:

- to examine the accounts under Section 145 of the 2011 Act
- to follow the procedures laid down in the General Directions given by the Charity Commission (under Section 145(5)(b) of the 2011 Act); and
- to state whether particular matters have come to my attention.

Basis of the independent examiner's report

My examination was carried out in accordance with the General Directions given by the Charity Commission. An examination includes a review of the accounting records kept by the charity and a comparison of the accounts presented with those records. It also includes consideration of any unusual items or disclosures in the accounts, and seeking explanations from you as trustees concerning any such matters. The procedures undertaken do not provide all the evidence that would be required in an audit, and consequently no opinion is given as to whether the accounts present a 'true and fair view' and the report is limited to those matters set out in the statements below.

Independent examiner's statement

In connection with my examination, no matter has come to my attention:

- (1) which gives me reasonable cause to believe that, in any material respect, the requirements
 - to keep accounting records in accordance with Section 130 of the 2011 Act; and
 - to prepare accounts which accord with the accounting records and to comply with the accounting requirements of the 2011 Act

have not been met; or

- (2) to which, in my opinion, attention should be drawn in order to enable a proper understanding of the accounts to be reached.

Miss M R Corfield
ACA ACMA
Corfield Accountancy Limited
Chartered Accountants
Myrick House
Hendomen
Montgomery
Powys
SY15 6EZ

Date: 6 June 2016



THE PALAEOLOGICAL ASSOCIATION

**Statement of Financial Activities
for the Year Ended 31 December 2015**

	See Note	Unrestricted funds £	Designated funds £	31.12.15 Total funds £	31.12.14 Total funds £
INCOME AND ENDOWMENTS FROM					
Donations and legacies		50,627	32,896	83,523	86,061
Charitable activities	3				
Public Meetings		35,460	—	35,460	—
Publications		268,753	—	268,753	268,660
Investment income	2	<u>13,564</u>	<u>232</u>	<u>13,796</u>	<u>13,587</u>
Total		368,404	33,128	401,532	368,308
EXPENDITURE ON					
Raising funds	4	32,667	—	32,667	29,631
Charitable activities	5				
Public Meetings		72,736	—	72,736	47,141
Grants & Awards		38,950	13,995	52,945	60,173
Administration		45,441	—	45,441	40,821
Publications		169,202	—	169,202	188,918
Governance Costs		<u>20,989</u>	<u>—</u>	<u>20,989</u>	<u>20,115</u>
Total		379,985	13,995	393,980	386,799
Net gains/(losses) on investments		<u>4,647</u>	<u>—</u>	<u>4,647</u>	<u>31,354</u>
NET INCOME/(EXPENDITURE)		(6,934)	19,133	12,199	12,863
RECONCILIATION OF FUNDS					
Total funds brought forward		<u>743,977</u>	<u>123,797</u>	<u>867,774</u>	<u>854,911</u>
TOTAL FUNDS CARRIED FORWARD		<u>737,043</u>	<u>142,930</u>	<u>879,973</u>	<u>867,774</u>

CONTINUING OPERATIONS

All income and expenditure has arisen from continuing activities.



THE PALAEOLOGICAL ASSOCIATION

**Balance Sheet
At 31 December 2015**

	See Note	Unrestricted funds £	Designated funds £	31.12.15 Total funds £	31.12.14 Total funds £
FIXED ASSETS					
Investments	10	619,336	—	619,336	626,180
CURRENT ASSETS					
Debtors	11	142,252	—	142,252	132,249
Cash at bank and in hand		<u>13,673</u>	<u>142,930</u>	<u>156,603</u>	<u>174,448</u>
		155,925	142,930	298,855	306,697
CREDITORS					
Amounts falling due within one year	12	<u>(38,218)</u>	<u>—</u>	<u>(38,218)</u>	<u>(65,103)</u>
NET CURRENT ASSETS		<u>117,707</u>	<u>142,930</u>	<u>260,637</u>	<u>241,594</u>
TOTAL ASSETS LESS CURRENT LIABILITIES		<u>737,043</u>	<u>142,930</u>	<u>879,973</u>	<u>867,774</u>
NET ASSETS		<u>737,043</u>	<u>142,930</u>	<u>879,973</u>	<u>867,774</u>
FUNDS					
	13				
Unrestricted funds:					
General fund				737,043	743,977
Designated funds:					
Sylvester Bradley				31,451	36,815
Jones-Fenleigh				25,750	24,362
Hodson				6,293	8,172
Callomon				5,113	6,500
Whittington				14,549	17,415
Stan Wood				<u>59,774</u>	<u>30,533</u>
				<u>879,973</u>	<u>867,774</u>
TOTAL FUNDS				<u>879,973</u>	<u>867,774</u>

The financial statements were approved by the Board of Trustees on 6 June 2016 and were signed on its behalf by:

Dr P. Winrow – Trustee



THE PALAEOLOGICAL ASSOCIATION

Notes to the Financial Statements for the Year Ended 31 December 2015

1. ACCOUNTING POLICIES

Basis of preparing the financial statements

The financial statements of the charity, which is a public benefit entity under FRS 102, have been prepared in accordance with the Charities SORP (FRS 102) 'Accounting and Reporting by Charities: Statement of Recommended Practice applicable to charities preparing their accounts in accordance with the Financial Reporting Standard applicable in the UK and Republic of Ireland (FRS 102) (effective 1 January 2015)', Financial Reporting Standard 102 'The Financial Reporting Standard applicable in the UK and Republic of Ireland' and the Charities Act 2011. The financial statements have been prepared under the historical cost convention with the exception of investments which are included at market value, as modified by the revaluation of certain assets.

Reconciliation with previous Generally Accepted Accounting Practice

In preparing the accounts, the trustees have considered whether in applying the Charities SORP FRS 102 a reinstatement of comparative items was needed. No restatements were required. In accordance with the requirements of FRS 102 a reconciliation of opening balances and net income for the year is provided with the net income under previous GAAP adjusted for the presentation of investment gains/(losses) as a component of reported income.

Reconciliation of Reported Net Income:

Net income/(expenditure) as previously stated	(£18,491)
Adjustment for gains on investments now treated as a component of net income	<u>£31,354</u>
2014 Net income as restated:	£12,863

Financial reporting standard 102 – reduced disclosure exemptions

The charity has taken advantage of the following disclosure exemption in preparing these financial statements, as permitted by FRS 102 'The Financial Reporting Standard applicable in the UK and Republic of Ireland':

- the requirements of Section 7 Statement of Cash Flows.

Income

The charity's income principally comprises subscriptions from individuals and institutions which relate to the period under review, and sales of scientific publications.

All income is recognised in the Statement of Financial Activities once the charity has entitlement to the funds, it is probable that the income will be received and the amount can be measured reliably.

Expenditure

Liabilities are recognised as expenditure as soon as there is a legal or constructive obligation committing the charity to that expenditure, it is probable that a transfer of economic benefits will be required in settlement and the amount of the obligation can be measured reliably. Expenditure is accounted for on an accruals basis and has been classified under headings that aggregate all cost related to the category. Where costs cannot be directly attributed to particular headings they have been allocated to activities on a basis consistent with the use of resources.



THE PALAEOLOGICAL ASSOCIATION

Notes to the Financial Statements – *continued***1. ACCOUNTING POLICIES – continued****Allocation and apportionment of costs**

Administrative costs have been allocated to the various cost headings based on estimates of the time and costs spent thereon.

Taxation

The charity is exempt from tax on its charitable activities.

Fund accounting

General Funds are unrestricted funds which are available for use at the discretion of the Council in furtherance of the general objectives of the charity and which have not been designated for other purposes.

Designated funds comprise unrestricted funds that have been set aside by Council for particular purposes. The aim of each designated fund is as follows:

- Sylvester-Bradley Fund: Grants made to permit palaeontological research.
- Jones-Fenleigh Fund: Grants to permit one or more delegates annually to attend the Symposium of Vertebrate Palaeontology and Comparative Anatomy (SVPCA) meeting.
- Hodson Fund: Awards made in recognition of the palaeontological achievements of a researcher within ten years of the award of their PhD.
- Callomon Fund: Grants made to permit palaeontological research with a strong fieldwork element.
- Whittington Fund: Grants made to permit palaeontological research with an element of study in museum collections.
- Stan Wood Fund: Grants in the area of vertebrate palaeontology ideally involving fieldwork, due to generous donations in memory of the Scottish fossil collector Mr Stan Wood.

2. INVESTMENT INCOME

	31.12.15	31.12.14
	Unrestricted	Total
	funds	funds
	£	£
Deposit account interest	3,827	3,773
Investment Income	<u>9,969</u>	<u>9,814</u>
	<u>13,796</u>	<u>13,587</u>



THE PALAEOLOGICAL ASSOCIATION

Notes to the Financial Statements – *continued*

3. INCOME FROM CHARITABLE ACTIVITIES

	Public Meetings	Publications	31.12.15 Total activities	31.12.14 Total activities
	£	£	£	£
Scientific Meetings	35,460	—	35,460	—
Palaeontology	—	259,392	259,392	255,074
Special papers	—	4,287	4,287	8,378
Offprints	—	475	475	775
Newsletter	—	—	—	250
Field Guides	—	4,289	4,289	3,933
Distribution	—	310	310	250
	<u>35,460</u>	<u>268,753</u>	<u>304,213</u>	<u>268,660</u>

4. RAISING FUNDS

	31.12.15 Unrestricted funds	31.12.14 Total funds
	£	£
Voluntary Income Costs:		
Administration	28,917	25,977
Investment Management Costs:		
Stockbroker Fees	<u>3,750</u>	<u>3,654</u>
	<u>32,667</u>	<u>29,631</u>

5. CHARITABLE ACTIVITIES COSTS

	Direct costs	Support costs (See note 6)	Totals
	£	£	£
Public Meetings	72,736	—	72,736
Grants & Awards	52,945	—	52,945
Administration	45,441	—	45,441
Publications	169,202	—	169,202
Governance Costs	—	20,989	20,989
	<u>340,324</u>	<u>20,989</u>	<u>361,313</u>

6. SUPPORT COSTS

	Governance costs
	£
Governance Costs	<u>20,989</u>



THE PALAEOLOGICAL ASSOCIATION

Notes to the Financial Statements – *continued***7. TRUSTEES' REMUNERATION AND BENEFITS**

There were no trustees' remuneration or other benefits for the year ended 31 December 2015 nor for the year ended 31 December 2014.

Trustees' expenses

The total travelling expenses reimbursed to 20 Members of Council was £12,153 (2014: £12,143)

8. STAFF COSTS**Analysis of Staff Costs and Remuneration**

	£ 2015	£ 2014
Salaries	59,582	63,017
Social Security Costs	3,925	4,505
Pension Costs	<u>22,513</u>	<u>18,537</u>
Total	<u>86,020</u>	<u>86,059</u>

The average monthly number of employees during the year was as follows:

	31.12.15	31.12.14
Publications	1	1
Administration	<u>1</u>	<u>1</u>
	<u>2</u>	<u>2</u>

No employees received emoluments in excess of £60,000.

9. INVESTMENT GAINS AND LOSSES

All gains and losses are taken to the Statement of Financial Activities as they arise. Realised gains and losses on investments are calculated as the difference between sales proceeds and their opening carrying value or their purchase value if acquired subsequent to the first day of the financial year.

Unrealised gains and losses are calculated as the difference between the fair value at the year end and their carrying value. Realised and unrealised investment gains and losses are combined in the Statement of Financial Activities.

Investment Gains/Losses	31st December 2015	31st December 2014
Realised Gain/(Loss)	(£292)	£2,607
Unrealised Gain/(Loss)	<u>£4,939</u>	<u>£28,747</u>
Total per Statement of Financial Activities	<u>£4,647</u>	<u>£31,354</u>

10. FIXED ASSET INVESTMENTS

Investments are initially recognised at their transaction value and subsequently measured at their fair value as at the balance sheet date. The statement of financial activities includes the net gains and losses arising on revaluation and disposals throughout the year.



THE PALAEOLOGICAL ASSOCIATION

Notes to the Financial Statements – *continued*

11. DEBTORS: AMOUNTS FALLING DUE WITHIN ONE YEAR

	£ 2015	£ 2014
Prepayments	1,261	1,587
Accrued Income-receivable within 1 year	<u>140,991</u>	<u>130,661</u>
	<u>142,252</u>	<u>132,248</u>

12. CREDITORS: AMOUNTS FALLING DUE WITHIN ONE YEAR

	31.12.15 £	31.12.14 £
Trade creditors	19,098	37,560
Taxation and social security	1,553	1,679
Other creditors	<u>17,567</u>	<u>25,864</u>
	<u>38,218</u>	<u>65,103</u>

13. MOVEMENT IN FUNDS

	At 1.1.15 £	Net movement in funds £	Transfers between funds £	At 31.12.15 £
Unrestricted funds				
General fund	743,977	(6,934)	—	737,043
Designated funds:				
Sylvester Bradley	36,815	(5,364)	—	31,451
Jones-Fenleigh	24,362	1,388	—	25,750
Hodson	8,172	(1,879)	—	6,293
Callomon	6,500	(1,387)	—	5,113
Whittington	17,415	(2,866)	—	14,549
Stan Wood	<u>30,533</u>	<u>29,241</u>	<u>—</u>	<u>59,774</u>
	<u>867,774</u>	<u>12,199</u>	<u>—</u>	<u>879,973</u>
TOTAL FUNDS	<u>867,774</u>	<u>12,199</u>	<u>—</u>	<u>879,973</u>

Net movement in funds, included in the above are as follows:

	Incoming resources £	Resources expended £	Gains and losses £	Movement in funds £
Unrestricted funds				
General fund	368,404	(379,985)	4,647	(6,934)
Designated funds:				
Sylvester Bradley	170	(5,534)	—	(5,364)
Jones-Fenleigh	1,988	(600)	—	1,388
Hodson	15	(1,894)	—	(1,879)
Callomon	113	(1,500)	—	(1,387)
Whittington	134	(3,000)	—	(2,866)
Stan Wood	<u>30,708</u>	<u>(1,467)</u>	<u>—</u>	<u>29,241</u>
	<u>401,532</u>	<u>(393,980)</u>	<u>4,647</u>	<u>12,199</u>
TOTAL FUNDS	<u>401,532</u>	<u>(393,980)</u>	<u>4,647</u>	<u>12,199</u>



THE PALAEOLOGICAL ASSOCIATION

Notes to the Financial Statements – *continued*

14. RELATED PARTY DISCLOSURES

There were no related party transactions for the year ended 31st December 2015.

15. FIRST YEAR ADOPTION

Transitional relief

The charity has not taken advantage of any Transitional relief.



Detailed Statement of Financial Activities for the Year Ended 31 December 2015

	31.12.15 Unrestricted funds £	31.12.14 Total funds £
INCOME AND ENDOWMENTS		
Donations and legacies		
Donations	34,175	32,220
Subscriptions	49,348	53,841
	<u>83,523</u>	<u>86,061</u>
Investment income		
Deposit account interest	3,827	3,773
Investment Income	9,969	9,814
	<u>13,796</u>	<u>13,587</u>
Charitable activities		
Palaeontology	259,392	255,074
Special papers	4,287	8,378
Offprints	475	775
Newsletter	—	250
Field Guides	4,289	3,933
Distribution	310	250
Scientific meetings	35,460	—
	<u>304,213</u>	<u>268,660</u>
Total incoming resources	401,532	368,308
EXPENDITURE		
Raising donations and legacies		
Administration	28,917	25,977
Investment management costs		
Stockbroker Fees	3,750	3,654
Charitable activities		
Palaeontology	51,996	62,935
Special Papers	—	3,994
Offprints	—	930
Field Guides	—	27
Newsletters	16,971	16,100
Distribution	—	1,035
Marketing	2,298	2,330
Publication Costs	69,079	64,464
Editorial Costs	28,858	37,103
Public Meetings	72,736	47,141
Grants & Awards	37,821	45,241
Research Grants	15,124	14,932
Administration	45,441	40,821
	<u>340,324</u>	<u>337,053</u>
Support costs: Governance costs		
Trustees' expenses	12,153	12,143
Accountancy and legal fees	574	550
Administration	8,262	7,422
	<u>20,989</u>	<u>20,115</u>
Total resources expended	393,980	386,799
Net income/(expenditure) before gains and losses	7,552	(18,491)
Realised recognised gains and losses		
Realised gains/(losses) on fixed asset investments	4,647	31,354
	<u>4,647</u>	<u>31,354</u>
Net income	<u>12,199</u>	<u>12,863</u>

**Palaeontological Association year ended 31st December 2015.**

Nominal	Holding	Cost (bought pre 2015) £	Value end 2014 £
£20,000	UK 4.5% Gilt 07/03/19 GBP 0.01	20,092.99	23,120.00
£18,000	UK 4.75% Stock 07/03/20 GBP 100	18,145.87	21,449.00
£64,176.46	COIF Charities Fixed Interest Fund	85,000.00	87,600.87
500	BG Group Ordinary 10p shares	3,977.95	4,325.00
1,425	BP Ord 25c shares	5,047.35	5,857.00
804	Royal Dutch Shell B shares	4,671.00	17,953.00
600	BHP Billiton \$0.5 shares	4,341.48	8,331.00
600	South32 Ltd (Di)		
437	IMI Ord 25p shares	4,267.00	5,519.00
1,728	Melrose Indust Ord 0.1p	5,562.00	4,965.00
420	Experian Ord 10c	3,444.95	4,570.00
300	Diageo Ord	5,826.00	5,546.00
400	Persimmon Ord 10p	4,516.00	6,312.00
400	Persimmon Ord 10p		
300	Unilever PLC Ord GBP 0.031111	4,326.21	7,884.00
170	Astrozeneca Ord 25c	8,145.00	7,744.00
650	Glaxo Smithkline Ordinary 25p shares	10,232.42	8,944.00
2,000	Tesco Ord GBP 0.05	6,225.78	3,780.00
460	Pearson Ordinary 25p shares	8,069.00	5,474.00
175	Carnival Plc Ord USD 1.66	3,996.49	5,108.00
2,150	BT Group Ordinary 5p shares	7,409.00	8,632.00
2,277	Vodafone Group Ord USD 0.11428571	3,434.00	5,070.00
700	National Grid Ord GBP 0.113953	3,648.26	6,427.00
2,250	Barclays 25p Ord shares	4,867.00	5,479.00
1,465	HSBC Holdings Ordinary 0.5 US Dollar shares	4,534.00	8,916.00
1,200	Great Portland Estates Ord	8,503.00	8,856.00
4,400	TR Property Ord 25p shares	7,560.85	12,518.00
1,500	Jupiter Ord 2p	6,066.00	5,474.00
4250	Fidelity EUR Value Ordinary 25P shares	4,059.07	6,906.00
650	RIT Capital Partners Ordinary £1 shares	4,903.90	9,081.00
670	Blackrock World Mining Ord 5P	4,019.09	2,079.00
3,900	Edinburgh Dragon Trust Ordinary £0.20 shares	4,478.10	10,652.00
1,225	Brown Advisory US Equity Value £B	14,789.62	22,148.00
425	Findlay Park Partners US Smaller Companies	6,158.47	21,620.00
2,825	Ishares S&P 500 GBP	20,319.63	37,622.00
120	GLG Japan Corealpha Equity I H Acc	11,330.79	18,661.00
150	GLG Japan Corealpha Equity I Acc		
65	Roche Hldgs Ag Genusscheine Nvp	7,226.55	11,321.00
6,600	Henderson Gbl Invs European Special Sits I Inc	7,037.91	9,893.00
6,600	Fund Partners Ltd Crux European Spl Situation		
26	Veritas Asset Mgmt Veritas Asian A GBP	8,182.27	9,453.00
900	JPMorgan Am UK Ltd Emerging Markets I Instl	5,043.10	5,196.00
2,499	Bluecrest Allblue Ord Nvp GBP shares	3,020.28	4,653.00
300	Morgan Stanley	9,958.00	9,918.00
4,443	Aberdeen Investment Property Trust B	4,681.00	5,220.00
1,283.80	COIF Charities Investment Fund Acc Units	75,000.00	145,902.71
	Total	442,117.38	626,179.58



Investment Portfolio 2015

Schedule of Investments (Note 10 to the Accounts)

Proceeds (sold in 2015) £	Cost (bought in 2015) £	Gain realised during 2015 £	Value end 2015 £	Gain unrealised during 2015 £
			22,502.00	-618.00
			20,887.00	-562.00
			84,353.54	-3,247.33
			4,925.00	600.00
			5,045.00	-812.00
			12,406.00	-5,547.00
			4,560.00	-3,771.00
	700.26		315.00	-385.26
			3,765.00	-1,754.00
			5,027.00	62.00
			5,044.00	474.00
			5,570.00	24.00
			8,108.00	1,796.00
380.00	0.00	380.00		
			8,780.00	896.00
			7,848.00	104.00
			8,925.00	-19.00
2,986.46		-793.54		
4,304.72		-1,169.28		
			6,766.00	1,658.00
			10,142.00	1,510.00
			5,032.00	-38.00
			6,563.00	136.00
			4,925.00	-554.00
			7,855.00	-1,061.00
			9,936.00	1,080.00
			13,257.00	739.00
			6,776.00	1,302.00
			7,395.00	489.00
			10,927.00	1,846.00
			1,213.00	-866.00
			9,419.00	-1,233.00
			21,144.00	-1,004.00
			23,304.00	1,684.00
			39,070.00	1,448.00
22,501.01		3,840.01		
	22,838.31		21,653.00	-1,185.31
			12,181.00	860.00
7,140.00		-2,753.00		
	7,140.00		10,991.00	3,851.00
			10,272.00	819.00
			4,626.00	-570.00
4,856.54		203.54		
			8,850.00	-1,068.00
			5,526.00	306.00
			153,452.49	7,549.78
42,168.73	30,678.57	-292.27	619,336.03	4,938.88



Nominations For Council

At the AGM in December 2016, the following vacancies will occur on Council:

- Vice-President
- Secretary
- Newsletter Editor
- Publicity Officer
- Outreach Officer
- Education Officer
- Internet Officer
- Three Ordinary Members.

Nominations are now invited for these posts. Please note that each candidate must be proposed by at least two members of the Association and that any individual may not propose more than two candidates. Nominations must be accompanied by the candidate's written agreement to stand for election and a short paragraph describing their interests.

All potential Council Members are asked to consider that:

Each Council Member needs to be aware that, since the Palaeontological Association is a Registered Charity, in the eyes of the law he/she becomes a Trustee of that Charity. Under the terms of the Charities Act 1992, legal responsibility for the proper management of the Palaeontological Association lies with each Member of Council. Further details of Trustee responsibilities can be obtained from <secretary@palass.org>.

The closing date for nominations is **5th October 2016**. They should be sent to the Secretary: Prof. Richard J. Twitchett, Department of Earth Sciences, Natural History Museum, Cromwell Road, London, SW7 5BD, UK; e-mail <secretary@palass.org>.

Nominations received thus far are as follows:

- Vice President: Prof. Richard J. Twitchett*
- Secretary: Dr Crispin T.S. Little*
- Newsletter Editor: none
- Publicity Officer: Dr Liam G. Herringshaw (2nd term)*
- Outreach Officer: Dr Lucy M. E. McCobb
Dr Maria E. McNamara
- Education Officer: Dr Caroline J. Buttler (2nd term)*
- Internet Officer: Dr Alan R. T. Spencer (2nd term)*
- Ordinary Members: Prof. Andrew S. Gale*
Dr Alexander M. Dunhill
Dr David P. G. Bond

* denotes Council nominations.



