INTRODUCTION

The year 1874 was one of consolidation, reflection, and turmoil for Darwin. He spent the early months working on second editions of *Coral reefs* and *Descent of man*; the rest of the year was mostly devoted to further research on insectivorous plants. A vicious dispute over an anonymous review that attacked the work of Darwin's son George dominated the second half of the year. When requested to provide words to celebrate what would have been the naturalist and traveller Alexander von Humboldt's 105th birthday, Darwin obliged with a reflection on his debt to Humboldt, whom he had greatly admired in his youth: 'I have always looked on him as one of the greatest men the world has ever produced. He gave a wonderful impetus to science by showing what could be done by observation during prolonged intervals' (letter to D. T. Gardner, [*c.* 27 August 1874]). The death of a Cambridge friend, Albert Way, caused Darwin's cousin, William Darwin Fox, to reminiscence about their university days together, and the long-abandoned pleasures of shooting and collecting beetles (letter from W. D. Fox, 8 May [1874]). Such reminiscences led Darwin to the self-assessment, 'as for one's body growing old there is no help for it, & I feel as old as Methusalem; but not much in mind except that I think one takes everything more quietly, as not signifying so much. And … one looks backwards much more than forwards' (letter to W. D. Fox, 11 May [1874]).

The year started for Darwin with a week's visit to London, staying at his brother Erasmus's house. He requested a visit from his doctor, Andrew Clark, whom he had been consulting since August 1873. Darwin had originally thought that Clark's dietary treatment would 'do wonders', but as he confessed to his old *Beagle* shipmate Bartholomew James Sulivan, 'it was an illusory hope.— I feel very old & helpless' (letter to B. J. Sulivan, 6 January [1874]). Darwin mentioned his poor health so frequently in correspondence that Ernst Haeckel inferred that he was well from his silence on the matter (letter from Ernst Haeckel, 26 October 1874). Darwin excused himself for reasons of health from various social activities, even the opportunity to contact the spirit world. While Darwin was in London, his son George organised a séance at Erasmus's house. The event was led by the medium Charles E. Williams, and was attended by George Henry Lewes and Marian Evans (George Eliot), but Darwin excused himself, finding it too hot and tiring. 'The Lord have mercy on us all, if we have to believe in such rubbish', he confided to Joseph Dalton Hooker (letter to J. D. Hooker, 18 January [1874]). Later in the month, another Williams séance was held at the home of Darwin's cousin

Hensleigh Wedgwood. Those present included George Darwin, the psychic researcher Frederick William Henry Myers, and Thomas Henry Huxley, who sent a long report to Darwin with the spirit-busting conclusion that Mr Williams was 'a cheat and an imposter' (letter from T. H. Huxley, 27 January 1874). Darwin agreed that it was 'all imposture', and could not believe that his cousin could be so easily 'humbugged'; his theory was that Williams managed to get the two men on each side of him to hold each other's hands, instead of his, '& that he was thus free to perform his antics' (letter to T. H. Huxley, 29 January [1874]). This did not stop word getting to America of the 'strange news' that Darwin had allowed 'a spirit séance' at his home (letter from T. G. Appleton, 2 April 1874).