Awards And Prizes

The Palaeontological Association recognizes excellence in our profession by the award of medals and other prizes. The Association sees its lists of medal and award winners as a record of the very best palaeontologists worldwide, at different career stages, and offering different kinds of contributions to the field. The Association stresses the importance of nominations, and encourages all members to make nominations.

Lapworth Medal

The Lapworth Medal is the most prestigious award made by the Association. It is awarded by Council to a palaeontologist who has made a significant contribution to the science by means of a substantial body of research; it is not normally awarded on the basis of a few good papers. Council will look for some breadth as well as depth in the contributions, as well as evidence that they have made a significant impact, in choosing suitable candidates.



The medal is normally awarded each year. Candidates must be nominated by at least two members of the Association. Nominations should include a single page that summarizes the candidate's career, and further supported by a brief statement from the two nominating members. A list of 10 principal publications should accompany the nomination. Letters of support by others may also be submitted. Council will reserve the right not to make an award in any particular year.

The career summary, statements of support and publication list should be submitted in MS Word or PDF format, ideally as a single document if possible.

Nominations should be sent to <secretary@palass.org> by **31st March**.

The Lapworth Medal is announced at the AGM and presented at the Annual Meeting.

President's Medal



The President's Medal is a mid-career award given by Council to palaeontologists who have had between 15 and 25 years of full-time experience after their PhD, in recognition of outstanding contributions in their earlier careers, coupled with an expectation that they will continue to contribute significantly to the subject in their further work.

The medal is normally awarded each year. The candidate must be nominated by at least two members of the Association. Nominations should include a single page that summarizes the candidate's career, and further supported by a brief statement from the two nominating members. A list of 10 principal publications should accompany the nomination. Letters of support by others may also be submitted. Council will reserve the right not to make an award in any one year. If a candidate has taken time out from her/his professional career for family and other purposes, this should be highlighted.



The career summary, statements of support and publication lists should be attached in MS Word or PDF format, ideally as a single document if possible.

Nominations should be sent to <secretary@palass.org> by **31st March**.

The President's Medal is announced at the AGM and presented at the Annual Meeting.

Hodson Award

The Hodson Award is conferred on a palaeontologist who has had no more than 10 years of full time experience after her/his PhD, excluding periods of parental or other leave, but not excluding periods spent working in industry, and who has made a notable contribution to the science.

The candidate must be nominated by at least two members of the Association and the application must be supported by an appropriate academic case, namely a single page of details on the candidate's career, and a brief statement from each of the two nominating members. A list of principal publications should accompany the nomination. Letters of support by others may also be submitted. If a candidate has taken time out from her/his professional career for family and other purposes, this should be highlighted.

The academic case, statements of support and publication list should be attached in MS Word or PDF format.

Nominations should be sent to <secretary@palass.org> by **31st March**.

The award will comprise a fund of £1,000, and is presented at the Annual Meeting.

Mary Anning Award

The Award is open to all those who are not professionally employed within palaeontology but who have made an outstanding contribution to the subject. Such contributions may range from the compilation of fossil collections, and their care and conservation, to published studies in recognized journals.

The candidate must be nominated by at least one member of the Association. Nominations should comprise a short statement (up to one page of A4) outlining the candidate's principal achievements, as well as one or more letters of support. Members putting forward candidates should also be prepared, if requested, to write an illustrated profile in support of their nominee for inclusion in the *Newsletter*.

Nominations should be attached in MS Word or PDF format and should include the full contact details of the candidate.

Nominations should be sent to <secretary@palass.org> by **31st March**.

The Award comprises a cash prize of £200 plus a framed scroll, and is presented at the Annual Meeting.



Honorary Life Membership

To be awarded to individuals whom Council deem to have been significant benefactors and/or supporters of the Association. Recipients will receive free membership.

Nominations should be sent to <secretary@palass.org> by **31st March**.

Honorary Life memberships are announced at the Annual Meeting.

Annual Meeting President's Prize

Awarded for the best talk at the Annual Meeting. All student members of the Palaeontological Association, and all members of the Association who are early career stage researchers within one year of award of a higher degree (PhD, MSc, *etc.*), excluding periods of parental or other leave, are eligible for consideration for this award. Cash prize of £200. The prize is announced at the end of the Annual Meeting.

Annual Meeting Council Poster Prize

Awarded for the best poster at the Annual Meeting. All student members of the Palaeontological Association, and all members of the Association who are early career stage researchers, *i.e.* those within one year of the award of a higher degree (PhD, MSc, *etc.*), excluding periods of parental or other leave, are eligible for consideration for this award. Cash prize of £200. The prize is announced at the end of the Annual Meeting.

Best Paper Award

Awarded since 2015 for the best papers published in *Palaeontology* and *Papers in Palaeontology* during the calendar year. Corresponding authors of winning papers will be offered 'gold open access' paid for by the Association for one nominated paper submitted to *Palaeontology/Papers in Palaeontology* within the following 18 months (and subsequently accepted). In the case of joint authorship papers, the corresponding author can, by agreement, transfer the prize to one of the co-authors. All eligible papers are automatically considered for this award by the Editor-in-Chief and Editorial Board members, and their decision is announced at the Annual Meeting.

Golden Trilobite Award

Golden Trilobite Awards recognize high-quality amateur and institutional websites that promote the charitable aims of the Association. Nominations for websites, which should consist of a link to the site and a brief supporting case, should be sent to the secretary (<secretary@palass.org>) by **31st March**. The award comprises a 'Golden Trilobite banner' and links to Association website. Awards will be announced in the *Newsletter* and on the Association website.





Palaeontological Association Undergraduate Prize Scheme

We have made some changes to the way that this scheme operates because our previous practice of writing to individual British and Irish departments in May has not been as inclusive as we would like.

The scheme annually invites all departments where a palaeontology course is taught after the first year as part of a degree programme, to recommend one of their undergraduate students to receive this prize. The award consists of free membership of the Association for the rest of the year in question, plus the following year. It provides electronic access to both our journals, paper copies of the *Newsletter*, and all the other advantages of membership. Receipt of the award also looks good on a recipient's CV.

The award scheme is continuing and, as of last year, has been extended to undergraduate students in other countries, but we no longer send out invitations to individual departments. Instead they are invited to contact us at <palass@palass.org> with a nomination (name, address and e-mail) and we will then sign up the student as a member and let them know. Departments may use any criterion for selection, though most prefer to use the scheme as an acknowledgement of best performance in a relevant exam or project.

If you are a staff member who is involved with exam assessment at UK or Irish universities you will know about the scheme and be familiar with the selection process. Please ask your department to carry on making recommendations to us in the normal way. If you are a teacher of palaeontology, and a PalAss member, in a university further afield who is unfamiliar with the scheme, then we invite you to join the scheme and tell people in your department about it. The award is available to only one person per year in any one institution, who should be an undergraduate student, not a post graduate, when they are selected.

We will repeat this Newsletter announcement periodically as a reminder.

Jo Hellowell
Executive Officer



GRANTS

Palaeontological Association grants are offered to encourage research, education and outreach through different means. Undergraduates, early stage researchers and otherwise unfunded persons are given special encouragement to apply. All of these awards and grants are core to the charitable aims of the Palaeontological Association. A full list of the Association's grants is also available on the Association's website (<www.palass.org>).

Grants-in-aid: meetings, workshops and short courses

The Association is happy to receive applications for grants from the organizers of scientific meetings, workshops and short courses that lie conformably with its charitable purpose, which is to promote research in palaeontology and its allied sciences. Application should be made in good time by the scientific organizer(s) of the meeting on the online application form. Such requests will be considered by Council at its March and October meetings each year. If the application is successful, we will require that the support of the Association is acknowledged, preferably with reproduction of the Association's logo, in the meeting/workshop/short course literature and other media. Inquiries may be made to the Secretary (<secretary@palass.org>).

Applications should be made through online submission via the appropriate page on the Association's website, for which you will need the following information:

- Title of meeting / workshop / short course
- Date and Place proposed
- Name, position and affiliation of the organizer(s)
- Brief description (not more than ten lines) of the rationale behind the meeting / workshop / short course
- Anticipated number of attendees
- Amount requested (also whether request is for a loan or a grant)
- Other sources of funding applied for
- Specific use to which requested funds will be put

Note: If funds are requested to support one or more keynote speakers, then full details of their names, affiliations and titles of presentations should be included. The application will be strengthened if the keynote speaker agrees to submit their paper as a review article for possible publication in *Palaeontology*.

The deadlines are **1st March** and **1st September** each year.



Outreach and Engagement Grants

Awards are made to encourage educational outreach, public engagement, and related initiatives in palaeontological themes. Normally, the budget for an individual grant would be less than £5,000. Under exceptional circumstances, a budget of up to £15,000 for an individual application will be considered. Grants can support either stand-alone complete projects, or they can be 'proof of concept' case studies that have their own outcomes but that form the groundwork for a larger bid elsewhere. The award is open to both amateur and professional palaeontologists and the principal applicant must be a member of the Association. Preference will normally be given to candidates who have not previously received a grant.

Proposals must fit with the charitable aims of the Association and preference is given to applications for a single purpose (rather than top-ups of grants for existing projects). We particularly encourage applications with an innovative aspect, such as engaging with new media, and especially cases that will disseminate good practice. Successful applicants must produce a report for the Palaeontological Association *Newsletter*, and any publicity associated with the activity should mention the support of the Association. Full details of application procedures, terms and conditions are available on the Association's website at <www.palass.org>.

For more information, please contact the Association's Outreach Officer, Dr Fiona Gill, School of Earth and Environment, University of Leeds, Leeds, LS2 9JT; e-mail <outreach@palass.org>.

The deadline is **1st October** each year. The awards will be announced at the AGM, and funds will normally be available from 1st January.

Small Grants Scheme

The Association offers multiple awards each year, in honour of four donors, to fund palaeontological research, travel and fieldwork; these are integrated together under the Small Grants Scheme. These grants are open to any member of the Association, although preference is given to students, early career researchers, and members of the Association who are retired.

1. **Sylvester-Bradley Awards:** Multiple awards of up to £1,500 each, for palaeontological research.
2. **Callomon Award:** An award of up to £1,500 for a project which is normally field-based.
3. **Whittington Award:** An award of up to £1,500 for a project which is normally based on museum collections.
4. **Stan Wood Award:** An award of up to £1,500 for projects in vertebrate palaeontology, and ideally involving fieldwork and fossil collecting.

There will be one application form and Council will decide on the allocation of the awards based upon the nature of the project made in the application.



Applications should be made through online submission via the appropriate page on the Association's website, and will comprise:

- An account of project aims and objectives and expected outcomes
- A breakdown and justification of the proposed expenditure
- A curriculum vitae
- Two references: one to review the project, and one personal reference for the applicant
- A summary suitable for the non-specialist, which will be published in the *Newsletter* when the award is made

Successful applicants will be required to produce a final project report that will be published in the *Newsletter* and are asked to consider the Association's meetings and publications as media for conveying the research results.

Further details and a full list of terms and conditions for the Small Grants Scheme can be found on the appropriate page of the Association's website. Inquiries may be made to the Secretary (e-mail <secretary@palass.org>).

The deadline is **1st November** each year.

The awards will be announced at the AGM, and funds will normally be available from 1st January.



Undergraduate Research Bursary

The Palaeontological Association Undergraduate Research Bursaries are aimed at giving undergraduate students the opportunity to acquire research skills and experience that will significantly transform their academic career. The bursaries will support projects co-designed by students and their supervisor(s) that give students registered for an undergraduate degree their first experience of undertaking a palaeontological research project. The bursaries provide a stipend for the student of £200 per week for up to eight weeks. The scheme is not intended to fund students to undertake routine work for the supervisor(s) and the Association expects the supervisor(s) to provide significant personal mentoring of successful student applicants.

Applications should be made by the principal supervisor through online submission via the appropriate page on the Association's website, and will include:

- Details of the principal supervisor making the application, and other members of the supervisory team
- Details and academic track record of the named student
- An account of the project aims, methods and expected outcomes
- A project plan including details of supervision
- Ethics statement
- A referee statement in support of the named student

After completion of the work, successful students are required to produce a short report of the findings suitable for publication in the *Newsletter*. This report should be submitted to <palass@palass.org> within eight weeks of the stated end date of the project. Successful candidates are requested to prioritize the Association's meetings and publications as media for conveying the research results.

Further details, including eligibility criteria for supervisors and students, and a full list of terms and conditions for the Undergraduate Research Bursary Scheme, can be found on the appropriate page of the Association's website. Inquiries may be made to the Secretary (<secretary@palass.org>).

The deadline is 24th February each year.

Successful applicants will be notified by the middle of May and funds will normally be available from 1st June. A full list of awards will be announced at the AGM.



Research Grants

Awards are made to assist palaeontological research up to a maximum value of £10,000 each, normally in support of single research projects or 'proof of concept' proposals with an aim of supporting future applications to national research funding bodies. Field-based projects are also eligible, but the scientific objectives and outcomes of the research must be made clear. Applications for investigator's salary costs will only be considered in exceptional circumstances and if awarded all legal and financial liability will lie with the applicant.

Preference is given to applications for a single purpose (rather than top-ups of other grant applications). The award is open to both amateur and professional palaeontologists, but applicants will normally have a PhD as a minimum qualification and must be members of the Association.

Applications should be made through online submission via the appropriate page on the Association's website, and will comprise:

- A two-page curriculum vitae of the principal researcher
- A two-page 'Case for Support' which addresses the following points:
 - + Underlying rationale and scientific issues to be addressed
 - + Specific objectives of the research
 - + Anticipated achievements and outputs
 - + Methodology and approach
 - + Programme and/or plan of research
 - + How the research fits the charitable aims of the Association
 - + Proposals for wider dissemination of results including those relating to the wider public understanding of science
 - + A list of pending and previous applications (with funding bodies and results) for funds to support this or related research
- A breakdown and justification of the proposed expenditure
- A list of suggested referees who may be approached to review the proposal

Successful applicants will be required to produce a final project report that will be published in the *Newsletter* and are asked to consider the Association's meetings and publications as media for conveying the research results.

Further details and a full list of terms and conditions for the Research Grants Scheme can be found on the appropriate page of the Association's website. Inquiries may be made to the Secretary (e-mail <secretary@palass.org>).

The deadline is **1st March** each year.

Funds will normally be available from 1st June, and the awards will be announced at the AGM.



ASSOCIATION MEETINGS



60th Annual Meeting of the Palaeontological Association

Université Claude Bernard Lyon 1, France 14 – 17 December 2016

The Annual Meeting of the Palaeontological Association will be held at the University Claude Bernard Lyon 1, organized by Gilles Cuny, Bertrand Lefebvre, Vincent Perrier and Jean Vannier, with the help of the “Cellule Congrès” of the University.

Symposium

The meeting will begin with a symposium on the afternoon of Wednesday 14th December at the Laënnec building, Domaine de la Buire, University Claude Bernard Lyon 1, followed by an evening reception at the Villeurbanne City Hall.

The topic for the Annual Symposium this year is ‘Assessing palaeoenvironments and palaeobiology through geochemistry’.

- 13.15 – 13.50 Deep-sea barnacle shells: geochemical signal and microstructure
Ana-Voica Bojas (University of Salzburg)
- 13.50 – 14.25 Reconstructing Ordovician (Floian) conodont ecology and Laurentian seawater temperatures using oxygen isotopes
James Wheeley (University of Birmingham)
- 14.25 – 15.00 Isotope perspectives in vertebrate palaeobiology
Jeremy Martin (UCBL)
- 15.00 – 15.35 Isotopic ordering in fossil biominerals as an indicator of body temperatures and taphonomy
Robert Eagle (University of California)
- 15.35 – 16.05 Tea/coffee break
- 16.05 – 16.40 Isotopic aspects of dinosaur reproduction
Romain Amiot (UCBL)
- 16.40– 17.15 The foraging ecology of pterosaurs – implications from stable isotope analysis
Thomas Tütken (University of Mainz)
- 17.15 – 17.50 Decoding the palaeoecological information recorded in fossil bioapatite: stable isotope data in Cenozoic mammalian faunas from Spain
Laura Domingo (Geosciences Institute, Spanish National Research Council and Complutense University of Madrid)

Conference and Annual Address

The Conference will be held at the Laënnec building and will begin on Thursday 15th December with a full day of talks and posters. The Annual Address will be given by Prof. Manolo Gouy (University Claude Bernard Lyon 1) on the topic: “Molecular thermometers: reconstructing the evolutionary history of the adaptation to environmental temperature along the tree of life”. In the



evening there will be a nocturnal visit to the new museum “Musée des Confluences” on the banks of the river Rhône, followed by the Annual Dinner at the same location.

Friday 16th December will be a full day of posters and talks in parallel sessions (depending on demand). Talks for both days will be allocated 15 minutes including time for questions.

The Association AGM will take place after lunch and a wine and local products tasting session will be organized at the end of the day.

A hot lunch will be provided to delegates on both the 15th and 16th of December and is included in the registration fee. Attendees will be able to purchase one-day travel passes for public transportation upon arrival at the meeting at a special price of €2.50 instead of the public price of €5.50.

Field-trip

A field-trip to the city of Autun, approximately 190 km North of Lyon, is planned for Saturday 17th December. We shall visit the Natural History Museum in Autun as well as the type localities for the Autunian in the area, which have yielded among many other things the temnospondyl *Onchiodon (Actinodon) frossardi*. Access to the collections of the Museum, which hosts the fossils from the Lagerstätte of Montceau-les-Mines, could be arranged rather than to go in the field for those interested. We shall be back in Lyon around 8:00 pm.

Getting to Lyon

By Train:

The centre of Lyon is connected to all major French cities by the high-speed TGV trains via the three stations of Perrache, Part Dieu and Lyon-Saint Exupéry. Lyon Part-Dieu railway station is just two hours from Roissy CDG airport by TGV, and there is also a direct connection from London St Pancras to Lyon Part-Dieu, but only on Saturdays during December. For the rest of the week, you'll need to change train either in Lille or in Paris. It is easier to do so in Lille, as in Paris you need to change stations (from Gare du Nord to Gare de Lyon). For information see <<http://www.eurostar.com/>>

By Coach:

Lyon is served by a few regular coach services from towns and cities across France; these are often cheaper than trains. For information see Starshipper Bus (<http://www.starshipper.com/en/destinations-map_p243>) and Flixbus (<<http://www.flixbus.com>>).

By Car:

There is limited parking around the University, and almost none on campus, so driving to the meeting venue is not the best option. Lyon is two hours away from the Alps. Distances from other cities by road:

- Paris-Lyon: 465km (A6);
- Marseille-Lyon: 315km (A7);
- Genève-Lyon: 149km (A40);
- Montpellier-Lyon: 303km (A7-A9).

By Plane:

Lyon Saint Exupéry International Airport offers more than 115 direct connections, including regular flights to 68 international destinations, daily flights to 29 destinations in France, and low-cost airline companies connected to several European destinations. There are direct connections to Lyon for participants arriving at Paris CDG Airport by plane or by train.



An express tramway, Rhônexpress, links the Lyon Saint Exupéry airport to the central Lyon Part-Dieu railway station in 25 minutes, with departures every 15 minutes guaranteeing safe swift access to the heart of the city. Note that it is cheaper to buy tram tickets in advance on the Internet or at the station than inside the trams. Website: <<http://www.rhonexpress.fr/>>.

Public Transportation in Lyon

The network of metros, trams and buses of the T.C.L. (Transports en Commun Lyonnais – Lyon Public Transportation) enables rapid and easy transport from one place to another in the city and its suburbs through four metro lines, five tram system lines, two cabin transport lines and more than 130 urban bus lines.

The Domaine de la Buire is served by metro D, two tram lines (T2 and T5), and 6 bus lines (C8, C13, C16, C22, C26 and 24), stations “Laënnec” or “Grange Blanche”. Website: <www.tcl.fr>.

Registration and booking

Registration, booking and abstract submission are now open. Abstract submission will close in September (date to be confirmed) and abstracts submitted after that date will not be considered. Registration after that date will incur an additional administration charge of approximately €50, with the final deadline for registration in November 2016. Registration and bookings will be taken on a strictly first-come, first-served basis. No refunds will be available after the final deadline.

Registration, abstract submission, booking and payment (by credit card) are available online via the Palaeontological Association website (<www.palass.org>).

Accommodation

Accommodation is available within walking distance of the University and should be booked separately. Lyon has an accommodation capacity of more than 17,000 rooms in hotels and apartment hotels, which can be booked through the usual online resources (see for example <www.booking.com/lyon-hotels>).

Greater Lyon offers a choice between the charm and elegance of châteaux hotels and the dependable comfort of major international chains (Accor-Sofitel, Mercure, Best Western, Boscolo, Crowne Plaza, Hilton International, Holiday Inn, Louvre Hotels, Relais & Châteaux, Radisson BLU, Warwick).

The conference organizers will book a block of rooms and studios (up to four persons) at the Appart'hôtel Odalys Bioparc, just behind the Rockefeller Conference Centre. Prices will range from approximately £22 GBP in a shared studio to £89 GBP per person per night. To make your reservation e-mail <bioparc@odalys-vacances.com>, using the code ‘UCBL1’. Please mention the name of the Meeting. The deadline for reservations is 13th November 2016. After this date, reservations will still be possible with the code ‘UCBL1’ depending on availability.

Travel grants to student members

The Palaeontological Association runs a programme of travel grants to assist student members (doctoral and earlier) to attend the Annual Meeting, in order to present a talk or poster. For the Lyon 2016 meeting, grants of up to £100 (or the euro equivalent) will be available to student presenters who are travelling to Lyon. The actual amount available will depend on the number of applicants and the distance travelled. Payment of these awards is given as a disbursement at



the Meeting, not as an advance payment. Students interested in applying for a PalAss travel grant should contact the Executive Officer, Dr Jo Hellowell (e-mail <jo.hellowell@palass.org>) once the organizers have confirmed that their presentation is accepted, and before 1st December 2016. Entitle the e-mail “Travel Grant Request”. No awards can be made to those who have not followed this procedure.

Collections

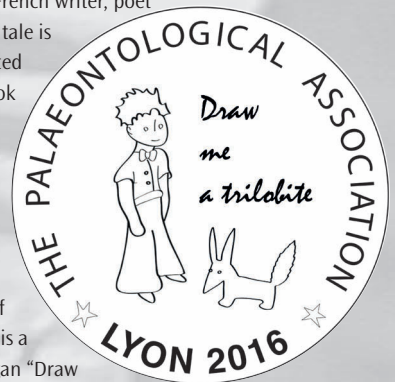
Attendees who would like to take this opportunity to visit the palaeontological collection of the University Claude Bernard Lyon 1, the largest French university collection, or the palaeontological collection at the Musée des Confluences Centre de Conservation et d'études des Collections need to contact Emmanuel Robert (e-mail <emmanuel.robert@univ-lyon1.fr>) for the former and Didier Berthet (e-mail <didier.berthet@museedesconfluences.fr>) for the latter, well in advance of the Annual Meeting, to arrange their visit.

Lyon

Lyon (<www.onlylyon.com/en/visit-lyon.html>), Capital of Gaul, is an ancient Roman city and a UNESCO world heritage site. It is also a world capital of gastronomy with, among many others, Paul Bocuse restaurants. It is situated in the middle of famous vineyards (Beaujolais – Côtes du Rhône). The “festival of lights” will take place a few days before the Conference.

Logo and slogan

The Little Prince (Le Petit Prince) is the most famous novel by French writer, poet and pioneering aviator Antoine de Saint-Exupéry. This poetic tale is named after its main character, a young boy, who is represented in our logo. *The Little Prince* is the fourth most-translated book in the world and was voted the best book of the 20th century in France. Translated into more than 250 languages, it has become one of the best-selling books ever published. As Saint-Exupéry was born in Lyon (29th June 1900) and gave his name to the Lyon Airport, we thought it relevant to use the Little Prince as the ambassador for the Annual Meeting in Lyon. The Little Prince logo is used with kind permission of the Succession Antoine de Saint-Exupéry. “Draw me a sheep” is a famous catch phrase of the Little Prince and inspired our slogan “Draw me a trilobite”, inviting colleagues to present their work in Lyon.



We look forward to seeing you in Lyon in December.



Palaeontology *and* Papers in Palaeontology *have more impact*

The 2016 Thomson Reuters Journal Citation Reports® have been released, with new impact factors announced based on citations for the calendar year to December 2015.

Palaeontology has continued to increase its impact, with a new impact factor of 2.31, keeping the journal at 6th out of 54 journals in the Journal Citation Reports Ranking for Paleontology. This is a measure of our citation influence on the broader literature and reflects the continuing high standard of submissions accepted by the journal. We are also pleased to report that we have reduced the average time from acceptance to publication to 39 days, ensuring the speedy publication of authors' work once it has passed the refereeing stage.

Papers in Palaeontology is now listed in the Web of Science and we are receiving a healthy stream of submissions to this journal. While there were no papers published in an issue in 2014 (the first issue was February 2015), Thomson Reuters registered six citations because papers are published immediately online as Early View, which bodes very well for the future. Time from acceptance to publication currently stands at an average of 47 days. Submissions to both journals usually receive a first decision within five weeks.

A massive thank you to all of our authors for choosing to publish with *Palaeontology* and *Papers in Palaeontology*!

Sally Thomas

<editor@palass.org>

Fossils in the news, Spring–Summer 2016

Usually I keep an eye on palaeontology in the news, but for this issue I decided to broaden my scope somewhat, and monitor fossils instead. A semantic difference, you might argue, but it seems many of our friends in the media remain rather confused about our discipline and its terminology, so I was curious to see what difference a change of search-word made. The discovery in a Peterborough clay pit of both *Eve* the plesiosaur (now in the Oxford University Museum of Natural History: <<http://www.oum.ox.ac.uk/visiting/presenting.htm>>) and the Must Farm Bronze Age village (<<http://www.mustfarm.com/bronze-age-river/forterra/>>) enabled even the BBC to enter the realms of palaeontological-archaeological conflation (see e.g. <<http://www.bbc.co.uk/news/science-environment-36384054>>). So what hope do fossils have of being correctly reported?

Well, to start with our own publications, the *Palaeontology* article by Lynn Harrell and colleagues on possible thermoregulation by late Cretaceous mosasaurs (<<http://onlinelibrary.wiley.com/>>



doi/10.1111/pala.12240/abstract>) attracted plenty of attention. “Were dinosaurs WARM-BLOODED?” boomed our old friends the *Daily Mail*, in the inevitable taxonomic tangent (<<http://www.dailymail.co.uk/sciencetech/article-3580669/Were-dinosaurs-WARM-BLOODED-Aquatic-reptiles-living-Cretaceous-period-body-temperatures-similar-sea-birds.html>>), though they did at least make it clear that mosasaurs weren’t dinosaurs in the article itself. Most other outlets that covered the research plumped for more appropriate terms, such as ‘aquatic lizards’ (<<http://www.redorbit.com/news/science/1113414010/ancient-lizard-warm-blooded-050916/>>) or ‘marine reptiles’ (<<http://www.techtimes.com/articles/156996/20160510/new-evidence-reveals-ancient-marine-reptile-mosasaurs-were-warm-blooded-creatures.htm>>).



<<http://www.ratbotcomics.com/>>

Whether Mesozoic squamates were warm-blooded is one thing, but whether NASA will find dinosaurs on Mars is quite another. This probably wasn’t one of the key questions James Witts and his colleagues at the University of Leeds and British Antarctic Survey were setting out to address with their study of the fate of Cretaceous–Palaeogene molluscs in Antarctica (<https://www.leeds.ac.uk/news/article/3871/antarctic_fossils_reveal_creatures_werent_safer_in_the_south>); however, it was one of the more mystifying ones engendered by the publication of their work in *Nature Communications*, proposed by a venerable media outlet called Claptrap, sorry, *Clapway* (<<http://clapway.com/2016/06/01/antarctica-aliens-dinosaur-age/>>). Maybe a submission to the next round of PalAss research grants is in order?

Out of order, and genuinely in need of closer scrutiny, is the apparent clamour for digging up the cliffs of East Anglia in the search for Pleistocene giants. ‘Fossil hunters at risk of destroying Norfolk coastline,’ said the Daily Telegraph (<<http://www.telegraph.co.uk/news/2016/05/15/fossil->

NEWS



hunters-are-at-risk-of-destroying-norfolk-coastline-by-ha/>), describing how mammoth-yielding cliffs near West Runton are being dug up by spade-wielding visitors. Both the Norfolk Museums Service and the Geological Society of Norfolk urged people to show “common sense and decorum” whilst hunting for fossils.

Further up the east coast of the UK, a local housing association has been chopping down trees in Sunderland, turning them into ‘ugly, rotten fossils’: <<http://www.sunderlandecho.com/news/ugly-rotten-fossils-anger-over-plans-to-hack-back-trees-1-7924255>>. One wag, commenting on the article, wondered whether the phrase wasn’t in fact referring to local politicians. It seems outside of scientific parlance, ‘fossil’ is rarely used in anything other than disparaging terms.

I was happy, therefore, to come across a more positive story, and even more delighted that it linked palaeontology and cricket. The glad tidings came courtesy of the *Worcester News* and their announcement that a local team of veteran cricketers, known as ‘The Fossils’, had claimed a piece of silverware: <http://www.worcesternews.co.uk/sport/14521107.Veteran_cricket_team_Fossils_win_Peter_Tudge_Trophy/>. Even better, their star bowlers were called Cliff and Pete, which is surely a special kind of nominative determinism. Elsewhere in sport, but rather less jovially, the members of a Scottish golf club elected not to permit women as members, leading the *Herald Scotland* to announce that “[t]he Muirfield fossils have sentenced themselves to irrelevance” (<http://www.heraldscotland.com/opinion/14508745.The_Muirfield_fossils_have_sentenced_themselves_to_irrelevance/>). The writer speculated that these “living fossils” (implying mysteriously that there are golfers preserved in the fossil record somewhere) also wished to “create an impermeable wall of stone” between themselves and the outside world. That sounds a lot like biogenic sedimentology to me: perhaps the golfers have their heads in the sand in more than one way.

Staying (and ending) with trace fossils, then, the most surprising of all ‘fossils’ news was my discovery, via the *New Historian*, that “Ichnology has a new fossil” (<<http://www.newhistorian.com/ichnology-new-fossil-lepeichnus-giberti/6442/>>). Even more remarkably, the ichnotaxon in question wasn’t a dinosaur footprint, but *Lepeichnus giberti*, a probable crustacean burrow from the Miocene of southwest Spain. Named in honour of the much-missed Dr Jordi di Gibert, *L. giberti* is particularly noteworthy in that the complex burrows preserve evidence of the tracemaker’s ontogenetic development. If the new concept of ‘ichnogeny’ doesn’t make it into the next round of news stories, I shall be most disappointed.

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MYSTERY FOSSIL 24

This mystery fossil is from Namurian (Late Carboniferous) sediments at Dunbeg Beach, west County Clare, Ireland, and has been proffered by Emma Glanville of the Irish National Parks and Wildlife Service (via Maria McNamara). The specimen is about 35 mm wide. Comments to Maria McNamara (<newsletter@palass.org>), please!



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Legends of Rock

Barnum Brown and the legend of Tyrannosaurus rex

It is difficult to imagine a scientific discovery that has cast a longer cultural shadow than that of *Tyrannosaurus rex*. It is among the most enduring icons of the 20th century. It towers over us in our museums, haunts our imaginations from the pages of children's books, and devours misplaced lawyers in our cinemas. In the media *Tyrannosaurus* is the dinosaur to which all other dinosaurs are compared, almost to the absurd.

We look up to the dinosaurs as the serpents and wyverns of a new mythology. The palaeontologists who unearthed their remains are the gallant knights who vanquished them: Mary Anning, Gideon Mantell, Othniel Marsh, Edward Cope, Earl Douglass and, of course, Barnum Brown. What more heroic palaeontological deed could there be than to discover the most infamous dinosaur of all?

Barnum Brown was the youngest of four children, born to a frontiersman in the newly-established state of Kansas. His father William built a farmhouse near a rich coal seam, now known to have been Upper Carboniferous in age. Barnum Brown clearly held great reverence for his father, once saying that "...*Father's finest gift to me: it was of himself.*"

His upbringing was far from idyllic. At the time, the United States was a nation divided over the matter of federal versus individual states' political power. With the outbreak of the American civil war, William departed to join the abolitionist cause, leaving his wife Clara to care for the four children alone. As well as raising and providing for them, Clara had to protect the family from the assortment of armed militias on both sides of the conflict who frequented the area. Clearly she was of strong character, for she fulfilled this task with complete success. However, after William's return following the war, their farm was beset by drought and blighted by pests and disease.

Barnum Brown did not attend school until he was sixteen, where he came under the tutelage of one Professor Samuel Wendell Williston. The professor was a keen influence on Brown, and inspired him to pursue a career in palaeontology. Williston had risen to prominence as a dinosaur hunter against the highly competitive backdrop of the so-called 'bone wars'. Brown quickly revealed his talent as an excavator of fossils and became a fundamental member of Williston's expeditions.

It was on Williston's recommendation that Brown ascended to a position at the American Museum of Natural History (AMNH). It was during his tenure at the AMNH that he made his most notable finds, including *Tyrannosaurus*, *Kritosaurus*, *Hypacrosaurus* and *Corythosaurus*. And, it was at the AMNH that Brown became affiliated with Henry Fairfield Osborn, with whom he would collaborate on many occasions. This is perhaps testimony to Brown's character, for Osborn was notoriously pompous and difficult to work with.



During his career with the AMNH Brown devised pioneering new methods. He was among the first to make geological surveys from an aircraft and it was he who developed the use of plaster of Paris and burlap to protect his finds, a technique still in use today.

Despite his achievements, Brown cannot take sole credit for many of his scientific advances. When the remains of *Tyrannosaurus* were unearthed, Brown himself was not first on the scene; he had been following a tip-off from an elk hunter. In addition, Brown would seem to have been a reluctant scholar. He attempted to refuse the offer of a scholarship, secured by Osborn, for him to study at Columbia University, hoping instead to continue collecting fossils (his wish was not granted). Much of the analytical and descriptive work associated with his later discoveries was delegated to other academics. *Tyrannosaurus rex* was described and named not by Brown, but by Osborn.



Barnum Brown at Howe Quarry, Shell, Wyoming, 1934. Image #132806 courtesy of American Natural History Museum Library.

Today, the myth of *Tyrannosaurus rex* has overtaken the reality. It remains the undisputed king of the dinosaurs, still depicted as a bloodthirsty, scaly-skinned hunter. Its name is known to even the most uninspired of five-year-olds. By contrast its scientific relevance seems to lessen every year. Numerous carnivorous dinosaurs have been unearthed that rival or even exceed *Tyrannosaurus* in size. *Tyrannosaurus* itself appears to be but a large member of a diverse clade of similar dinosaurs. Academics continue to speculate over how much *Tyrannosaurus* supplemented its diet through scavenging; perhaps something of a lowly past-time for a king. Stripped of its status, even *Tyrannosaurus*' appearance has been defiled as evidence emerges that it may have been at least partially feathered.

The greatest irony of Barnum Brown's career comes not from one of his own discoveries but one made by Edward Cope in 1892. It consists of two vertebrae, one since lost, which Cope assigned to the genus *Manospondylus gigas*. More recent examination of these bones finds them to be identical to those found by Barnum Brown. Thus *Tyrannosaurus rex* is a junior synonym, named and known to science more than ten years before Osborn's 1905 description. Arguably Barnum Brown's greatest achievement, the most infamous dinosaur of all, never existed in the first place.

Max Stockdale

University of Bristol

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Behind the Scenes at the Museum

A whistle-stop tour of Norfolk Museums Service, UK

Located in a castle built between 1066 and 1075, perched atop a Norman mound, “Norwich Castle Museum can’t be missed,” says David Waterhouse, curator at Norfolk Museums Service. Norwich Castle Museum is just a small part of NMS, which is now regarded as one of the leading bodies in the UK Museums sector.



Figure 1. Norwich Castle Museum. Image © Norfolk Museums Service.

NMS was awarded “Major Partner Museum Status” in 2012 along with other museums in the UK, by Arts Council England. It was established in 1974 when the County and District Councils in Norfolk delegated their museum powers to a countywide Museums Service run by Joint Committee. The Norfolk Museums Service comprises museums, collection study centres and countywide services, which aim to enhance education, research and public outreach. “Many of the initial collections were donated,” says David – over the past 180 years the collections have been built up by locals and the generosity of geologists. As the sole member of the Natural History section at NMS, David deals with all natural history inquiries, “anything from fossil bones to plants”, an enormous task that sees over 800 specimen queries each year!

Today there are over 30,000 geological specimens (many of international importance) at Norfolk Collections Centre, Norwich Castle Museum and Cromer Museum. The Norfolk and Norwich Museum was established in 1825 and transferred to Norwich Castle in 1894 to become Norwich Castle Museum. Previously a medieval palace, the castle has entertained royalty but was later



transformed into a prison. The city of Norwich bought the building in 1887 and converted it into a museum; it was officially opened in 1894 by The Duke and Duchess of York.

At the castle you will find an array of specimen cases in the Natural History Gallery which contain Cretaceous echinoids, hyaena coprolites from the Cromer Forest-bed Formation, interglacial material including reindeer and hippopotamus remains, one of the largest flint ammonites ever discovered, and the West Runton mammoth vertebra and mandibles. “The West Runton mammoth (*Mammuthus trogontherii*), was an exciting discovery – the largest and oldest mammoth to have ever been discovered in the UK – and comes from the West Runton Freshwater Bed. Some of the material can be seen on display at Norwich Castle,” says David. A local couple, walking along West Runton shoreline following a stormy night, observed a large bone partly exposed in the base of the cliff and contacted NMS. The fossil was identified as the pelvic bone of a large mammoth. This significant find, along with other material found the following year, led to the first excavation in January 1992, with another major excavation in 1995 (funded by the Heritage Lottery Fund, M.G.C. Prism fund and Anglian Water).

Although the mammoth is accessioned to the Castle Museum, the majority of the skeleton is currently housed in special storage at the Norfolk Collections Centre, Gressenhall Farm and Workhouse, near Dereham (also apart of NMS) and can be seen by appointment or on special tour days. Exciting plans are underway to conduct a 3D laser scan of all the skeletal elements in the collection so that a full-sized 3D printed replica can go on display at the Castle, forming the centre-piece of impressive displays of the Cromerian Stage of the Pleistocene Epoch throughout Norfolk.



Figure 2. The huge partial skull and right tusk of the West Runton Mammoth at the Norfolk Collections Centre, Gressenhall, near Dereham. Image © Norfolk Museums Service.

Included among the ten sites of the Museums Service is Cromer Museum which was established by Cromer Town Council when they bought a group of cottages in 1967. It was over ten years,



however, before the Museum saw the first visitor pass through its doors. Due to an agreement when the cottages were purchased, the residents could stay as long as they pleased and it was not until 1978 that the Museum was declared officially open. With the aid of a public appeal for material to be donated to the Museum, the collections have grown in size and content. The largest collections of geological material within the NMS are on display here. “These offer a gateway into North Norfolk,” says David. The collections include Pleistocene megafaunal remains from the Cromer Forest-bed Formation and Norfolk Crag deposits. The Crag collection consists of marine mammals such as cetaceans and walrus, as well as land mammals such as elephantids. Material from the White Chalk Formation – some of the youngest chalk in Europe – also resides here, among which are belemnites, echinoids, mosasaur teeth and a replica of a mosasaur skull.



Figure 3. The geology gallery at Cromer Museum. Image © Norfolk Museums Service.

Cromer Museum received funding for a large re-development project during 2005–2006 which saw the addition of a new education room, shop and other new facilities. There is an array of events held at the Museum as part of school outreach programmes, which include a ‘Mammoths, Monsters and Minibeasts’ day. Other events handled by David and colleagues include their regular Fossil Roadshow, which engages members of the public of all ages.

The Cromer Fossil-bed Project, a joint project with the Natural History Museum and British Museum, has been under way since 2012 to develop a database including the location and inventory of material found at this site. David has big plans for the future too, including a smartphone app for helping the public record fossil material and a website to accompany it. At an early stage of project development is the ‘Deep History Coast’ tourism package, similar to the ‘Jurassic Coast’ in Dorset and Devon, which will “link the landscape to the material on display at our museums” says David.



David's top three "must see" palaeontological objects/collections at the NMS are:

- The West Runton mammoth
- *Dama roberti* – Robert's Fallow Deer
- The Norman Peake collection of Cretaceous chalk fossils

Orla Bath Enright

University of Portsmouth

Official webpage: <www.museums.norfolk.gov.uk/Research/Collections/Geology_Collections>

 @NatHistNMS

 Natural History, Norfolk Museums Service

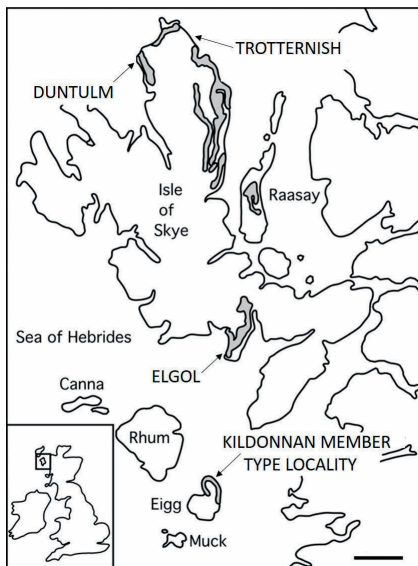
The Great Estuarine Group (Jurassic, Scotland) as a source of vertebrate fossils: some reminiscences and field trips

When I started research at Cambridge in 1956 for my PhD on the Middle Jurassic rocks of the Inner Hebrides, I gave no thought to their potential for vertebrate palaeontology. I quickly became most interested in the Great Estuarine Series (see Hudson and Trewin 2003), as it was then known. Its palaeoenvironment was a challenge, especially as the 'Estuarine Series' in Yorkshire had recently been interpreted as largely deltaic. I knew I had to study its sedimentology and invertebrate fauna, as well as sorting out its stratigraphy, but I was entirely ignorant of vertebrates. At that time, invertebrates were taught in the Department of Geology in Cambridge, led by Bulman, and vertebrates in Zoology, led by Parrington (rumour had it that they didn't get along).

The Eigg plesiosaur

The story began with Hugh Miller's visits to Eigg in 1844 and 1845. He discovered plesiosaur bones, the first record of these marine reptiles from Scotland, and wrote enthusiastically about them in his Free Church journal, *The Witness*. His writings gained wider circulation in the posthumous publication of *The Cruise of the Betsey* in 1858 (see Hudson 2003). Miller was also remarkably prescient about the palaeoenvironment of what Judd later called the Great Estuarine Series, but while his writings were a great popular success they were largely ignored by later authors, presumably because they were not published in scientific journals. There are scattered mentions of vertebrate finds, mostly of fish, in the Geological Survey Memoirs of the early 20th century, but without emphasis.

My own involvement started in the late 1950s when I visited Eigg and found some well-preserved plesiosaur vertebrae. I showed them to my contemporary, Arthur Cruickshank, at that time a PhD student under Parrington, and he prepared a specimen from its recalcitrant matrix and suggested I send it to Alan Charig at the Natural History Museum in London. The specimens attracted the attention of W. E. Swinton, then curator of vertebrates, who wrote me a rather remarkable letter



Map showing the Great Estuarine Group outcrops in grey and some of the main localities, redrawn after Hudson et al. (1995) and Holmden and Hudson (2003). Scale bar is 10 km.

reminding me of his position, and of Charig's. Shortly after this, Swinton left for Canada and Charig succeeded him. Re-awakened interest led to Barney Newman collecting a great deal of material from Eigg (and reputedly enlivening the social scene there); the collection remains in the NHM. I published a paper on "Hugh Miller's Reptile Bed and the *Mytilus* Shales", rather incongruously written at Caltech in Pasadena, in 1966. This confirmed Miller's observation that the "Reptile Bed", the thin, iron-rich limestone that is the source of all the plesiosaur bones, occurs low in the succession on Eigg, in what we now refer to as the Kildonnann Member of the Lealt Shale Formation. I think this paper played a part in encouraging the next phase of research by David Brown at Newcastle. This has not been fully published, but led to the construction of an excellent model of this small plesiosaur in time for an exhibition at the National Museum of Scotland, marking the 2002 bicentenary of Miller's birth. I told

this part of the story at a gathering in honour of Arthur Cruickshank in 2009.

The Kilmaluag Formation 1: mammals

So far, all plesiosaur. That changed dramatically in 1971. For a Jurassic symposium held in 1969, I had written a field guide that mentioned bone fragments could be found in the Ostracod Limestones (now Kilmaluag Formation) at Glen Scaladal, near Elgol on the Strathaird peninsula of Skye. Science teacher Mike Waldman went there with a party from Stowe School to take a look and found a mammal tooth. He immediately told his mentor, Bob Savage from Bristol, who apparently drove all the way to Skye and was on the outcrop by first light. I was told about this, and sworn to secrecy (it seems vertebrate palaeontologists are a competitive bunch). Soon afterwards, a skeleton of the mammal was discovered. On publication in 1972 *Borealestes* was the second named Middle Jurassic mammal in the world (Waldman and Savage 1972); there are many more now.

The Kilmaluag Formation at Glen Scaladal consists of fine-grained, somewhat argillaceous and dolomitic limestone, interbedded with marls, with many levels of deep mudcracks showing emergence (see Andrews 1985). The fine-grained lithology allows faithful preservation, although it is indurated due to slight metamorphism from proximity to the Cuillin plutonic centre. Perhaps this helps with collecting, as the limestones form bold low cliffs that yield many large coherent fallen blocks, and bones weather proud on exposed surfaces. It also means that invertebrate fossils, especially the ostracods that gave the Formation its former name, are poorly preserved at Glen Scaladal. So, in 1980 Jim Harris and I made Kilmaluag in north Skye the type locality (Harris and Hudson 1980). It is of similar facies but unmetamorphosed and yields a sparse macrofauna,



mainly of unionid bivalves and the gastropod *Viviparus*, and a microfauna of abundant freshwater ostracods and spinicaudatans (conchostracans). Deposition was in extensive, shallow freshwater lakes (probably close, but not connected, to the sea), that periodically dried up. A strongly seasonal climate is indicated. The absence of rootlet horizons is somewhat surprising, but maybe intervals of emergence were too brief and evaporation too strong. Had we known how important a vertebrate locality it was to become, we might have called it the Scaladal Formation.

The 1972 field trip

It was partly because of Waldman and Savage's discoveries that I decided to organize a field trip to the Great Estuarine Series to show it to interested friends and colleagues. By then I had made many field visits for my own research and I thought I knew the outcrops reasonably well. I simply wrote to people asking if they were available, and quite a few of them were. It is hard to imagine this happening now. Several participants subsequently had notable careers in diverse fields. They included Waldman, Savage, Tim Palmer, later Executive Officer of the Palaeontological Association, Mike Barker, at one time its Membership Treasurer, Hugh Torrens, now doyen of geological historians, Keith Duff, then my PhD student on Oxford Clay bivalves and ultimately chief scientist of the Nature Conservancy, David Palframan who also worked on the Oxford Clay, Alastair Robertson, who had mapped Eigg for an undergraduate project and subsequently became an authority on Cyprus and Turkey, Terry Scoffin, who wrote a textbook on carbonate rocks, Rob Raiswell, a geochemist interested in concretions (another prominent feature of Great Estuarine geology), Peter Boyd, a great collector who sadly didn't complete his work on the microfossils, and Roy Clements, curator at Leicester who made a collection of material for our Department. We had a great time and collected a great deal of rock, especially for extracting microvertebrates. Waldman and Savage collected a lot of important material that eventually led to the next phase of investigation.

The Kilmaluag Formation 2: small reptiles and more mammals

I can claim no direct involvement in this next phase, led by Mike Waldman, Susan Evans (University College London), Paul Barrett (Natural History Museum, London) and many colleagues, which led to the most important discoveries of tetrapod fossils (see Evans *et al.* 2006). From a number of field trips the Kilmaluag Formation yielded a remarkably diverse fauna of terrestrial and freshwater aquatic mammals, reptiles, amphibians and fish in at least 22 taxa, including sharks, amiid fish, salamanders, lizards, choristoderes, pterosaurs, crocodiles, turtles, and further mammals and tritylodonts. The most spectacular discovery on the 2004 field trip was an association of several turtles. The assemblage resembles that from roughly contemporaneous horizons in Oxfordshire, but differs in containing several associated specimens, not just isolated teeth.

Dinosaurs and their footprints

In 1982 I was with Julian Andrews, then my PhD student and now Professor at the University of East Anglia, investigating the Lealt Shale Formation at Trotternish, Skye. Julian noticed an inverted block of limestone, fallen from the cliff above, that bore an unmistakable print from a large dinosaur. The block could be assigned to a precise bed in the section by its distinctive lithology. At the time, dinosaur footprints were not known in Scotland, but were becoming well known in the Purbeck Beds of Dorset in rather similar lithologies to those of the Lealt Shale: alternating mudstones and shelly limestones. We consulted Paul Ensom, who had worked on



the Purbeck. Later, the block was collected for the Hunterian Museum in Glasgow by Stan Wood, assisted by Julian, and had a small paragraph in *The Scotsman* newspaper. Soon after this, Dugald Ross, a local resident, became interested in fossil collecting and set up a small museum near his home. More footprints were found, this time in the Valtos Sandstone Formation above the Lealt Shale, and dinosaur bones started to turn up too. Ross contacted the Hunterian Museum in Glasgow, as a result of which Neil Clark became involved. Since then both the Valtos Formation and the Duntulm Formation in Trotternish have yielded footprints, including trackways, and Paul Marshall extended the record to Strathaird. The Duntulm dinosaurs must have waded through salty water, as its abundant oysters show that the shallow lagoons were more saline at that time. Trotternish is now promoted as a dinosaur hotspot to tourists, with a signboard at the Kilt Rock viewpoint erected by the Lochaber Geopark. See Clark (2007) for more on the dinosaur discoveries.

The Kildonnan Member: the 1999 field trip

Many field visits continued, especially in the company of PhD students who studied aspects of the Great Estuarine Group much more intensively than I had been able to. In 1999, as part of the celebrations to mark my retirement from the University of Leicester, I invited some colleagues and former students to join me for a few days on Eigg, my favourite island. It started frustratingly with three days in Arisaig while a gale blew and ferries could not sail, but eventually we made it over and a good time was had by all. We naturally visited the Kildonnan Member section (see Hudson *et al.* 1995 for palaeoecology). The plesiosaur bones all come from one thin bed in the lower part of the Kildonnan Member; another thin bed is distinctive in being packed with fish teeth and scales, especially hybodont sharks. Charlie Underwood, then at Liverpool, joined us and collected a great deal of material from the Fish Bed, as well as other horizons (see Rees and Underwood 2007).

Transatlantic involvement has contributed further insight into the Kildonnan Member palaeoenvironment. I had made contact with Bill Patterson, then at Syracuse University, who is an authority on fish otoliths. In 1995 Matt Wakefield and I showed Bill and his student the Kildonnan Member outcrop. The samples he collected yielded the oldest otoliths known still preserved in their original aragonite (see Patterson 1999). Another successful collaboration, with Chris Holmden from Saskatchewan, also built on the exceptional preservation of aragonite at Kildonnan, via analysis of the geochemistry and composition of the bivalves. Although not directly concerned with vertebrates, the results helped to re-interpret the environment, showing that the water in the shallow lagoons in which the sediments accumulated was overwhelmingly freshwater (Holmden and Hudson 2003). Some marine connection is still required to interpret the otoliths of migratory fish, but much less than we used to think. It seems likely that the plesiosaurs, as well as the sharks, were freshwater animals.

The 2013 field trip

In 2011 I met Martin Munt from the Natural History Museum, London, at a PalAss meeting. He had a poster on Chinese freshwater bivalves and I hoped he might use his Chinese contacts to help investigate the possibility that some of those in the Great Estuarine Group had crossed from China via the 'polar route', as I had tentatively suggested. He responded by proposing a field trip, intended to go to Eigg. We were joined from the vertebrate fraternity by Roger Benson from Oxford and David Ward, the authority on sharks. Shades of 1999: we arrived at Mallaig with an



easterly gale blowing and no ferries to Eigg, so squeezed back into our small vehicle and drove to Kyle and over the bridge to Skye. I had taken no literature on Skye, but fortunately could remember enough localities to keep us happy for a couple of days. Eventually we made it to Eigg for a curtailed visit, although unfortunately David Ward had to leave, but we collected some Fish Bed samples for him. The others were suitably impressed by the Kildonnan Member section, and several reptile bones were found. The bivalves, however, still await re-interpretation.

New blood and more footprints

Perhaps, as an American, Steve Brusatte won't mind being called the new kid on the block. He is now based in Edinburgh and is a leading light in PalAlba, a group pressing Scotland's claim to be a hotspot for vertebrates, especially dinosaurs and marine reptiles (see Brusatte 2015). It includes Stig Walsh and Nick Fraser from the National Museum of Scotland, Neil Clark from the Hunterian Museum in Glasgow, and Dugald Ross from Skye. A particularly welcome part of their activities, with Stig Walsh's student, is the long-delayed full description of the *Borealestes* skeleton found by Waldman and Savage in 1971. Brusatte made contact with me in 2014 asking about specimens in Leicester and field localities. He visited in 2015 to give a talk and we had a long chat afterwards. I showed him a piece of bone from the Duntulm Formation, which he decided was the jaw of a small crocodile. I recommended a visit to Duntulm, and while there Steve and others found yet more footprints in outcrops that I must have walked over many times without noticing them.

Research on the Kilmaluag Formation fauna continues. Benson, following up the 2013 trip, returned to Skye in 2014 and 2015 with colleagues: finds included mammal jaws, such as the jaw of the stem therian *Palaeoxonodon ooliticus*, a taxon previously only known from teeth, and new remains of amphibians and reptiles. Most recently (autumn 2015), Julian Andrews and colleagues have found dinosaur prints in the basal part of the Kilmaluag Formation in inland Strathaird. Being a fairly obscure locality I might forgive myself for not visiting it, but surely I should have found more prints and bones than I did, over the decades. My old notes record loadcasts from several horizons within the Great Estuarine Group and I now wonder what applied the load. Fortunately, a field lifetime is short on a geological time scale. Progress is much faster now – long may that continue.

At Kildonnan, the view is of the mountains of the west Highlands; at Duntulm, those of Harris across the Minch; and on Strathaird, most dramatic of all, the Black Cuillin. Can there be more beautiful field localities in the whole world?

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The Kilmaluag Formation locality.



How to own a mammoth

It's only natural to wonder why species have gone extinct, and then fantasize what it would be like to see them returned to life. Generations that enjoyed Doyle's "The Lost World", or Crichton's "Jurassic Park" are testament to such a fantasy. Will we – and should we – resurrect any of the hugest, and fiercest, and strangest animals? Over the past 32 years, the field of ancient DNA has contributed to the debate by retrieving ever larger fragments of genetic information from extinct species. In the popular consciousness, we understand that DNA equals life. Now papers published on the genetics of extinct animals are met with: "can we clone it yet?" The short answer is no. The long answer is maybe; but should we?

Thanks to the persistence of ancient DNA researchers, we have genomes from many extinct Quaternary mammals: mammoths (*Mammuthus primigenius*), cave bears (*Ursus spelaeus*), aurochs (*Bos primigenius*), Neanderthals (*Homo neanderthalensis*), and Denisovans (*Homo x*). More are on the way. These hard-won datasets reveal fascinating details about the phylogeny and phenotypes of species. But biology is messy; we can't just plug our recreated genomes into an empty cell, sit back, and wait for a baby mammoth (Shapiro 2015a). To understand why this is the case, we need to look at some of what we've learned from the DNA of old bones.



Columbian mammoth (*Mammuthus columbi*) at the Page Museum in Los Angeles, California. Photo by WolfmanSF, used under the CC BY-SA 3.0 licence.

DNA is an unstable molecule. Ridiculous amounts of cellular energy go into keeping it from breaking down, and patching it up when it inevitably gets broken. When an organism dies, these processes are left unchecked. DNA very quickly suffers from radiation damage, hydrolysis, depurination, deamination, strand breaks, and assorted other issues that make it unreadable



(Briggs *et al.* 2007). Very rarely, circumstances conspire to slow down the damage. In a similar way to drying or freezing food to extend its shelf-life, the environments in dry caves and frozen permafrost can allow DNA to hang on. It seems like every time someone digs up a mammoth mummy (or for that matter, an adorable cave lion, *e.g. Panthera spelaea*) in Siberia, there appears a flurry of news articles about how this find will be used for cloning. What these stories ignore is that even with the best permafrost preservation, DNA is often broken into segments of only 500–1,000 base pairs (the ACGT ‘letters’ of DNA). When you consider that a single chromosome may have 250 million base pairs, complete without a single gap, and that the working of the chromosome depends critically on the uninterrupted order of the base pairs contained within it, you see the problem. No one is ever going to clone a mammoth by using frozen cells from the permafrost. There has to be some kind of rebuilding of the ancient genome before we can think about cloning.



Woolly mammoth (*Mammuthus primigenius*) mummy ‘Dima’. Photo by A.V. Lozhkin, NOAA PD, public domain.

So how do you rebuild a genome, broken into random fragments? It’s like the smallest ever 6-million-piece puzzle. And if you put just one piece in the wrong place, you get nothing. Luckily, researchers have got around this issue in an ingenious way. Using the genomes of related, but extant, species as a scaffold, it is possible to map the ancient DNA to an approximate position within the genome (Poinar *et al.* 2006; Miller *et al.* 2008). Of course, using this approach constrains the number of species you can work with. The degree of divergence between mammoth and elephant, or human and Neanderthal, is small enough that the modern genomes and ancient genomes map well enough. But what modern genome could act as scaffold to an extinct notoungulate? This method also forces us to ignore aspects of evolutionary change that could have had large effects on the living animal but which can’t be picked up, *e.g.* chromosomal inversions or chromosomal fusions.



Assuming we do have a patched-up genome from an extinct mammoth, why not just synthesize the chromosomes and bung them into an elephant egg cell? This wouldn't work either. Chromosomes have features on their centres and at the tips of their arms (centromeres and telomeres) that are essential to the process of mitosis and are made up of long repeating sequences. Current DNA sequencing technologies work very badly with repetitive DNA, to the extent that we don't even know the correct sequence for human repetitive regions.

But all is not lost. There is an alternative strategy that may be more likely to succeed. Instead of trying to recreate an extinct genome, we could theoretically identify which genes code for unique phenotypic traits in extinct species, e.g. abundant hair, curved tusks, and anal flap in the woolly mammoth, then modify those genes in the zygote of a close relative. This approach becomes somewhat like the ship of Theseus: at what point does a modified elephant become a mammoth, if ever? Would we be satisfied with a palimpsest mammoth? The technology exists now to modify genes in living cells. CRISPR/cas9 is a relatively new biotechnology based on a process identified in the primitive immune system of prokaryotes. Within bacterial cells, this protein/nucleic acid complex acts to identify foreign DNA and tag it for destruction. Subtle modifications of the CRISPR/cas9 system have been developed in the lab: it can now be programmed to find any DNA sequence and replace it. Last year, researchers in Harvard modified living elephant cells with genes recovered from mammoth for fat storage, haemoglobin, and hair length (Shapiro 2015b).

So, theoretically, we could identify every position in the elephant genome that differs from the woolly mammoth, change them, and then have a good facsimile of a living mammoth cell. What should we do with it then? Animal cloning involves swapping nuclei from a somatic cell to a zygote, before goading the new hybrid into mitosis and growth into an embryo that can be implanted in a surrogate. At that point we have a pregnancy, right? Not quite. There are problems even at this stage. To put it mildly, assisted reproduction in elephants is a complicated, delicate, and dangerous business. Elephants ovulate only once in five years, releasing one or two large ova, and in the wild nearly immediately become pregnant. Another issue involves elephant hymens. These tough, elastic structures regrow between pregnancies and are impermeable except for a microscopic opening that allows the entry of sperm (but not the exit of eggs).

Even if all the technological obstacles were surmounted, should we clone extinct species? Certainly, the technical accomplishments necessary could prove important for conservation. Thousands of tissue samples of endangered and soon-to-be extinct species are held in the 'frozen zoo' in San Diego. If we could clone a mammoth, we could clone a panda. But all the money spent on figuring out how to clone mammoths could be used now *to prevent pandas going extinct!* Conservation funding is often small and localized. Shouldn't we look after what we have, rather than pining for what we don't?

What would we even do with a mammoth? The mammoth steppe habitat it lived in is gone. Perhaps reintroducing mammoths to the tundra would help to bring it back (Zimov *et al.* 1995). Still, I doubt modern-day Siberians or Alaskans would appreciate sharing their land with a giant, pissed-off proboscidean. Few people are even willing to countenance reintroduction of lynx, wolves or bears: why should the mammoth be different? Should it live, isolated and alone, in a zoo? Would this be ethical? Isn't the mammoth better as a creature of the past, where it lived a free life in free herds, its extinction through human agency a dire warning to the present (MacDonald *et al.* 2012)? When humans and mammoths lived together during the Pleistocene,



we sought them out for meat, for ivory, for bone. We knew them living, but wanted them dead (Pitulko *et al.* 2015). Perhaps we'll eventually learn how to clone a mammoth, but we will never know how to own a mammoth.

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Late Pleistocene (13ka BP) spear-thrower carved in mammoth ivory, in the image of a mammoth. Photo by Discott, used under the CC BY-SA 3.0 licence.



Bring on the Deluge

A century and a half on, the pictures keep turning up, wheeled into service once more when there's a need for some dramatic scene or other of an ancient Earth. A Jurassic seascape, perhaps? Here's one with ichthyosaur battling plesiosaur on storm-tossed seas against a glowering sky – why, it's the very thing! A Carboniferous forest, maybe? Well, there's none better than this, where primeval trees grow and die in half-darkness, some leaning precariously and about to topple on to the foetid swamp floor. And there are others of this atmospheric ilk. The cast includes the most carapacious armoured fish, the wickedest dinosaurs, the creepiest skeletons and a *Megatherium* that is climbing out of the page to embrace you. Doubtless they will be turning up to shiver spines, still, in another century and half.

These are the pictures that Edouard Riou was commissioned to draw for Louis Figuier's *La Terre Avant Le Déluge*, one of those nineteenth century geology epics that has always been just a dim legend to me – other, of course, than those pictures, which have long passed through my retina to take up permanent residence in the stratigraphic sector of my cranium. So what of the book itself? Written at a time when the study of ancient Earth and ancient life was just cranking up – what could an avowedly antediluvian history offer to the modern reader? These days, such antiquarian relics can be abstracted from the ether without having to search through library basements or the more eccentric kind of second-hand bookshop, so it was clearly time to settle down with a cup of tea and excavate the words – and the wordsmith – that went with these most phantasmogoric of pictures.

The wordsmith, it turns out, was of a curious modernity. Louis Figuier was, expressly, a popular science writer, rather than being one of the early savants of palaeontology. By background he was a chemist, a professor of pharmacy like his father¹, and seemingly set for a career in this line. He ran afoul, however, of what is hinted to have been a little political skullduggery by an academic rival, so changed tack to make writing for the public his main profession. None of this was mentioned when, late in life, he gave an interview in which he simply asserted that writing had always been his chosen path.

Whether pushed into writing, or pulled into it by a love of the craft, Figuier as a writer turned out to be both prolific – with volumes on the earth and the sea, on great inventions ancient and modern, and others in which he more or less covered the length and breadth of the science of the day – and, indisputably, a class act. *La Terre avant la Deluge* is 435 pages long, yet it zips along. If Rossini could say that, given a laundry list, he could put it to music, so Figuier pulled off the trick of taking a succession of fossil names and weaving them into narrative that rattles along both blithely and – as he made clear – instructively.

His motives and target audience were expressed clearly at the outset. This was to be a book for children – and it was expressly aimed *against* the standard fantastical subjects of childrens' literature – witches and demons, good spirits and bad spirits, enchanters, magicians, people changed into mice, mice turned into princes, beggar-ladies changed at the waft of a wind into jewel-strewn princesses, gods, half-gods and (I quote from his long list) quarter-gods. To have

¹ Louis's elder brother, Oscar, was in the same trade too, and obtained a smidgeon of fame and fortune through the invention of a syrup based on an extract of snails, that reportedly was 'sovereign against colds, bronchitis and catarrhs' (Delauney, 1937).



such nonsense, he averred, as formative influences upon the susceptible brains of the young, is just asking for trouble in later life. Far better, he said, to tell them stories of the marvellous new realities of the world they live on – and of real ancient worlds too, relics of which the savants were busily disinterring from the strata.

Well, there's nothing to be really argued with there and, of course, even then Figuier wasn't quite alone in the construction of literature for 'improvement' of the young. At about the same time, Charles Kingsley, in between his day job as a reverend and composing his weightier novels – *Hereward the Wake*, and such – was trying his hand at popular science, including popular geology and palaeontology, for children, with some success. Now Kingsley's books of this kind, including the deliciously titled *Madame How and Lady Why*, have considerable charm of their own and no small literary merit. But one can tell at a glance that *they are for children*. If one would wish, a little cruelly, to pick holes in the Kingsleyan prose of this kind, then one might point at the expressly teacherly style (though the teacher is going out of his way to be benign), and to the sprinkling of phrases such as 'dear child' among the pages. The story-telling style is laid on with a trowel of spade-like proportions².

There is not a hint of this with Figuier. The children in his literary cross-hairs are not being treated in the least like children. Tell them a story straight, he clearly says; give them lots of interesting facts, and they will just have to cope. Just as he did not wish French youth to have their brains addled by make-believe, he equally was not going to talk down to them, not one little bit. The refusal to make any allowances of this kind make this not just a book for children of all ages, but simply a book that clearly found as many, or more, takers among the grown-ups as it did amongst the young. So, it is a book on Earth history, based on the science of the day. It is, bar a section tacked on to the end about volcanoes (a touch bizarrely, but perhaps understandably, so as not to let any drama pass by unreported) chronological and systematic.

There is a lot to go at here (far more, indeed, than the dimensions of this column will allow), but a few things are striking. First, the pace of scientific progress. Figuier quotes Buffon and his 1778 epic *Les Époques de la Nature*, approvingly (their styles, indeed, are not completely dissimilar). In that first Earth history, Buffon was realizing that the strata around his Montbard estate contained the remains of animals and plants now vanished from the Earth: would not it be useful, he asked, if people developed a study of these petrified relics, and compared them to living forms of animal and plant?

Well, a bit less than a century later, that science had not only started – it had developed and matured. The main section of the book is built around successions of fossils, now identified most elegantly, and illustrated just as beautifully. The title page lists the 25 'idealised views of ancient landscapes' by Riou – but also 310 'other figures'. These are half-tone engravings of individual fossil species, done with the combination of scrupulousness and that 'better-than-the-real-thing' aura that only the very best palaeontological illustrators can achieve, and these – perhaps even more than Riou's atmospheric and brooding reconstructions – form the visual backbone of the book. It is in some ways rather like a combined and *very* heavily annotated version of those classic British Museum (Natural History) booklets of British Palaeozoic, Mesozoic and Cenozoic Fossils.

² In France, an equivalent might be Pierre Boitard's 1861 *Paris avant les hommes*, where the prehistory is told by a combination of hero and amiable demon, carried back into the past on a flying stone.



From those fossils the geological time-scale was emerging – no, had emerged. The frontispiece is a vividly-coloured cartoon of the Earth's crust. Molten red magma at the base snakes up through strata to emerge as a smoking volcano. Those strata start with 'ancient, primitive and metamorphic terrain' of the 'primeval epoch' – so the time-rock duality was then well in place – in a children's book, no less. After the 'primeval epoch' comes the 'transitional epoch', starting with the Silurian – at the sight of which Roderick Murchison would doubtless have looked smug while Adam Sedgwick would have been spitting into his beard³. From there on, all our familiar Palaeozoic periods are included, and the Mesozoic ones too, while the 'Tertiary Epoch' shows Eocene, Miocene and Pliocene 'terrains', with little mounds of 'Diluvium' of the Quaternary Epoch on top. For the children, quite a few of the subdivisions ('Zechstein', 'Lias', 'Inferior Oolite' and so on) were also laid out. A functional stratigraphy, hence: done and dusted, bar a little tinkering done in subsequent years. If our current first-year students knew all those divisions, and those fossil names, we'd be as pleased as Punch.

The real interest for comparative history-loving stratigraphers comes at the joins – beginning, middle and end. And it shows (it shouldn't come as a surprise, but it always does) that one can dig out a lot of facts about a planet without *really* understanding how it works.

The beginning, now, has an Earth cooling from incandescence, a part of which still remains in its hot interior. Figuiet notes that he is only following a path already trodden by Descartes, Leibniz and Buffon, which is true enough. But his own embroidery of the concept is striking. Let us take, he says, the thermal gradient of one degree per thirty-three metres and project it to the centre of the Earth, which gives ... (after, doubtless, some rapid scribbling on the back of whatever would then have approximated to a handy beermat) ... 195 000 degrees⁴! It is a beautiful demonstration of the perils of projection⁵, and is projected backwards in time too, to have the first Earth not just as matter torn from a star, but a fully-fledged star in its own right. One of the less-reproduced figures from his book is of a brightly shining first Earth – the size, say, of a beach ball – alongside the almost invisibly small cool marble that Figuiet posited as the modern Earth for scale.

Cool, that is, at the surface. Such subterranean fires mean that Figuiet's Earth is a thin crust atop a sea of superheated magma. The resultant surface pliability is invoked, for instance, to explain the accumulation of the Coal Measures as the land sinks beneath the weight of sediment. This is not dissimilar to modern ideas of load-driven subsidence – albeit with an emphasis on the perils below, fit to turbocharge youthful imaginations.

Then, the main history. Here, the perilously molten interior looms large again with catastrophic foundering or raisings of the crust to cause periodic annihilations of living things, following which new species arise. Hence, all of those fossils succeeding one another through the epochs and periods. For Figuiet, the new species of animals and plants appeared under the careful hand and watchful eye of a benevolent Creator, progressing to, finally, their ultimate, perfected, state – us, that is. Hence, Figuiet in his book was also taking clear aim at Darwin's dangerous ideas,

³ Sedgwick seemed not to have a beard, at least from the usually reproduced portraits, but under such duress, it seems incumbent to grow one.

⁴ He doesn't say whether Fahrenheit or Centigrade but with those numbers, it doesn't really matter.

⁵ Figuiet, to be fair, does cover himself though by saying 'assuming that the trend is uniform'.



published a few years earlier and causing no little intellectual ferment on the French, as well as the English, side of the Channel.

After that ... the Deluge – a large enough part of the story to be put into the title, illustrated by no less than two of Riou's most vigorously crafted tableaux, all sweeping currents and gigantic flotsam, in Europe and Asia respectively. I had always casually assumed that, for these, Figuier had simply interpreted boulder clays and erratic blocks and such, within the panorama of the Biblical flood. And so, in part, he had. But there's more to it than that. For why have just the one kind of melodrama when one can have two?

Figuier had clearly done his homework on what the likes of Agassiz were discovering in, and deducing from, the Alpine terrain. He followed the European Deluge (indeed, two European Deluges) with a *période glaciare*, a mysterious Ice Age. The evidence he adduces for its presence is entirely reasonable (as it pretty well was from the beginning), and includes the usual suspects – moraines, ice-scratched pavements, perched blocks and the like. What caused it? With commendable frankness, he wrote that in science one should never be afraid to say 'I do not know'. Then, to finish with (before that extended coda on volcanoes) – one more Deluge (the Asian one), and the Creator finally creates people. The story is complete. The Earth has reached its apogee.

Figuier's book is a sprightly read, for sure – even assuming contemporary (im)patience thresholds – and had quite an impact in its day. Its translation⁶ into English by that stalwart (and later Director) of the British Geological Survey, Henry Bristow, was likely many a person's introduction to the prehistoric world in the late nineteenth century. It influenced Jules Verne (some of whose novels Riou also illustrated), to the point that there were suggestions that that fast-working novelist plagiarized parts of it (like the battle between ichthyosaur and plesiosaur in *Journey to the Centre of the Earth*). If so, Figuier didn't seem to mind one bit – it meant that his work had made a bit of a splash. In any case, he liked the literary scene. Shortly before his death, in 1897, he was interviewed by one Ida M. Tarbell for the periodical *Popular Science*, and waxed lyrical about the brilliant circle of his youth, dropping a slew of names – Victor Hugo, Georges Sand, Lamartine – quite shamelessly⁷. And he still harboured hopes (never fulfilled) of staging his tales of science and scientists as earnest melodrama to theatre audiences – a man of grand dreams to the end.

That combination of lots of emerging fine detail obstinately refusing to illuminate large enigmas still rings a bell these days – indeed most clamorously. The planet next door is one of many cases in point. Circled by satellites, crawled over by rovers, peered at by cameras, strata now seen in well-nigh microscopic close-up, there are still large unanswered questions. Was the red planet once blue, for instance?

The question of whether Mars once had oceans has been nothing less than, well, a sea of contradictions. Nicely flat northern plains abutting against the southern highlands seems to fit the idea of a once-marine basin. Delta-like forms here and there somewhere around the join

⁶ It's a carefully cavalier translation. The volcanoes are moved to the beginning, for instance, and the Creator is given less responsibility for the nitty-gritty of palaeontological microevolution, but perhaps a touch more for setting the general course and transcendent final goal (*i.e.* us). Richard Somerset has explored, in considerable depth, how this example of *la différence* in this particular case of trans-Channel sensibilities, worked.

⁷ A circle only tangentially impinging upon, it seems. But still.



help the case. So far, so good. But where are the shorelines, those sets of proto-cliffs and palaeo-beaches that should be a trans-planetary constant? There are hints of such shoreline structures – but nothing that goes much beyond the frustratingly tantalizing.

Now one possible answer has emerged – and it's beautifully Figuièrian in concept. Take a four billion year-old Martian ocean, substantial but doomed. Give it some standard shorelines. Then, amid immense torrents of swirling sediment, rock and water, knock those shorelines flat and smear them across the landscape.

That's pretty much the latest hypothesis, hatched by J. Alexis Rodriguez⁸ and his colleagues, the raging torrents in this case being tsunami triggered by huge meteorites impacting into that cooling and freezing sea, citing evidence such as debris lobes pointing uphill and backwash channels. Problem solved? Well, perhaps. There is still a very mid-nineteenth century feel to Mars theorizing, despite all the high-tech gear being deployed. Time will tell.

It's a fine story, though, with all the spirit of 'plus ça change' that one could wish for. And, for exopalaeontologists hitching a lift on future missions, it seems like promising terrain to hunt for such useful clues as flood-carried stromatolite fragments. The scene could naturally do with the pens of a latter-day Figuièr-plus-Riou combination to bring the full drama across to today's jaded youth. They might, of course, create their tableau complete with suggestions of divine wrath – but then what *could* the Martians have been doing to deserve such a fate, before the Deluge?

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⁸ There's a spooky coincidence of initial here with J Harlan Bretz, who unpicked another classic catastrophic landscape, Washington State's channelled scablands. In Bretz's case, though, the initial J came bereft of full stop. And as Stephen Jay Gould once recounted with glee, Bretz's wrath for anyone who tried to insert one could be terrible to behold.



>> **Future** Meetings of Other Bodies



XIV Annual Meeting of the European Association of Vertebrate Palaeontologists (EAVP)

Haarlem, The Netherlands 6 – 10 July 2016

The XIV Annual Meeting of the European Association of Vertebrate Palaeontologists will be held in Haarlem, The Netherlands, in the beautiful historical building of the Teylers Museum. With a symposium on early hominid evolution, and another on fossil ethics, as well as field trips to either Pleistocene North Sea beds or the Type Maastrichtian, there should be something for everybody.

Please see the EAVP website for updates: <<http://www.eavp.oscartrapman.nl/>>.



Palaeo Down Under 2 (PDU2)

Adelaide, Australia 11 – 15 July 2016

A full conference programme is proposed, covering all aspects of palaeontology and associated disciplines. Dedicated symposia on the Ediacaran and Cambrian systems will be a highlight of the programme, under the auspices of the respective International Subcommissions on Stratigraphy, focusing on recent rapid advances in our understanding in these areas. The Conference will include guest keynote lectures, general and thematic sessions, symposia and posters.

The Conference will be preceded by a field excursion to Ediacaran and Cambrian fossil localities in the renowned Flinders Ranges to the north of Adelaide, and will also feature the Emu Bay Shale Konservat-Lagerstätte on Kangaroo Island, south of Adelaide. A half-day mid-conference field excursion will visit a location of international geological interest in the vicinity of Adelaide. A post-conference camping-style excursion to Mesozoic and/or Cenozoic fossil localities in the arid Lake Eyre Basin is also under consideration, pending number of interested participants.

For further information, please see the conference website: <www.pdu2.org>.



9th International Meeting of the Society of Avian Paleontology and Evolution

Diamante, Argentina 1 – 5 August 2016

The Meeting will be hosted by and held at the Centro de Investigaciones Científicas y Transferencia de Tecnología a la Producción de Diamante (CICYTTP-CONICET). It will be dedicated to Larry Martin (USA), in order to honour his memory and his outstanding palaeornithological contributions. The schedule includes a fossil identification session and pre- and post-conference excursions.

Please see the conference website for more information, at <<http://www.cicyttp.org.ar/sape2016.html>>.



**64th Symposium of Vertebrate Palaeontology & Comparative Anatomy (SVPCA 2016)
and 25th Symposium of Palaeontological Preparation & Conservation (SPPC 2016)**
Liverpool, UK 22 – 26 August 2016

The SPPC (22 August) and the SVPCA (22–26 August) will this year be held in Liverpool, UK. The Symposia will be held at the Foresight Centre, University of Liverpool. SPPC will include a tour of the geology and zoology collections at the Liverpool World Museum, and SVPCA will include a post-conference trip to Chester Zoo on 26th August.

Please see the website for more information, at <<http://svpca.org/>>.



7th International Symposium on Extant and Fossil Charophytes
Astana, Kazakhstan 30 August – 2 September 2016

The forthcoming 7th International Research Group meeting on Charophytes is open to all aspects of research regarding living or fossil charophytes (*sensu* Charales). The two-day pre-Congress excursion is to the Burabay lake district (modern charophytes). The post-Congress excursion will climb the Aktau Mountains to collect fossil charophytes (Oligocene to Quaternary). To obtain the complete second circular of the Symposium, please e-mail Dr Raikhan Beisenova (<irgc.astana@gmail.com>) with the subject '7 IRGC 2016'. The Symposium website is at <<http://irgc.uow.edu.au/index.html>>.



The Micropalaeontological Society 5th Silicofossil and Palynology Joint Meeting
Florence, Italy 15 – 16 September 2016

The first day of the Conference will be dedicated to silicofossils (radiolarians, diatoms, silicoflagellates, sponges *etc.*) and the second day to the palynomorphs (pollen, dinoflagellate cysts, spores). The main purpose of the Conference is to bring together micropalaeontologists, biologists, sedimentary geochemists and ecologists to analyze and discuss the role of each group in the different research fields. The meeting will consist of sessions for oral and poster presentations and will take place in the conference venue of the University of Florence. See the website for more details, at <<http://www.tmsoc.org/silico-paly-2016/>>.



9th European Conference on Echinoderms (9ECE)
Sopot, Poland 17 – 19 September 2016

This will be the first echinoderm meeting in Poland and is entitled "Echinoderms: from ossicles to the big picture". All living and extinct echinoderm classes will be covered, with scientific sessions on more than 20 general topics, including both local and global approaches. Proposals for special/thematic sessions with a pre-arranged convenor are cordially welcome! Please see the website for more details, at <<http://www.iopan.gda.pl/ECOE2016/>>.



Joint Meeting of the TSOP, AASP and ICCP

Houston, Texas, USA 18 – 23 September 2016

This is the first joint meeting of these three related geological, geochemical and biological societies: The Society for Organic Petrology (TSOP), The Palynological Society (AASP), and the International Commission for Coal and Organic Petrology (ICCP).

The purpose of this joint meeting is to discuss the close relationships between organic petrology and palynology, to foster thoughtful discussion, and address issues that may be of benefit to furthering the respective sciences. Key themes to be addressed during joint activities include palynofacies and source rock assessment. Symposia include: Microscope methodologies in recognizing and characterizing organic microporosity, Palynofacies and Kerogen, Multi-modal Characterization of Source Rocks, Palynofloral Contributions to Source Rocks, and an Alfred Traverse Symposium. There will also be a short course on “Integration of microscopy and geochemistry in petroleum source rock evaluation”. Pre- and post-conference field trips are planned.

Please see the TSOP and AASP websites for updates: <<http://www.tsop.org>> and <<http://www.palynology.org>>.



IX Congreso Latinoamericano de Paleontología

Lima, Peru 20 – 24 September 2016

The organizing committee invites the palaeontological community and especially its Latin American members to participate in this great event to be held in Lima. Please see the website for more information, at <<http://ixcongresopaleo.com/inicio/>>.



XIV International Palynological Congress and the X International Organization of Palaeobotanists Congress (IPC XIV / IOPC X 2016)

Salvador, Brazil 23 – 28 October 2016

This will be the first time that both the International Palynological Congress (IPC) and the International Organisation of Palaeobotany Conference (IOPC) will gather together in the southern hemisphere. Several field-trips are being planned in Bahia State and to the Tocantins Fossil Trees Natural Monument (Bielândia/Filadélfia, Tocantins State).

Please see the website for more information, at <<http://www.ipciopcbrazil.com/>>. *Registration and abstract submission are now open.*



SVP 76th Annual Meeting

Salt Lake City, UT, USA 26 – 29 October 2016

Each year, vertebrate palaeontologists, preparators, writers, artists and enthusiasts convene to share the latest research, attend workshops and field trips, and meet new fossil fans as well as old friends.



It's the world's foremost forum on vertebrate paleontology: the Annual Meeting of the Society of Vertebrate Paleontology or SVP.

Please see the conference website for updates, at <<http://vertpaleo.org>>. *Registration is now open, but abstract submission closed.*



25th International Workshop on Plant Taphonomy

Meeting Location University of Bonn, Germany 25 – 26 November 2016

This year's International Workshop on Plant Taphonomy will be held on the last weekend in November in Bonn. The date provides terrific opportunities for stimulating discussions over Glühwein at the Bonn Christmas Market, so please mark it on your calendar! The 2016 workshop will feature a keynote lecture from Bob Gastaldo (Colby College, Maine, USA) and a round-table discussion on the taphonomy of leaf cuticle led by Lutz Kunzmann (Senckenberg Research Institute, Dresden, Germany). Talks and posters on all aspects of plant taphonomy are welcome.

Despite the formal presentations, we hope the meeting will retain its informal, discussion-oriented, workshop flavour. Thus, students and new members wanting to check out plant taphonomy are especially welcome. The deadline for pre-registration and abstracts is 1st October. There will be more information in a second mailing at the end of summer. If you would like to receive this second circular or if you have any questions, please e-mail Carole Gee (<cgee@uni-bonn.de>).



DINO11: 11th International Conference on Modern and Fossil Dinoflagellates

EPOC Laboratory, Bordeaux University, France 17 – 21 July 2017

Six sessions are planned for both modern and fossil dinoflagellate themes. Sessions will be led by scientific committee teams gathering members from the local organization, French partners and international specialists. Additional workshops will be organized in parallel to the meeting: any proposals are welcome.

Please see the conference website for updates, at <<http://www.laplif.org/dino11/calquedino11.htm>>.



5th International Palaeontological Congress

Paris, France 9 – 13 July 2018

The fifth International Palaeontological Congress, IPC5, will be held in Paris. More details to follow.

Please help us to help you! Send announcements of forthcoming meetings to
<newsletter@palass.org>.



Meeting REPORTS



European Geosciences Union General Assembly 2016

Austria Center Vienna (ACV), Vienna, Austria 17 – 22 April 2016

Association-funded palaeontology at EGU

The European Geosciences Union (EGU) General Assembly is the premier Geosciences meeting in Europe, attracting thousands of scientists from across the world. The meeting in April this year was a great success with 4,863 oral, 10,320 poster, and 947 PICO presentations delivered by 13,650 scientists from 109 countries.

EGU's Division on Stratigraphy, Sedimentology and Palaeontology (SSP: <<http://www.egu.eu/ssp>>) is in good shape and growing. Within SSP, there is a strong desire to see more *palaeontology* represented in sessions at the General Assembly. In line with these goals, the number of submitted abstracts in the field of palaeontology quadrupled this year, from 30 in 2015 to 125 in 2016. The Association proudly sponsored two successful sessions at EGU: Session SSP4.6, *Evaluating historical changes in past ecosystems with conservation paleobiology, stratigraphic palaeobiology and biomineralization* (convened by James Nebelsick, Martin Zuschin, Adam Tomasovych, Fiona Gill, Liz Harper and Clemens Vinzenz Ullmann); and session SSP4.2, *Experimental solutions to deep time problems in palaeontology* (convened by Duncan Murdock and Mark Purnell). Both sessions were very well received, both by the audience and by the press. You will find a full account in the following article by PhD student Thomas Clements.

The next General Assembly is scheduled for 23 – 28 April 2017 in Vienna. The Association wants to continue its support and to promote palaeontology as a frontier science at this meeting. This involves ensuring that more, quality palaeontology sessions are proposed, filled and actually run. We are now actively seeking suggestions from the membership for topical sessions that you would like to attend or be willing to convene at the meeting. The Association is committing significant funding to support one or more sessions at EGU 2017 through our regular Grants-in-Aid scheme (deadline: **1st September**). Funding will be made available to help support the travel and/or registration costs of convenors, keynote speakers and other poster/oral presenters. We anticipate that individual awards will be in the region of £4,000. Council will make its decision in mid-October and convenors will be informed soon after.

Members interested in this opportunity are strongly encouraged to contact the Secretary or the Meetings Coordinator at their earliest convenience, providing a brief description of the proposed session, and a list of invited speakers. We will guide you through the process, and hope to receive many suggestions!

Thijs Vandenbroucke

(PalAss Meetings Coordinator & SSP science officer)
Ghent University

Richard Twitchett

(Pal Ass Secretary & SSP science officer)
Natural History Museum, London



Palaeontology at EGU: a PhD student's perspective

I hadn't considered the European Geoscience Union (EGU) General Assembly as a place where I would normally present my work, especially when considering the financial costs involved for an international conference as a PhD student with limited funding. So when I heard that the Palaeontological Association was sponsoring two sessions, I jumped at the chance to go.

I'd heard a lot about the conference from other PhD students in my department who go each year, so I was really excited to visit Vienna, a city famous for its beautiful architecture, beer halls and schnitzel. This, combined with a slot to present some of my work and meet new palaeontologists, seemed like a great opportunity to network and gain new experiences.

My first impression of EGU was that the scale of the event was much bigger than any I previously visited. Having previously attended palaeontological conferences of only a few hundred people, I was astounded by the number of people at the icebreaker and the utter size of the venue – I loved how the conference staff used scooters to get around quickly. The sheer number of attendees meant a broad diversity of research was presented and I met lots of potential collaborators for future projects.

With so many posters and oral sessions to choose from it did seem quite frantic getting from talk to talk, but there is a handy smartphone-app to keep you organised and not *too* lost. Both (great) PalAss-sponsored sessions (<<http://bit.ly/1RMkHGS>> and <<http://bit.ly/1XfwS7F>>) were convened very professionally and were well attended – with my favourite talk being by **Claire Belcher** (Exeter University) and her presentation on modelling palaeo-wildfires. Many regular EGU-goers I spoke to were quite surprised as to why we (*i.e.* palaeontologists) hadn't come *en masse* previously and asked if we were going to return in the future.

Non-academically, it was marvellous to visit such a beautiful city and experience the local culture and cuisine with other like-minded people, albeit resulting in a slightly sore head the following day. I would highly recommend the Naturhistorische Museum, which is one of the best museums I've ever visited.

On a personal note, I am very grateful to the Association for assisting me with funds to go to EGU this year. Aside from networking with a wide range of new scientists and receiving lots of feedback on my poster, it introduced me to new experiences including being interviewed by the EGU press team for one of their blogs (<<http://egu.eu/1ITSC4>>) and presenting at a press conference, something I had not imagined I would ever do. I'd like to go again next year with a 'Pico talk' as the set-up looked like a really fun and dynamic way to present your science. Hopefully next year, with these experiences, I'll be able to find my session without getting too lost...

Thomas Clements

University of Leicester



7th International Conference on Fossil Insects, Arthropods and Amber (Fossils X3)
National Museum of Scotland, Edinburgh, UK 26 April – 1 May 2016

The 7th International Conference on Fossil Insects, Arthropods and Amber (Fossils X3) took place in Edinburgh from 26th April to 1st May 2016 and was organised by Dr Andrew Ross and the team at the National Museum of Scotland (NMS). No conference in the Scottish capital would be complete without a welcoming whisky-tasting, which took place at the Royal Society of Edinburgh.

Proceedings at the Museum began with a welcome from the NMS Director of Collections, Dr Xerxes Mazda, and Keeper of Natural Sciences, Dr Nick Fraser, providing an overview of the origins of the Museum, which celebrates its 150th anniversary this year. Prof. Dany Azar was first to allude to *Jurassic Park* in his talk about the long-awaited formation of the International Palaeontological Society (IPS). He traced the history of entomology through to “a certain Hollywood film”, and the resulting increase in interest in palaeontomology and amber.

In his talk ‘Fossil spiders and ancient salt lakes’, student **Matthew Downen** revealed what leg flexure in fossil spiders may reveal about salinity, and **Scott Anderson** discussed his search for blood traces in engorged amber-preserved ticks. We then ventured to Iceland with Dr **Torsten Wappler**, where a continuous 15-million-year fossil record provided a 100,000 strong specimen database to study insect/plant interactions. In the Diptera (flies)-themed parallel session, Dr **John Skarveit** addressed the messy nomenclature of French Bibionidae (love-bugs), leaving Prof. **Ryszard Szadziewski** to outline the value of Ceratopogonidae (biting midges) in ecological reconstruction and biostratigraphy.



Dr Andrew Ross delivers the keynote on the first day. Photo: Rachel Russell (NMS)

Dr **Andrew Ross** gave delegates an overview of Scotland’s impressive Palaeozoic terrestrial arthropods in his keynote speech. Scotland has the earliest terrestrial arthropod, harvestman, land-living scorpion, and hexapods (insects). Many specimens are from “Romer’s Gap” and their diversity disputes theories of a low-oxygen Earth during this time.



We were treated to the gentle chirrup of crickets in a biomechanical talk by Dr **Thorin Jonsson**, who is creating computer models of extant ensiferan (cricket) wings to understand how form relates to frequency and resonance of song. The day was rounded-off with Prof. **Paul Selden**'s Palpimanidae spiders and stunning images of the first matrix-preserved spider studied by CT-scanning.

The next day we enjoyed Prof. **Ed Jarzembowski**'s enthusiastic keynote speech: 'What everyone should know about British fossil insects'. He illustrated how the technological advances in recent decades, together with increased funding opportunities and passionate volunteers, make this an exciting time to study fossil insects.

Dr **Yingying Cui** discussed Plecoptera (stoneflies) systematics and implications for palaeobiogeography. Dr **Jacek Szwedo**'s passion for Hemiptera (bugs) was clear as he discussed morphological diversity. We travelled to Lebanon with micropalaeontologist Dr **Sibelle Maksoud**, who talked us through the revised stratigraphy of amber deposits. In the Hymenoptera parallel session, Dr **Phillip Barden** talked about Eocene ants, and Prof. **Denis Michez** and student **Manuel Dehon** presented work on the geometric morphometrics of bee wings.

After the IPS General Meeting (open to all), talks focused on the Mesozoic. Student **Xiao Zhang** highlighted how the morphology of Chinese Auchenorrhyncha relates to extant cicada habitat and ecology. Student **Richard Kelly** explored Dermaptera (earwigs), explaining how historical mistakes make it necessary to revisit collections and revise taxonomy. Dr **Shih-Wei Lee** finished the day's proceedings with Blattodea (cockroaches) from the Crato Formation.

The final day started with Dr **David Penney**'s keynote speech on amber research, which generated lively discussion. He illustrated how imaging – such as digital dissection and online videos – has brought research into the public sphere, with one video receiving an impressive average of 125 views per day for over four years.

Dr **Antonio Arillo** shared stunning images of feathers, skin, and entire lizards preserved in amber, before discussing the co-evolution of haematophagous invertebrates with Mesozoic mammals and avian dinosaurs. Dating rare African amber was the subject of Dr **Vincent Perrichot**'s presentation, before Dr **Mónica Solórzano Kraemer** took an ecological approach to assessing the representativeness of amber insect faunas; comparing them with sticky traps in modern Malagasy forests.

Meanwhile there was a heated debate in the parallel session dedicated to Coleoptera (beetles) and Mecoptera (scorpionflies). Prof. **Wiesław Krzemiński** highlighted homology in wing venation in Mecoptera, and there were proposed revisions in the family Orthophlebiidae in a presentation



Photo: Mary Freeman (NMS).



by Dr **Agnieszka Soszyńska-Maj**. Finally, **Xiaodan Lin** presented work on the proboscis of early mecopterans, and later received the award for the best student talk.

In the afternoon, palaeobotany student **Eva-Maria Sadowski** and Prof. **Alexander Schmidt** used plant remains and lichens to determine the habitat in which Baltic amber was formed. Finally, Prof. **Dany Azar** reviewed the wonderfully rich amber deposits of Lebanon.

Two venues were proposed for the next conference in 2019: Gdansk in Poland, or the Dominican Republic. Delegates voted for the Dominican Republic. With full support from the government and proposed trips to amber mines and local rainforests, it promises to be the conference of a lifetime.

The Conference ended with a fabulous three-course meal at The Hub, in the shadow of Edinburgh Castle. Delegates were up early the following day for a long bus ride to Stonehaven and then on to Rhynie, near Aberdeen, where they were given pieces of the famous Rhynie Chert as a take-home gift. The weather was kind, with glorious sun shining on the snow-covered peaks of the Cairngorms on the return journey. On Sunday a second trip took them to East Lothian: first to Siccar Point (Hutton's famous unconformity), then on to a new early-Carboniferous site at Chirside, followed by the Devonian to Carboniferous succession at Burnmouth. Before and after the Conference, some of the delegates took the opportunity to visit the Collection Centre on the north side of the city to study the Museum's collections.

All in all, a fantastic trip around non-marine Palaeozoic Scotland.

Elsa Panciroli

University of Edinburgh



Burnmouth. Photo: Andy Ross (NMS).



Burnmouth. Photo: Yves Candela (NMS).



Lyme Regis Fossil Festival

Lyme Regis, Dorset, UK 29 April – 1 May 2016

This year saw a few changes for the annual Lyme Regis Fossil Festival. Gone was the large marquee on the beach, with the event more spread out across the town. This new layout allowed visitors to explore Lyme Regis itself, guided by colourful dinosaur footprints. Local fossil traders, children's activities and the Natural History Museum London were each housed in separate smaller marquees with the latter featuring a popular sieving exercise, where small fossil shells and teeth could be



found and kept by members of the public. These stalls were situated next to the Marine Theatre which hosted, among others, the PalAss stand, Dinosaur Isle and the Micropalaeontological Society. Down on the sea front, in the Pavilion, things were rather chilled as the British Antarctic Survey, Polar Museum and UK Antarctic Heritage Trust had set up a replica Antarctic camp and even brought along a (stuffed) penguin. Events were also taking place in the Town Mill, the Hub and even in a masonic hall!

This year also saw a new creation from Emerald Aunt; the much awaited Iguanodon Restaurant; “Igggy”, inspired by the 1853 banquet that took place inside one of the concrete Iguanodon statues of Crystal Palace Park. The accompanying performance drew large crowds across the weekend, with young and old (and everyone in-between) enjoying the wonderfully energetic characters. The performance told the story of early palaeontologists, of ground-breaking discoveries that shook the established view of creation and also, of where one could get a good meal in 1853. Starting with Mary Anning (in good pantomime tradition, played by a man), we learned of her fossil-hunting exploits on the beaches of Lyme Regis and the discovery of an ichthyosaur skull. We met the eccentric William Buckland and heard something of his peculiar eating habits (the eating of snakes was a feature). We learned of Gideon Mantell’s bad back and all about Georges Cuvier, whose French accent was quite befitting of something from “’Allo ’Allo”. As all good stories need a villain, Sir Richard Owen fitted the part, making quite possibly the best pantomime-styled villain to grace any stage.



The Iguanodon restaurant with Sir Richard Owen (left) and Gideon Mantell (right). Photo: Jed Atkinson.

The PalAss stall saw the return of the “when am I?” feature, whereby the table was divided into quarters, each acting as a door in time to a geological period. Through the artistry of the talented James McKay and a selection of iconic fossils, visitors could be transported to the warm shallow



seas of the Silurian to marvel at eurypterids, orthocones and trilobites. They could then accelerate through time to the humid coal-swamps of the Carboniferous. Here they could learn of the diverse flora with *Lepidodendron* and *Calamites*, and also of the giant insects such as Meganeura, the giant dragonfly. The Jurassic period showcased some creatures more familiar to Lyme Regis: ammonites, ichthyosaurs and fish. With one more leap through time visitors could find themselves in the icy tundra of the last glacial maxima, with many people being dumbfounded by the sheer size of a mammoth's tooth and also by the surprisingly exotic megafauna Britain had during the Pleistocene.

The Friday of the event was open for school parties, with the PalAss stand welcoming a number of schools throughout the day. Children were taken on the adventure through time and space, and asked to think about which of the four time periods they would like to live in. Surprisingly some children were quite taken by the Carboniferous and its giant insects (budding entomologists perhaps?), but many settled for the ice age with its slightly more familiar beasts, although an extra coat would probably have been required.



Jo Hellawell explains the Jurassic seas while Caroline Butler demonstrates the size of Carboniferous insects. Photo courtesy of Autumn Pugh.

Across the Saturday and Sunday, palaeo-artist **James McKay** was offering free paintings of children's favourite British prehistoric creatures. This was unsurprisingly very popular and resulted in increased interest in our time-travelling stall as children debated over which beast they wanted a painting of. At hand to guide them through the mists of time were: **Jo Hellawell, Caroline Butler, Lucy McCobb, Fiona Gill, Gemma Benevento, Autumn Pugh, Jacob Morton** and yours truly, all sporting our new PalAss t-shirts linked to the time intervals that could be visited using our "time machine".



The Festival offers a great opportunity to engage with the public about palaeontological matters, providing a platform to showcase some of the current research and shed light on what exactly palaeontologists do (beyond collecting fossils). Let us hope that the weekend inspired a few, young or old, to pick up the hammer and chisel to pursue palaeontology.

Jed Atkinson

University of Leeds



The PalAss "time machine". Photo courtesy of Autumn Pugh.



Progressive Palaeontology

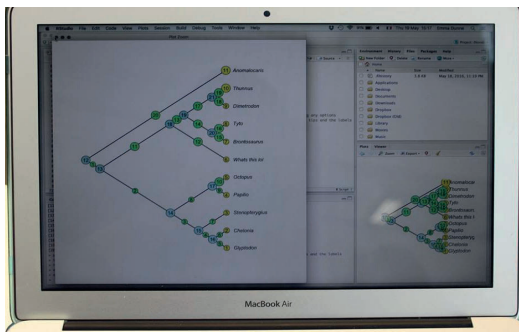
University of Oxford, UK 19 – 22 May 2016

This year's Progressive Palaeontology meeting can be summarized using a typical saying of my father's: "All was exceptionally good, tasty and abundant." Although the standard set by the University of Bristol in 2015 was incredibly high (thanks to an impressive venue and excellent hosting skills), the University of Oxford has, if anything, raised the bar even higher. Oxford University Museum of Natural History (OUMNH), which has just been crowned "Best of the Best" by the Museums and Heritage 2016 Awards for Excellence, was a magnificent location for ProgPal 2016. There were 120 delegates, including six international students from Ireland, Italy, Germany and France who received travel grants to support attendance, thanks to the efforts of the 2015 ProgPal committee and to many generous donations over the last 12 months.

The Conference commenced on the 19th with two useful workshops: 'Introduction to SPIERS' and 'Introduction to R' led by Oxford's own Dr Imran Rahman and Dr Roger Benson, respectively. Afterwards, there was a short question-and-answer session hosted by publishers Wiley-Blackwell on publishing practices. Later that evening, the delegates gathered for the icebreaker under the vigilant eyes of Charles Darwin and the rest of the 'inhabitants' of the OUMNH in the Museum's atrium as we made new acquaintances and reconnected with friends and colleagues.

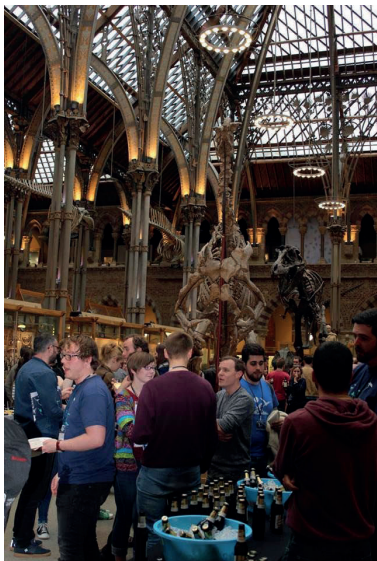


Progressive Palaeontology 2016 T-shirt. Unfortunately the phylogeny featured on the commemorative T-shirts was discovered to be somewhat inaccurate.



R Workshop. A screenshot from Gemma Benevento (chair of the ProgPal 2016 committee) who attempted to fix the phylogeny pictured on the T-shirt using R during the R workshop.

The oral sessions commenced early in the morning of the 20th at the OUMNH Theatre. In addition to standard 12-minute presentations, the sessions also featured 4-minute ‘lightning talks’, a concept introduced at ProgPal 2014 (University of Southampton) as a way to showcase, and get feedback at, the early stages of PhD research. Topics included taxonomy, phylogeny, taphonomy, palaeoecology, conservation and mass extinctions. The poster sessions were held at the Earth Sciences Building accompanied by coffee and biscuits, which in combination made for enjoyable conversations. The quality of research and presentation skills was, as always, excellent for both oral and poster presentations, making the task of selecting prizewinners extremely difficult. However, winners must be chosen and these were acclaimed later that evening:



Ice breaker. Full house during the ice breaker hosted at OUMNH main court.

of Birmingham, was awarded the prize for the best conference talk for “Exploring the phylogeny and form of Phytosauria”. **Ellen MacDonald**, from the University of Bristol, won the best lightning talk for “Investigating Siliceous Microfossils using Imaging and Flow Cytometry”. Finally, **Lukas Laibl**, from the National Museum of Prague, won the prize for the best poster for “Morphological variability of *Sao hirsute* (Trilobita, Cambrian) and the case for neutral evolution”.

As usual, all oral presentations are available at the Palaeocast website thanks to the hugely appreciated work of Dave Marshall: <<http://www.palaeocast.com/progressive-palaeontology-2016/>>.

After a full day of talks and posters we were guided through the heart of Oxford towards the breath-taking Exeter College, the venue for the annual conference dinner. As I approached my place at the table I wondered if Charles Lyell had ever sat in that exact



Exeter College, Oxford, which features a painting of Charles Lyell.

spot during his years in Oxford. Supervised by his portrait, we thoroughly enjoyed our Oxfordian dinner and the annual auction conducted by the irreplaceable **Dr David Button**. The charitable donations plus David's auctioneering skills raised an impressive £1,168 for next year's travel grant budget. Memories of that night will accompany all of us for many years to come.

The next morning 34 delegates left on a (very early) bus for a two-day trip to the Isle of Sheppey led by **Professor Matt Friedman**. Thanks to Matt's impressive field skills, the field group returned triumphant with their fossil finds from the Ypresian London Clay, including shark teeth, fish and snake vertebra, a bird phalanx and a few well-preserved crustacean fossils. Other delegates enjoyed guided behind-the-scenes OUMNH tours led by **Dr Hilary Ketchum**, whose contagious enthusiasm, fun facts and interesting specimens made for a memorable experience.

It was a pleasure to attend this year's ProgPal meeting in Oxford and the committee did a marvellous job. I'm looking forward to Progressive Palaeontology 2017 already!

Nidia Álvarez Armada

University College Cork



Sheppey field-trip.

Left: All field-trip attendees except the leader, Prof. Matt Friedman (Oxford University), who took the photo.

Right: Field-trip attendees are driven wild by the shocking finding of a fossil crustacean with articulated appendages.

Photos courtesy of the Progressive Palaeontology Web and Facebook pages; see <<http://www.palass.org/meetings-events/progressive-palaeontology/2016/progressive-palaeontology-2016-oxford-overview>>



OBITUARY

Robin Charles Whatley

1936 – 2016

Robin Whatley died in Wales on 4th June aged 79. He was born in Hawkhurst, Kent, on 2nd December 1936, and educated at the Sir Norton Knatchbull Grammar School in Ashford, Kent. He worked variously as a farmer (1954), National Serviceman (1955–1957) and inshore fisherman (1957–1959), graduating from Hull University with a First-class honours degree in Geology and Zoology in 1962. His PhD (1965), also from the University of Hull, was on the Callovian and Oxfordian Ostracoda of England and Scotland. He joined the staff of the Geology Department of the University College of Wales at Aberystwyth in 1965, where he deservedly received a personal chair in 1988 and the status of Professor Emeritus in 2001. Although retired and facing serious health problems, he managed to produce valuable research even until the day of his death with the indefatigable help and support of his wife, Dr Caroline Maybury.

With broad interests in geology and palaeontology, he particularly devoted himself to the study of post-Palaeozoic ostracods. He was a prolific author, publishing close to four hundred relevant and lasting contributions to our knowledge of these microfossils from many places around the world, including South America and Argentina in particular. His numerous papers, often monographic, appeared in leading journals, several books and symposia proceedings. He was also committed in his involvement of the revision of the ostracod *Treatise on Invertebrate Paleontology, Part Q*, untangling a number of complex taxonomic issues. He felt at ease with fossil as well as extant taxa, dealing with various aspects of their biology, systematics, ecology, taphonomy, biogeography, biostratigraphy and evolution.

Robin supervised undergraduate, Masters and PhD students by the hundreds, and was responsible, together with Professor John Haynes, for building up an impressive, superbly-curated micropalaeontological research collection at Aberystwyth. Following the closure of the Aberystwyth Geology Department in 2000, the 62 microslide cabinets housing catalogued microfossils from the world's oceans and more than a hundred different countries were bequeathed to the Natural History Museum, London. His expertise was internationally renowned and widely recognized by his colleagues; for example, he was made an honorary life member of The Micropalaeontological Society in 2004.

A bold personality coupled with an inquisitive, sharp mind stimulated Robin to undertake every endeavour with verve; he was hospitable, generous and had a witty sense of humour. His many hobbies were mostly outdoors, such as hunting, shooting (aided by his gundogs: Darwin, Wallace, Huxley and Lyell), birdwatching, gardening, salt- and fresh-water fishing and lobster potting. He was also an accomplished military and naval historian, classicist and model railway enthusiast and he enjoyed listening to classical music. He was a keen traveller when health permitted, having visited all seven continents while attending conferences, acting as an external examiner, viewing specimens in repositories and collecting samples. Robin lived and worked in Argentina for three years during the early 1970s, supported by the overseas development agency of the British Council and the Argentinian National Research Council (CONICET). During that time he



laid the foundations of the Micropalaeontology Laboratory at the La Plata Museum, developing and maintaining many friendships with Argentinian scientists. He was an active member of the Argentine Palaeontological Association as part of the Scientific Editorial Board of *Ameghiniana*, and was distinguished as Corresponding Member of both the Argentine Geological Association (1995) and the National Academy of Exact, Physical and Natural Sciences (1991) in recognition of his influential achievements. All his friends from the Invertebrate Palaeontology Division of the La Plata Museum express our sympathy, and no doubt he will likewise be sorely missed in many other academic institutions worldwide.

Miguel O. Manceñido

Susana E. Damborenea

Natural Sciences Museum, La Plata



Robin handling a macroscopic crustacean aboard his vessel Old Jake in Cardigan Bay (summer 2000). Photo courtesy of Miguel Manceñido.



Sylvester-Bradley REPORT

Biomechanical impact of skull sutures in Palaeognathae

Nicola Stone

School of Earth Sciences, University of Bristol

Palaeognathae are a fascinating clade of birds demonstrating a diverse range of shape and size, with pre-Palaeogene origins according to molecular dating (Mitchell *et al.* 2014; Clarke *et al.* 2005). They include the secondarily flightless ostriches, emus, cassowaries, rheas, kiwis and their extinct relatives, the aerial tinamous and extinct lithornids. Two recently extinct groups are the moas and the elephant birds. The oldest fossil palaeognath, *Diogenornis fragilis* was a flightless bird from the Palaeocene resembling the rheidae (Alvarenga 1983; Carvalho de Taranto *et al.* 2011), and slightly younger Lithornidae are found in the middle Eocene of North America and early middle Eocene of Europe (Houde, 1981 and 1986).

Heterochrony, or shifts in the timing or rate of processes during development, is a key mechanism in dictating organismal size and shape and the evolution of form in organisms. For example, birds have been shown to have the paedomorphic skulls of dinosaurs (Bhullar *et al.* 2012). The Palaeognathae are commonly cited as having acquired diagnostic characteristics by heterochrony, including paedomorphic traits, *e.g.* patent sutures in the adult cranium, and peramorphic traits, *e.g.* pelvic girdle (Pycraft 1900; McGowan 1984). There is debate regarding the extent to which these traits are plesiomorphic for the group, what adaptive role they play, and the role of heterochrony in palaeognath evolution more broadly. The aim of my research is to quantify the extent of heterochrony in the palaeognath skull and to test the biomechanical significance of retention of patent sutures within the skull.

Growth heterochrony is usually studied in embryos where specific events at determined developmental stages are compared directly with an ancestor or outgroup. Comparison of developmental stages post-embryo, in museum collections, is difficult because specimens rarely have details of age, making direct comparisons across species impossible. However, the technique of sequence heterochrony developed by Smith (2001) allows one to do just that. Sequence heterochrony is established by ranking the order or sequence and then comparing each event with the developmental sequence in another species by a process called event-pairing (Jeffery, 2005). To achieve this, one needs a good spread of developmental stages, including chicks, juveniles and adults (with length of head used as a proxy for age).

Unfortunately, few chicks and juveniles exist in museum skeletal collections and are very rare as fossil forms. A Sylvester-Bradley Award (PA-SB201405) from the PalAss enabled me to travel to the USA to spend several weeks at the Smithsonian National Museum of Natural History, Washington DC



Taxa being compared	Kendall's coefficient of concordance
Palaeognathae vs. Neognathae	0.7647059
Palaeognathae vs. Galloanserae	0.7500000
Palaeognathae vs. Neoaves	0.6764706
Ratites vs. Neognathae	0.9411765
Ratites vs. Galloanserae	0.9264706
Ratites vs. Neoaves	0.8235294
Ratites vs. Tinamous	0.5427847
Tinamous vs. Neognathae	0.5725263
Tinamous vs. Galloanserae	0.5279139
Tinamous vs. Neoaves	0.5130431

Table 1. Concordance between taxa.

The following are tentative observations pending statistical analysis. There appear to be no major heterochronic shifts between the Palaeognathae and Neognathae clades, but there may be a heterochronic shift involved in the frontal/parietal and frontal/laterosphenoid suture patency in the skulls of tinamous. There is a possible heterochronic shift resulting in a change in the position of the pre-frontal bone in tinamous and Neognathae compared with ratites. Finally, there may be a heterochronic shift in suture closure leading to elongated squamosal bones in the Neognathae. My future studies will quantify the heterochronic shifts in birds and investigate the biomechanical implications of open sutures in the skulls of tinamous.

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Undergraduate Bursary **REPORTS**

Dissecting the rise of the archosaurs

Gareth Coleman

School of Earth Sciences, University of Bristol

The rise of the dinosaurs

The rise of the dinosaurs in the Triassic was once considered a 'poster child' example of evolutionary competition between two groups, with one group (the dinosaurs) outcompeting and replacing the other (crurotarsans, *i.e.*, crocodilians and their relatives). The crurotarsans were very diverse and disparate during the Triassic (252–201 Ma), but this changed at the end of the Triassic, when most of them went extinct. This seemed to coincide with an increase in diversity (or a 'radiation') of dinosaurs. It was thought that the dinosaurs, through some innate set of advantageous characteristics (*e.g.* bipedalism) were able to out-compete the crurotarsans, driving most of them to extinction and replacing them in many niches. However, this narrative of dinosaurian superiority has recently been questioned, and many have suggested that dinosaurs may have become successful due to chance opportunism. I set out to test whether the competitive displacement model or the opportunistic model was more likely.

Did dinosaurs really outcompete their rivals?

Research in recent years has suggested that the dinosaurs and the crurotarsans did not compete, and that an opportunistic model was more likely. Brusatte *et al.* (2008) used cladistic morphometrics (morphometrics using discrete data – namely the presence and absence of characters) to show that crurotarsans were actually more disparate and occupied a larger region of morphospace than the dinosaurs in the Late Triassic, and that they did not overlap. The rise of the dinosaurs was slow, and did not seem to have any impact on the crurotarsans. Brusatte *et al.* (2008) also showed that rates of evolution were indistinguishable between the two clades, whereas a competitive model would have suggested rising rates for dinosaurs matched by declining rates among crurotarsans. Sookias *et al.* (2012) used comparative phylogenetics to show that body-size increases during the rise of the archosaurs (dinosaurs, crurotarsans and relatives), including the dinosaurs, were driven by passive processes of trait evolution, not through strong trends, or active evolutionary processes.

It therefore seems more likely that dinosaurs diversified initially following chance events – notably two mass extinction events in the Late Triassic, which cleared ecospace / niches into which dinosaurs subsequently expanded (Figure 1).

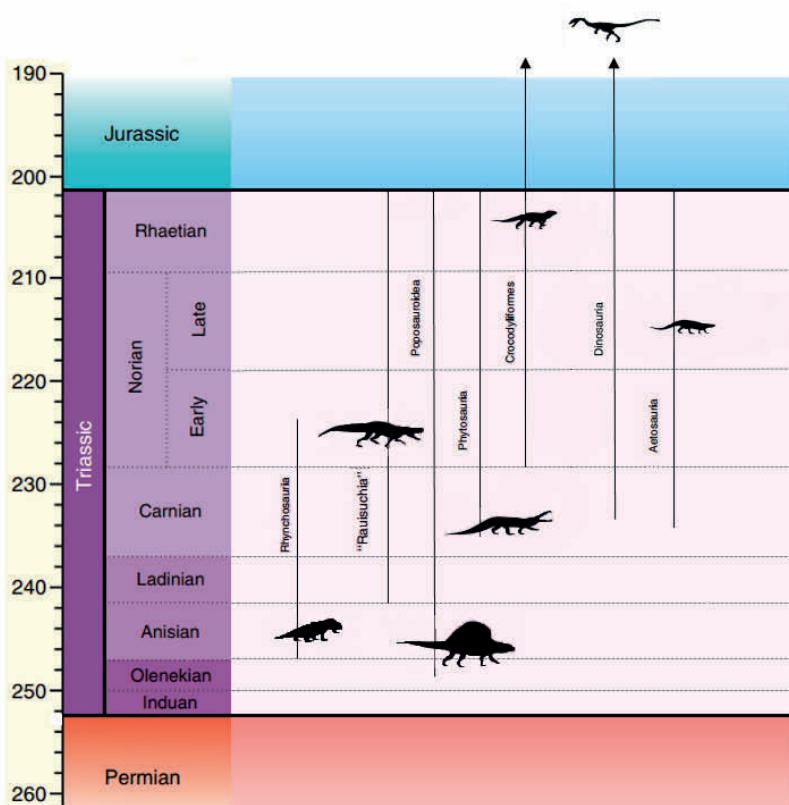


Figure 1. Triassic archosaurs. Redrafted form including Benton et al. (2014). Only the crocodyliformes, dinosaurs and pterosaurs (not pictured) survive into the Jurassic, whilst all other archosaur lineages go extinct.

My research

During summer 2015, I explored feeding and senses of the Triassic archosaurs by conducting a landmark morphometric study of their mandibles. This landmark approach has already been used in the context of archosaur evolution, as in Stubbs *et al.* (2013), who explored morphological and biomechanical disparity in crocodile-line archosaurs following the end-Triassic extinction. I took 92 archosauriform (archosaurs and relatives) skulls ranging in age from their origin in the latest Permian through to the end of the Early Jurassic. I used published mandible images in lateral view, whilst trying to ensure reasonably good coverage across all of the time bins. For each mandible, I used five permanent or fixed landmarks, and 54 semi-permanent or sliding landmarks. These were chosen in order to capture the skull height, elongation of the snout, and tooth row characters (Figure 2). I created tps files in tps.Util, and landmarked them in tps.Dig2. Landmark coordinates were superimposed using generalized least-squares Procrustes methods, removing the effects of orientation, positioning and scale, using tpsRelw64. The corrected Procrustes coordinates were then subjected to principal components analysis in PAST, and plotted to assess shape variation and to produce a morphospace.

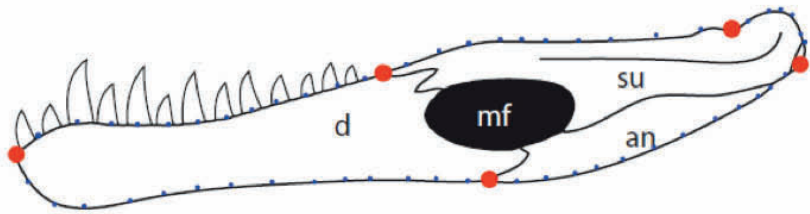


Figure 2. Mandible of *Batrachotomus kupferzellensis* with five permanent landmarks (red) and 54 semi-permanent landmarks (blue). Mandible from Nesbitt et al. (2013).

Results

The results show that there was no significant decrease in crurotarsan morphospace through the Triassic, and no corresponding increase in dinosaur morphospace (Figure 3). There is a decrease in crurotarsan morphospace from the first time bin (Late Permian–Mid Triassic) to the second time bin (the Late Triassic Carnian stage), but this is probably due to the difference in length of the time bins and the sampling through the time bins. There is a more notable decrease in the Jurassic, as well as an increase in dinosaur morphospace.

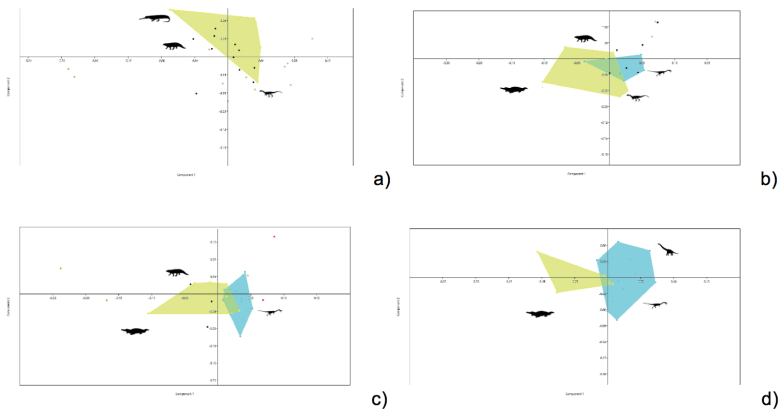


Figure 3. PCA plots of archosaurs through time. a) Late Permian to Mid Triassic, b) Carnian, c) Norian to Rhaetian, and d) Early Jurassic. Yellow signifies the crurotarsans and blue the dinosaurs. It can be seen that there is a shift and contraction of morphospace in the crurotarsans, but no expansion in the dinosaurs until the Jurassic.

This is not consistent with a gradual expansion of the dinosaurs by outcompeting the crurotarsans, but rather suggests that they expanded rather suddenly in the Jurassic, after the end-Triassic mass extinction event. Had the two groups been competing, one might expect that the dinosaurs would move to occupy morphospace that had been vacated by crurotarsans, but there is no increase in overlap, nor of such a change in dinosaurian morphospace occupation. This suggests that it



was an opportunistic expansion rather than competitive replacement. It seems that many of the crurotarsans disappeared, allowing for the dinosaurian expansion.

Competitive replacement is likely not the answer, and the rise of the dinosaurs should not be used as a textbook example of the expansion of one group at the cost of another due to some sort of inherently advantageous characteristics.

Acknowledgements

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3D textural analysis of tooth wear in insectivores, and its application to fossil mammals

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Introduction

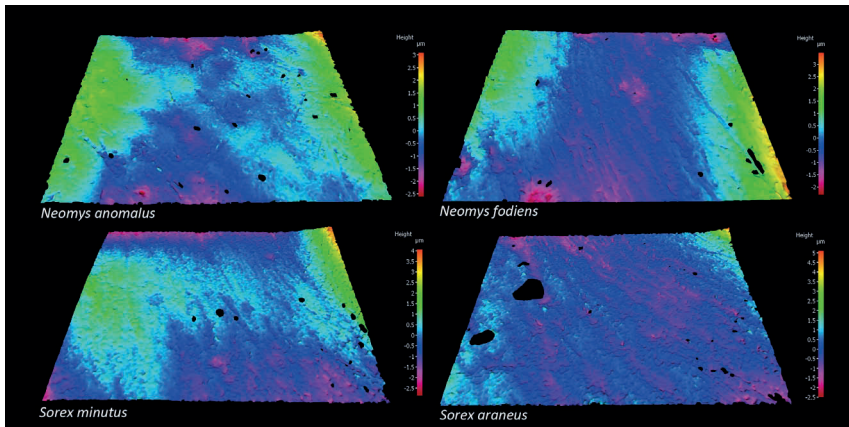
The occlusal surfaces of teeth, when processing food, develop microscopic textures – pitting and scratching – as a result of the interaction between food items and the tooth surface. Quantitative three-dimensional analysis of tooth surfaces from extant animals with known diets reveals that these microwear textures vary with diet. This relationship holds true across broad taxonomic distances, and analysis of dental microwear can thus be used to reconstruct diet and trophic niche, and provide robust tests of ecological and functional hypotheses. This is of particular relevance when considering the evolution of early mammals. Most early mammals were long thought to be generalized terrestrial insectivores, lacking ecological diversity. But more recent discoveries of exceptionally-preserved articulated skeletons reveal greater ecomorphological diversity than previously thought (Luo 2007). The degree to which this is true more generally of early mammals is difficult to evaluate because, being known only from their teeth, it is hard to test dietary hypotheses derived from functional morphology.



This project employed quantitative 3D microwear analysis, a technique that has recently revealed greater dietary specialization in Jurassic mammals than previously thought (Gill *et al.* 2014). The purpose of this study is to further develop microwear analysis of both extant and extinct insectivorous mammals by testing the hypothesis that microwear textures differ between four species of sympatric shrew with diets that are known to be subtly different but overlapping. The results from this study will be incorporated into existing microwear datasets to test the degree to which shrews provide a proxy for reconstructing the diets of early mammals based on microwear analysis.

Methodology

Four species of sympatric shrew from the Białowieża Forest region of Eastern Poland were used in this analysis: Southern water shrew *Neomys anomalus*, Eurasian water shrew *Neomys fodiens*, Common shrew *Sorex araneus* and Eurasian pygmy shrew *Sorex minutus*. 3D data were collected from the protoconid facet of the second molar in the lower left jaw to allow comparisons with existing studies. Scale-limited roughness surfaces were generated and International Organization for Standardization 25178-2 texture parameters were then generated from the resulting roughness surface. Data were explored using a variety of statistical tests and multivariate analysis.



Examples of 3D microwear textures from the shrew species studied.

Preliminary results

Statistical testing revealed that shrew species can be distinguished according to tooth microwear textures and this separation can be linked to dietary preferences, with species possessing specific diets (*Sorex minutus*) exhibiting microwear textures that are significantly different from more generalist feeders (*Neomys anomalus*). However, some of the observed differences in microwear textures could be due to the amount of sediment incorporated into the diet as a result of terrestrial feeding; this remains to be quantified. Projecting microwear textural data obtained from Jurassic and Palaeocene mammals into a multivariate analysis combining shrews, bats and other insectivorous mammals confirms support for hypotheses of dietary specialization in early mammals, and highlights the applicability of this technique to questions surrounding ecomorphology and competition across a broad range of taxa. These results provide further evidence that analysis of dental microwear texture is a robust tool for testing dietary hypotheses, and that it has the sensitivity to distinguish between sympatric species with subtly different diets. Its application



to Jurassic and Palaeocene fossil taxa demonstrates the potential of the technique for testing hypotheses of diet and niche partitioning throughout the mammal lineage, including taxa known only from their teeth.

Acknowledgements

This project was supported by a Palaeontological Association Undergraduate Research Bursary (grant number PA-UB201505). I am grateful to Prof. Leszek Rychlik for providing shrew specimens, dietary data and advice, and to Prof. Mark Purnell for advice and support throughout the project.

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Testing functional hypotheses in Cambrian cinctan echinoderms using computational fluid dynamics

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Introduction

Cinctans are a clade of asymmetrical non-radial echinoderms restricted to the middle Cambrian of Gondwana (including Avalonia) and Siberia. Like all echinoderms, they possess a calcite endoskeleton; they are also characterized by a flattened, rounded theca with a mouth and one or a pair of marginal food grooves at the anterior. Posteriorly, the theca grades into a rigid appendage. Cinctans are generally regarded as sessile suspension feeders that rested on the sea floor with their mouth facing downstream (Ubaghs 1967; Friedrich 1993; Zamora and Smith 2008). A pilot study (Rahman *et al.* 2015) used computational fluid dynamics (CFD) to infer the mode of life for the cinctan taxon *Protocinctus mansillaensis* and concluded that it was most probably an active pharyngeal filter feeder, lending support to the idea that this feeding mode is ancestral to Deuterostomia. However, there is substantial morphological variation within the Cincta, and the functional significance of these differences is an area open for exploration.

Methods

To test the functional significance of morphological variation within the Cincta, three-dimensional models of six cinctan taxa (see Figure 1) were constructed using the open-source 3D creation suite Blender (<<https://www.blender.org/>>) based on 2D reconstructions in multiple views taken from the primary literature (Ubaghs 1967; Friedrich 1993; Zamora and Smith 2008; Rahman and Zamora 2009; Zamora *et al.* 2013). These taxa were chosen to represent a range of morphologies from across cinctan phylogeny. CFD simulations were performed in COMSOL Multiphysics



(<<https://uk.comsol.com/>>) using semi-cylindrical flow domains, with flow velocities ranging from 0.05 to 0.5 m/s, comparable to flow velocities seen in recent shoreface/offshore conditions (Emelyanov 2005). All taxa were oriented with the mouth facing downstream and with their ventral swellings buried, the position considered most hydrodynamically stable based on previous studies (Rahman *et al.* 2015). To test whether this method was effective, we compared the results of simulations using a 3D model of *P. mansillaensis* constructed from CT scan data (Rahman *et al.* 2015) with those from our simulations using a 3D model of the same taxon based on 2D reconstructions.

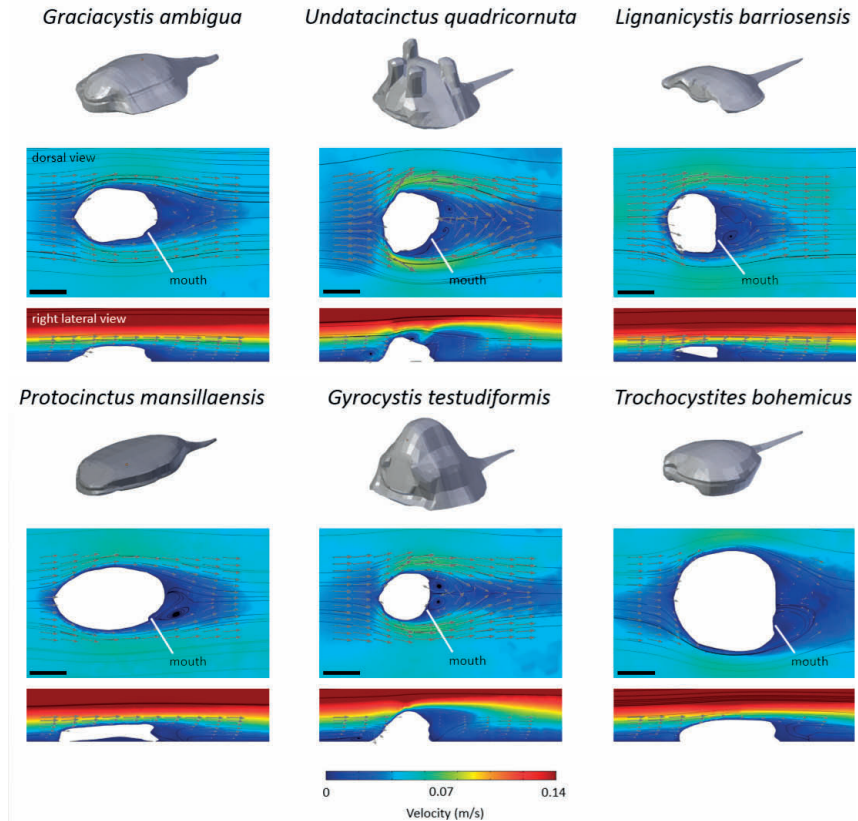


Figure 1. Patterns of flow velocity magnitude with flow vectors (arrows) and streamlines for different cinctans. In all cases, ambient flow is from left to right (inlet velocity of 0.2 m/s). Black bars = 5 mm. Species with dorsal protuberances and a swollen upper surface (*Undatacinctus quadricornuta* and *Gyrocystis testudiformis*) produce greater recirculation of flow downstream of the theca (shown by arrows and streamlines) than the other taxa.

Results

The flow towards the mouth was relatively low in all taxa (Figure 1). In addition, taxa with a taller theca (*G. testudiformis*) or prominent dorsal thecal projections (*U. quadricornuta*) created higher wakes than flattened taxa such as *G. ambigua*. Lift and drag coefficients are summarized for each taxon in Figure 2; flattened elliptical taxa (*P. mansillaensis* and *G. ambigua*) had low drag

coefficients, whereas forms with a tall theca (*G. testudiformis* and *U. quadricornuta*) had high drag coefficients. The highly asymmetrical *L. barriosisensis* and the fairly symmetrical *T. bohemicus* both had low drag coefficients. All taxa had a negative lift coefficient. The results for simulations of *P. mansillaensis* based on CT scan data (Rahman *et al.* 2015) and 2D reconstructions are very consistent.

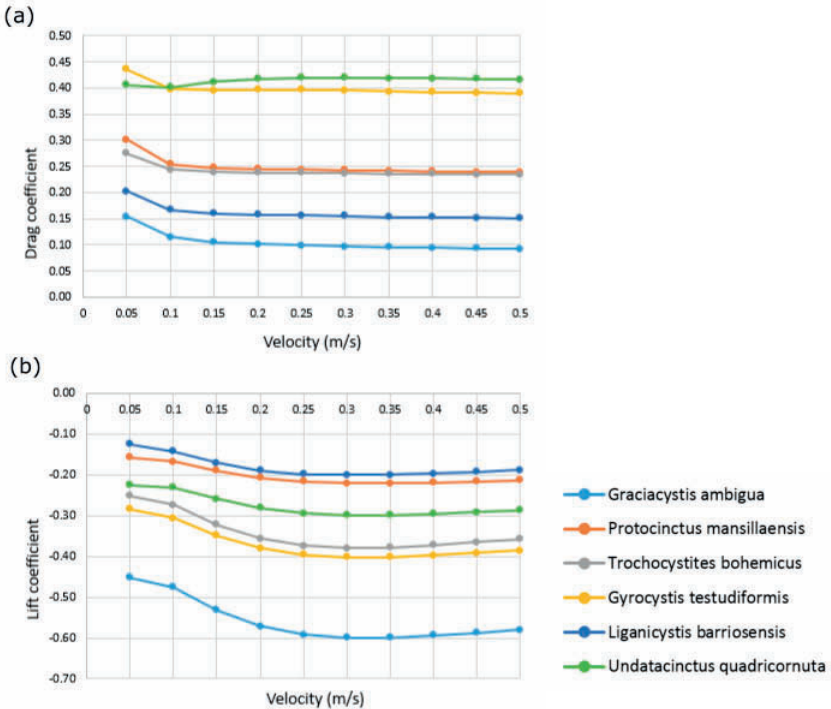


Figure 2. (a) Drag and (b) lift coefficients for different cinctans. Species with dorsal protuberances and a swollen upper surface have higher drag coefficients (*Undatacinctus quadricornuta* and *Gyrocystis testudiformis* respectively) than the other taxa. The lift coefficients are negative for all species.

Discussion

The generally low flow towards the mouth suggests that these animals may have relied on active suspension feeding in order to gather sufficient nutrients, as suggested for *P. mansillaensis* based on previous work (Rahman *et al.* 2015). The higher drag coefficients in taxa with dorsal projections or a taller theca (*U. quadricornuta* and *G. testudiformis*) suggest that these forms were less stable than flatter forms. However, the rate of food influx would have been very low near the sediment–water interface (Jumars and Gallagher 1982), especially in lower energy environments. By having an elevated theca, such forms made a taller wake and could have captured food particles from higher in the water column. This suggests that cinctan morphology partly reflects a trade-off between enhancing feeding and maintaining stability, and may in turn relate to differences between the environments occupied by different taxa.

Some measure of the error involved in this study is essential before any firm conclusions can be drawn. Further work will investigate how the degree of burial in the sediment affects fluid flow.



In addition, the significance of asymmetry, especially for taxa like *Liganicystis*, is still uncertain. Phylogenetic evidence suggests that pentaradial symmetry arose in echinoderms from the asymmetrical configuration found in cinctans and other 'carpoid' echinoderms (Smith and Zamora 2013). Understanding the drivers behind the origin of the echinoderm body plan may therefore require more investigation into the functional reasons for the abandonment of bilateral symmetry in these basal taxa.

Acknowledgements

I thank Imran Rahman, Stephan Lautenschlager, Samuel Zamora, Tim Ewin, James Tarver and Mike Benton for their help. I thank the Palaeontological Association for funding the project via an Undergraduate Bursary (PA-UB201507) and the University of Bristol Alumni Foundation for funding my attendance at the Annual Meeting of the Palaeontological Association in 2015.

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Book Reviews

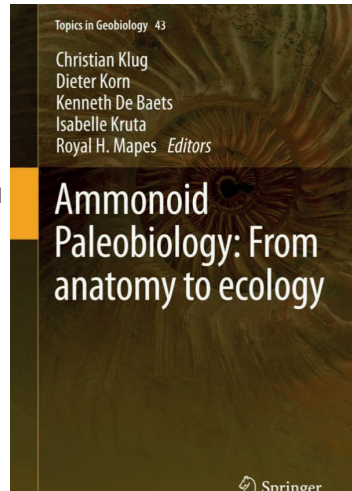
Topics in Geobiology 44: Ammonoid Paleobiology: From macroevolution to paleogeography

Christian Klug, Dieter Korn, Kenneth De Baets, Isabella Kruta and Royal. H. Mapes (eds). 2015, Springer. 605pp. ePub £122 / hardback £153. ISBN 978-94-017-9632-3.

This volume, together with *Topics in Geobiology Volume 43*, updates and extends the single volume 'Red Book' from 1996. If the original volume was for the ammonoid specialist, the updated version should attract a broader readership among Earth scientists, palaeontologists and evolutionary biologists. Within the range 'From macroevolution to paleogeography', the papers are grouped into three sections: macroevolution, palaeobiogeography, and key events in ammonoid evolution.

Part I, 'Macroevolution', comprises five papers that tackle the large-scale evolutionary patterns of Ammonoidea. The first paper, *Ancestry, Origin and Early Evolution of Ammonoids*, by Klug *et al.*, is noteworthy for bringing together an authorial team that combines expertise in early molluscan evolution and systematics, nautiloids, coleoid cephalopods and, well, ammonoids. As such, the paper reflects the growing trend of collaboration among those working on cephalopod evolution and is a timely summary of the recent research. The next two chapters are short but authoritative summaries of advances in research on taxonomic and morphological evolutionary patterns in Triassic and Jurassic ammonoids. The final two papers, with Claude Monnet as lead author, deal with morphological evolutionary patterns in ammonoids without imposing any temporal constraints. Monnet *et al.* provide fresh thoughts on Buckman's Rules of Covariation and in their overview of the literature draw attention to contradictory reports of these patterns, while considering processes. Chapter 5 presents an overview of the range of evolutionary patterns in the ammonoid fossil record and recalls that the late Dolf Seilacher, in 1988, made the case for ammonoids being the *Drosophila* of the fossil record. While I would personally assign that status to microfossil groups, this chapter reminds us of the importance of macrofossil groups with good fossil records as natural experimental systems for exploring evolution and macroecology.

Palaeobiogeographic patterns and processes are the focus of the five papers in Part II. Korn and De Baets tackle the Palaeozoic ammonoids in the first paper in this section with quantitative biogeographic approaches and cladograms to analyze whether distinctive warm and cool water ammonoid faunas existed. Brayard *et al.* provide an in-depth numerical analysis of Triassic ammonoid evolutionary patterns, using novel techniques that Brayard has pioneered. If you are





not familiar with Arnaud Brayard's previous publications, I would urge you to seek them out. His work deserves to be better known and is an extension of the wider tradition of novel application of multivariate statistical methods in many areas of evolution and ecology by Francophone researchers, which I first came across in the works of the ammonoid group at Dijon and through the English language edition of Legendre and Legendre's *Numerical Ecology*. Peg Yacobucci's chapter fills the obvious stratigraphic hole in Part I by considering spatial and temporal evolutionary patterns and processes among Jurassic and Cretaceous ammonoids, again with the use of a range of quantitative techniques. The concluding two chapters on the palaeobiogeography confine themselves much more to the pattern of occurrences without the quantitative approaches. The authorial teams on both papers acknowledge the lack of such work in both the Early and Late Cretaceous and highlight the opportunity for this work to be undertaken. One cannot help but regret that Fabrizio Cecca, who was such a strong advocate for cladistic and quantitative methods in marine invertebrates, particularly in the Jurassic and Cretaceous ammonoids, died in 2014.

The editors might have chosen to subdivide the final part of the volume into two sections: a biostratigraphy section and a final part dealing with the major extinction and diversification events. Monnet *et al.* offer a lucid introduction to biochronological methods that should become a classic on the topic, as it moves effortlessly from the earliest notions of index fossils and relative ages through to the challenging conceptual method of Unitary Associations, with an example using Hammer and Harper's PAST. Having co-supervised undergraduate projects that used some of these techniques, I wish this paper had been available at the time. Chapters 12 to 15 deal with the global and regional biostratigraphy of each major geological period in which the ammonoids were present. Chapter 12 covers the whole of the Paleozoic but at a similar level of detail to the individual chapters on individual Mesozoic periods.

Key events in ammonoid evolution are the focus of chapters 16 to 19. Chapter 16 once again examines the whole of the Paleozoic in a single chapter, dealing with taxonomic and morphological evolutionary patterns. Brayard and Bucher focus on the Permian–Triassic extinction and rediversification events in Chapter 17. Chapter 18 deals with the Triassic–Jurassic transition and Chapter 19 offers fresh insights into the twilight of the ammonoids at the K/Pg boundary from Landman *et al.*, including a useful summary of the global distribution of sections that draws attention to lesser known sections, as well as the famous sections in the Bay of Biscay, Western North America and Seymour Island.

The final chapter in this volume is probably of interest only to ammonoid researchers and should perhaps have been included in *Topics in Geobiology Volume 43*. Wani and Gupta cover some emerging techniques for studying the molecular products of decay of soft tissues, as well as reviewing the classic works of ammonoid shell taphonomy, which Dolf Seilacher contributed to so significantly with his distinctive illustrations.

As I indicated in the review of Volume 43 in the last Newsletter (91, p. 108) the whole volume is exhaustive but expensive and the ability to download individual chapters as PDFs should enhance the impact and circulation of the work. The editors have gathered a fine set of papers, with tremendous illustrations, that should serve ammonoid palaeobiologists well until the next omnibus work on ammonoids.

Al McGowan
GeoBioD



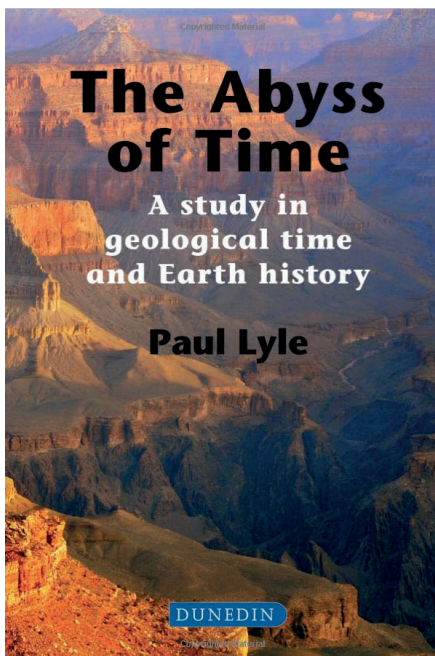
The Abyss of Time

Paul Lyle. 2015. Dunedin Academic Press. 204 pp.. £24.99 (hardback). ISBN: 9781780460390

As a Zoology undergraduate, I approached my Honours year elective palaeontological study and thesis with a zoological rather than geological background. With little prior knowledge of the geological processes that occur on our Earth and that actually make study of long extinct taxa possible, I dived into this book with gusto. I was met with a comprehensive overview of many crucial geological processes, with concepts explained in an accessible manner and real-world examples used to further illustrate them. This may sound like tedious revision to geological academics, but Lyle combines descriptions of the processes with an interesting history of study on these fields. For example, the pioneering work of James Hutton, Adam Sedgwick and Sir Roderick Murchison is presented along with that of their contemporaries, and divisions in the beliefs of geologists, be they on religious or purely academic grounds, are indicated.

Lyle also considers contributions made by other individuals not necessarily associated with geology – René Descartes, Ernest Rutherford and various theologians – making thought-provoking connections in scientific thought. The significance of the breakthrough discovery of radioactivity and its application to geology through radiometric dating, the application of geological techniques to the fields of archaeology and palaeobiology, and the application of magnetostratigraphy to palaeoanthropology, are described, making interesting connections between research fields.

Being a study in geological time, Lyle begins by contextualising measurements of time in a succinct and quirky manner, noting comparisons between subjective measures of time as perceived by a child at the end of the holidays and the objective measures used by researchers. He makes further creative comparisons between the way in which astronomers and geologists must incorporate time into their observations, and the geological history of the north-western Scottish Highlands is used both to exemplify our understanding of the ‘language’ of geology, and to juxtapose the cyclical and linear concepts of time. After setting this scene, the human fascination with the measurement of inexorably advancing time is discussed, from Neolithic monuments through to the digital devices of today. The Cognitive Revolution and development of culture by Neolithic man are shown to have encouraged the contemplation of time, both past and future. Lyle sweeps from this to the rigid management of time required by complex societal life through the Middle Ages to the minute subdivisions of the Industrial Revolution, as human and mechanical life demanded ever more





precise order. The concept of 'deep time' is proposed, and the short existence of *Homo sapiens* in this 'deep' context is presented, highlighting the astonishing exponential growth of our species. Narratives of the history of science and philosophy are woven together to explain the origins of current differences in perceptions of time.

Having set the scene, Lyle introduces provoking arguments surrounding the understanding of geological time and its influence on the environmental and economic challenges of today's societies. The book highlights the importance of vast geological timescales and how they relate to the processes that provide the non-renewable resources on which humans are now dependent. Intriguingly, the often unacknowledged role of the geological community in the sustenance of developed consumer culture is noted, with Lyle pointing to reasons why non-geologists should take an interest in understanding geological time. Frightening notions of resource shortages are suggested, provoking thought on the evolution of the global community and the cost to planet Earth which accompanies a 'developed' lifestyle. Economic, political and functional repercussions of our failure to appreciate geological time and the resultant over-exploitation of the Earth's resources are presented in a driven, matter-of-fact manner. These harsh truths are, however, sprinkled with positive suggestions regarding possible solutions. By using real-world examples that can easily be related to, such as the Himalayas and the Grand Canyon, the geological processes governing our Earth are detailed in a manner accessible and informative to non-geologists.

Lyle continues to juxtapose cyclical and linear concepts of time, alongside a presentation of the general history of scientific thought that is interesting and informative. Critically Lyle points out that, while the frightening issues that face our species may be obvious to geologists, they are not known to the majority of people and yet, if life on Earth is to survive, they need to be. He discusses the idea of the Anthropocene as a new geological period, based on the notion that humans are now the principal geological agent on the planet. This is exemplified through a quote from Mahatma Gandhi: "The future depends on what you do today". Lyle points at the influence humans have had on Earth in our exceptionally short existence, concluding that we are indeed in a human-dominated geological period and thus that debates on its official designation as the Anthropocene are irrelevant. The hot topic of correlations between global carbon dioxide levels and temperature are noted, with Lyle remaining perhaps unusually ambivalent on the matter, leaving readers to determine for themselves whether the observed patterns are unnaturally and anthropogenically sourced. He does, however, return to his earlier comments regarding the sheer lack of resources available to our expanding global population. On this matter Lyle expressly states that greenhouse gas emissions and fossil fuel usage simply must be reduced, alluding to diverse political, economic and social reasons that are not often considered in such debates.

Lyle finishes with a somewhat blunt passage on the insignificance of our species in the context of geological time, provoking thoughtful contemplation of our place in Earth's history. He points out that we will surely not be around to see the outcome of many future geological processes that we have learned of through studying the past. Thankfully, we are pulled philosophically from the disturbing notion that we are all insignificant by the reminder that acknowledgement of this truth should actually elicit a *carpe diem* attitude. We, as a species, must heed the wise words of Tolkien's wizard Gandalf – "All we have to decide is what to do with the time that is given to us" – in order to forge a sustainable, productive future for ourselves, our planet and all of its other inhabitants. Lastly, Lyle himself acknowledges that acceptance of this insignificance will be difficult for many, as



humans inherently seem to have an anthropocentric outlook, and seek purpose in life. What must be stressed, however, is that geological insignificance by no means renders an individual or a species insignificant – particularly one with the apparent power and huge potential of *Homo sapiens*.

Overall, Lyle provides an excellent description of the history of scientific thought, accessible and interesting to all audiences, within a framework based on a geological understanding of time. The factual content and quirky style make for constantly engaging reading, which I thoroughly enjoyed. Lyle weaves the history of how we attained our current understanding of geology and time with the societal and environmental issues we face today into a thought-provoking piece, which stimulates reflection on how we as societies and individuals must embrace geological processes if we are to forge a sustainable way of life on Earth. Though it is only 200 pages long, the scope and alternative perspective of *The Abyss of Time* makes this book well worth reading.

Struan Henderson

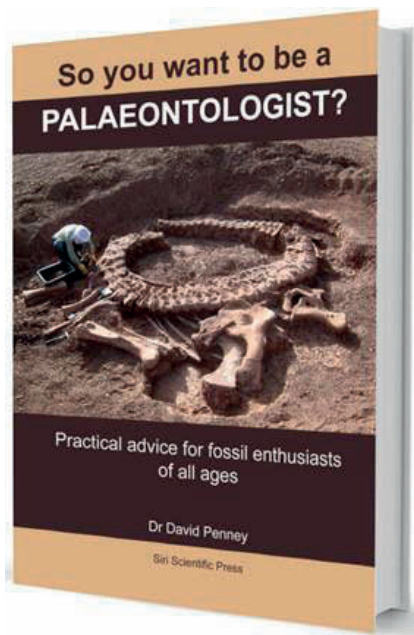
University of Edinburgh

So you want to be a palaeontologist? Practical advice for fossil enthusiasts of all ages

David Penney. 2016. Siri Scientific Press. 64 pp. £9.99 (Soft cover).
ISBN: 978-0-9929979-6-0

What a delightfully informative book, and congratulations to the author for detailing every route open to someone wishing to enter palaeontology as a career. This book highlights the fact that regardless of skills, knowledge and age, if you have a passion for fossils then there is a way to become a palaeontologist. I wish a book detailing these options had been available many years ago when I graduated from my undergraduate degree. In that case I would have been aware of the possibilities of volunteering in museums and how to gain experience, and thus a 'foothold', into a career in palaeontology.

This brings me to another point in the book – transferable skills. In a climate where there are so few jobs available in palaeontology and strong competition for positions, aspiring palaeontologists could easily become disheartened. This book stresses that many such enthusiasts probably already possess some (if not many) transferable skills gained from industry, their academic background, hobbies and / or interests. Many aspiring palaeontologists can pursue a career based around fossils even if they do not follow the traditional academic route. The key point is 'never give up' on your passion because there is always a way to be involved.





Other topics discussed in the book are the importance of palaeontology in society and industry, and the type of work undertaken by professional palaeontologists. Palaeontology often conjures up thoughts of dinosaurs to many people outside the industry and gives the subject the appearance of 'nerdy' specialism. However, as impressive, formidable and amazing as dinosaurs are, they are not the only facet of a career with fossils. This book showcases many niche specialisms in palaeontology and their related industries. People interested in specific palaeontological fields yet unsure of how these relate to industry will find this a very useful guide.

A drawback of the book is that there is only a short section describing the typical tasks undertaken by a palaeontologist and I feel that a greater emphasis on this would have been useful.

Moreover, rather than being 'practical advice for fossil enthusiasts of all ages' as indicated by the title, this book would be more useful to those who are still deciding on their career path or those who are mostly hobbyists and wishing to take their hobby down a more professional direction. This is not to say that the book would not be enjoyed by professional palaeontologists!

Despite all the positive aspects of this book, I was a little disappointed to discover that an A5, soft-back book with only 65 pages was retailing at £9.99. Considering the probability that many of the readers will be students with limited funds, perhaps a lower price would be more fitting?

Nonetheless, I consider this book well written and useful for readers of widely diverse knowledge and experience.

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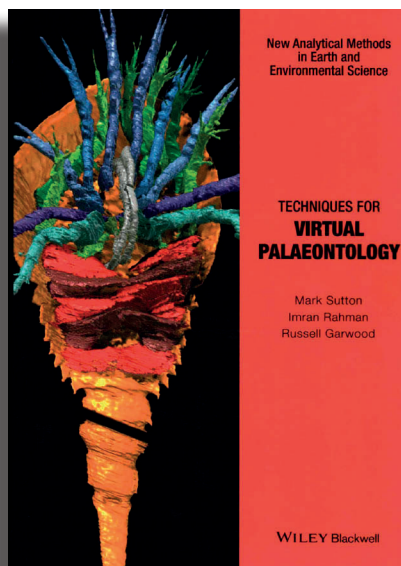
Techniques for Virtual Palaeontology

M. Sutton, I. Rahman and R. Garwood. 2014. Wiley Blackwell, 200 pp.
£75.00 (hardback), £26.99 (E-book). ISBN: 978-1-118-59113-0

In the late 1960s and 1970s palaeontology was revolutionized by developments in scanning electron microscopy. The use of stereopairs to increase three-dimensional viewing of highly-magnified specimens opened up new worlds and possibilities for palaeontological research. Over the past 10–15 years there has been another significant revolution in palaeontology, with not only the development of new microscopical techniques but also advances in computing power that can easily be sourced and developed. This volume by Mark Sutton and colleagues, in considering techniques for virtual palaeontology, traces and expounds many, but not all, of these new techniques. The volume deals with many important developments in the study of invertebrate and some vertebrate fossils but is light on palaeobotanical examples, which is a pity as their inclusion would have provided a more rounded volume.

The volume is divided into six parts:

Chapter One contains a short introduction and history of the subject, considering the developments of physical-optical tomography in the 20th century and outlining the development of CT scanning. The authors define virtual palaeontology as the study of three-dimensional fossils through digital visualizations. This, however, suppresses the power of the new technique that may not only involve



advances in computation that allow digital images to be produced, stored and reconstructed but also the development of new microscopical techniques that allow more sophisticated and different digital datasets to be obtained in the first place. We are all familiar with the problem of looking at a series of cross sections through a brachiopod or plant and the frustration of how to reconstruct the object before the advent of computerized systems. Reconstructing sections in wax was a technique long used by palaeobotanists and palaeoichthyologists, and the reconstruction of peel sections of coal ball plants remained (and remains) a significant issue today. Equally the development of new microscopical techniques, while finding new data from new imaging techniques, suffered from the lack of development in the computing field (at least with equipment and finances available to most palaeontological researchers).

For many of us a step change in the development of virtual palaeontology came with the discovery of the Hereford Lagerstätte and descriptions by Derek Siveter and others. Most would have thrown much of the material away. However, enough information was found to make new attempts to extract the data about the fossils a priority. Mark Sutton joined the project and most who saw presentations or read the first paper were 'blown away' by the reconstructions of soft-bodied fossils that none of us had suspected were there. Throughout this volume I cried out for more images that showed the power of the techniques described.

Chapter Two deals with destructive tomography. While for many this may be sacrilege – to obtain data while destroying the fossil – it is what has caused a major revolution in palaeontology as exemplified by the studies of the Hereford Lagerstätte. In this example serial grinding, digital photographic imaging and the use of reconstruction software has proven revolutionary. New methods of image capture, storage and manipulation were key for the development of the technique. While we are all familiar with the results of such studies the investment in time may be considerable – first obtaining the data, then in the manipulation and coding of the data before final reconstruction. The results, however, certainly warrant the investment in effort.

The chapter describes how the data are obtained through these destructive techniques that include serial grinding, sawing and slicing. The authors illustrate serial sections through a brachiopod – the type of illustration familiar to many generations of palaeontologists – but I would have liked to have seen an example of such a dataset reconstructed. In contrast to brachiopods, where the contrast of the fossil and medium may be good (an extracted brachiopod has no external matrix) or the Herefordshire fossils, where the fossil is isolated in a contrasting matrix, many fossil plants that preserve anatomical detail are hosted within lithologies where tracing specific organs may be problematic, *e.g.* coal balls. The authors illustrate a section through a permineralized plant organ (Fig. 2.3) but a discussion of the problem of organ reconstruction is thin and perhaps indicates



an unfamiliarity with the study of fossil plants. It is not simply a matter of using peels (or not); one important element omitted from the book is how to follow structures through a specimen accurately. Focused ion beam tomography is an interesting and underused tool. I first came across the technique through Russian authors who used ion beam milling to reveal botanical structures in anthracite (Kizilshtein and Shpitsgluz, 1982). Unfortunately this was never pursued, but using new tomographic techniques there may be a wealth of data waiting to be discovered!

For many of us, new non-destructive tomographic techniques have proved a revelation. It is in this area that so many spectacular advances have been achieved. I found Chapter Three both informative and frustrating at the same time. I would really have liked to have seen some more images as well as some palaeobotanical examples (see Collinson *et al.*, 2012). I can well remember the excitement of seeing the inside of small Precambrian spheres and learning that they represented embryos (Donoghue *et al.*, 2006). The whole range of CT-scanning is described and the area of microCT scanning is discussed. An area of rapid development has been the use of various synchrotrons. The Swiss Light Source has been used extensively for the study of plant fossils and I would have liked to have seen a discussion concerning its use for the study of small fossils including charcoal (*e.g.* Friis *et al.* 2007; von Balthazar *et al.* 2007; Scott *et al.* 2009.). Techniques for gathering organic chemical data would also have been a useful addition to the chapter.

Chapter Four examines surface-based methods. This relates mainly to the most important techniques in laser scanning and methods of digitizing the three-dimensional surface of fossils. These techniques have been developing at an incredible speed, not least because they are used extensively by Hollywood. The ability to reconstruct footprint tracks, fossil forests *etc.* on the larger scale is wonderful but on a smaller scale this will prove useful to bring the virtual reality of a wealth of fossils into the classroom.

There has been rapid development of computer software to aid in virtual reconstructions of fossils and the ability to link the end product to a 3D printer represents an exciting new development. A few reconstructions are presented but again I feel that an opportunity was lost to see what could be achieved on a wider range of material.

The final Chapter (Five) is concerned with applications beyond visualization. This looks at a range of applications such as use in dental wear analysis and body size estimation. There are many vertebrate examples but none of fossil plants. One of the interesting uses of the data on virtual fossils is for taphonomic studies. Smith *et al.* (2009) used synchrotron data to visualize successive layers within seeds to illustrate different possible preservation states of the plant. Other new approaches have allowed important organic chemical data to be obtained, such as almost unaltered chitin from Silurian and Carboniferous arthropod cuticles (Cody *et al.* 2011).

There is no doubt that this book documents an important revolution in palaeontology and has much to recommend it. The student of palaeontology would be well advised to try to use some of these approaches in a rapidly expanding field and these are exciting times. My only reservations are that the book could have been even better with a few additional illustrations in a highly visual field and also a broader attention to the range of fossils discussed and illustrated.

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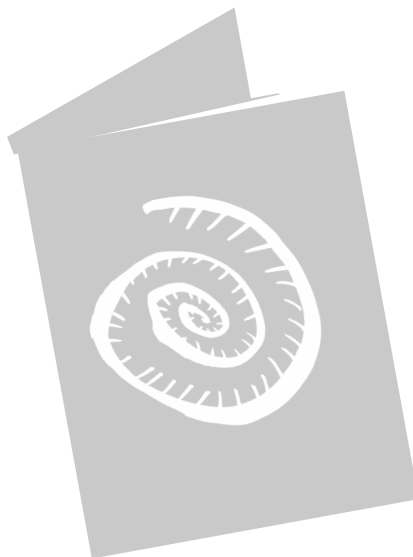
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- *The Tyrannosaur Chronicles*, by D. Hone.
- *Advances in Parasitology: Fossil Parasites*, by T. J. Littlewood and K. De Baets.
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Careering off course!

Inspirational palaeontologists



A palaeontologist with an unusual job

Will Watts is the founder and director of Hidden Horizons Ltd., which was established in 2013. Based in Scarborough, North Yorkshire, the company specialises in two main capacities: museum and heritage consultancy, and events and education relating to geology and natural history. Will graduated with a BSc degree in Geological Sciences from the University of Leeds in 1999, and prior to working in Scarborough, he was employed by the Yorkshire Geology Museum in order to catalogue the geology collections and at the Royal Ontario Museum, Canada. Before founding his company, Will was the Dinosaur Coast Project Officer for the Scarborough Borough Council and Head of Programmes with the Scarborough Museums Trust. He has been associated with, and played a leading role in, many other major museum developments, including the refurbishment and re-development of the Rotunda Museum which re-opened in 2008.

Hidden Horizons Ltd. deals with most areas of museum work including exhibition design, collection reviews, audience development, marketing, learning and interpretation plans, funding applications and accreditation returns. In the Scarborough countryside, the company has developed a series of public events and school resources – everything from fossil hunting trips to rock-pooling sessions.

Why did you study palaeontology?

I was raised in the North York Moors National Park and grew up with a love for outdoor activities. When I was twelve, my birthday party was a fossil-hunting day on the Yorkshire coast. There I discovered my first dinosaur footprint and (with later thanks to keen friends and to Paul Ensom (Curator at the Yorkshire Museum) in particular), I realised that palaeontology

would be the career for me. Since then I just never stopped!

What is your typical day as a palaeontologist?

My days at work vary but essentially deal with three main aspects: providing services to support museum and heritage organisations, education (both in the classroom and outdoors)



and organising geo-walking and fossil-hunting field trips. So my typical day would involve contacting colleagues at various museums, planning or giving lessons at schools and developing or guiding walking-tours along the coast.

Who do you bring with you on your geo-walks?

I bring everyone into the field! The ages vary quite a lot; the youngest was an eight-year-old child at a fossil-hunting birthday party. Families are common groups for the walking tours and they come from many parts of the world – I've led walks with families from America and Australia.

Why do you think it is important to share palaeontological and geological knowledge with the general public?

Everyone is interested in ancient things. But I feel that people need to understand some of these things better and see them as part of the big picture. A better knowledge of geological processes might help us to predict the outcomes of events in the future. In the short term these might be related to, for example, climate change and extinctions or at longer time-scales, landscape changes and even evolution. The most important thing is to try to keep people interested.

Do you have any hobbies?

Other than Palaeo-related ones!? I like various outdoor activities and especially fishing. My job can feel very stressful at times because of being constantly available by telephone and email, so I sometimes disappear for a while and go fishing. That is my escape.

If you could use a time machine to go back to any place and time period and see what the environment was really like, which would you pick and why?

That's easy! The middle Jurassic of the Yorkshire coast, mainly because it is the place and geological time with which I do most of my work. We know a lot about how the rocks around here were formed but there still remains a lot to be learned. Also, there are lots of dinosaur footprints in this area and I would love to see the animals that produced them.

Have you had a mentor during your studies or during your career?

A mentor? There is not one person but in fact there are more than a few who have been instrumental in progressing my career. In particular, Dorothy Ellison, a family friend who showed me how to split ammonite nodules when I was aged 7 and my father, Martin Watts, who was also a museum professional. I mentioned Paul Ensom previously but should also recognise Shirley Collier, my last boss when I worked in a museum.

You can find out about Hidden Horizons at:

<<http://www.hiddenhorizons.co.uk>>

Valentina Rossi

University College Cork



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