New editions of *Coral reefs* and *Descent* consumed the first three months of the year and, like many of Darwin's enterprises in the 1870s, were family affairs. His son Horace had suggested a new edition of the coral book in December 1873, when he realised the difficulty a Cambridge bookseller had in obtaining the first edition, published in 1842 (*Correspondence* vol. 21, letter to Smith, Elder & Co., 17 December [1873]). Darwin himself had some trouble in finding a copy. Having sent back his own to the publishers, he applied first to his friend Joseph Dalton Hooker, and finally borrowed one from Charles Lyell (letter to Smith, Elder & Co., 8 January 1874, letter to J. D. Hooker, 8 January 1874, and letter to Charles Lyell, [13 January 1874]). Darwin blamed his illness for the 'dreadfully written' parts of the draft sent to Smith, Elder & Co, and he was able to tackle the proofs only with the help of his daughter Henrietta, whom he thought 'a good dear girl to take so sweetly all the horrid bother of correction' (letter to H. E. Litchfield, 21 [March 1874]). The book came out in June with the later chapters on the formation and distribution of coral-reefs substantially revised, and an account of the sandstone bar off Pernambuco on the Brazilian coast was added to the appendix. Demand for the book may have been increased by the publication in 1872 of *Corals and coral islands*, by James Dwight Dana, an American zoologist, geologist, and leading expert on coral-reefs. In his preface (*Coral reefs* 2d ed., pp. v–vii), Darwin reasserted the priority of his work. Dana had complained that Darwin had not given enough weight to sea temperature or volcanic activity in accounting for the absence of coral-reefs in certain locations. Darwin countered with the facts that low temperature could not fully account for the absence of coral-reefs in some areas, and that a volcano could not affect the whole coastline of a large island. Dana also thought that Darwin had seen fringing reefs as proof of the recent elevation of the land, whereas Darwin thought they could also indicate that the land had long remained stationary (*Coral reefs*, p. vi). On receiving a presentation copy, Dana sent an apology for misinterpreting Darwin on this point (letter from J. D. Dana, 21 July 1874); however, he did not retract his criticism in his own second edition (Dana 1875, p. 274).

Alongside his revision of *Coral reefs*, Darwin went to work on a new edition of *Descent*. In the preface, he acknowledged his great debt 'to a large number of correspondents for the communication of a surprising number of new facts and remarks' (*Descent* 2d ed., p. v). Among the many contributors was George Cupples, a Scottish

deerhound expert who forwarded Darwin's queries about the numbers of males and females born into, and preserved in, litters of puppies to other dog breeders (letters from George Cupples, 21 February 1874 and 12 March 1874); the material was summarised in a note about how breeders' selective practices might influence sex ratios (*Descent* 2d ed., p. 258 n. 99). The former bishop of Honolulu, Thomas Nettleship Staley, and Titus Munson Coan, a physician in New York whose parents had been missionaries, provided information on female infanticide and disease in the Sandwich Islands (Hawaii; letters from T. N. Staley, 12 February 1874 and 20 February 1874; letters from T. M. Coan, 14 February 1874 and 22 June 1874). A civil servant in the Colonial Office, William Dealtry, also provided information on population numbers and sex ratios among the Pitcairn islanders (letter from William Dealtry, 16 January 1874).

One of the most significant additions to *Descent* was an eight-page note written by Huxley with the aim of ending a dispute over the structure of ape and human brains that had raged between himself and Richard Owen since the 1860s. Darwin had omitted this controversial topic from the first edition of *Descent* but, because some still doubted the close similarities between ape and human brains, he asked for a clarifying note from Huxley (A. Desmond and Moore 2004, pp. xxxv–xxxvi). Huxley obliged with a lengthy 'screed', stating: 'I think you will say that I have pounded the enemy into a jelly' (letter from T. H. Huxley, 14 April 1874). The technical nature of Huxley's argument prompted him to add, 'Put my contribution into the smallest type admissible for it will be read by none but anatomists; and never mind where it goes' (letter from T. H. Huxley, 16 April 1874).

The second edition of *Descent* was published in November 1874 (letter from R. F. Cooke, 12 November 1874). Though containing forty extra pages and three new illustrations, it was issued in a single volume at a much reduced price of nine shillings, in line with Charles Lyell's *Student's elements of geology*, and with the cheaper sixth edition of Darwin's own *Origin*. (The first edition had been in two volumes and had cost twenty-four shillings.) Murray's partner, Robert Francis Cooke, informed Darwin that the lower price would bring the profits on the first 2000 copies 'to almost nil' but, as the work had been stereotyped, the return on subsequent print runs would be very good (letter from R. F. Cooke, 12 November 1874). His son George had laboured hard on the revisions and wrote to his father: 'I hope you wo'nt think me bumptious if I say to you that I think it a splendid book & deserving of every inch of its reputation. Your power of marshalling facts under one point of view & the number of facts utterly staggers me; but I'm more struck than anything by the conciseness & clearness of your thought' (letter from G. H. Darwin, 20 April 1874).

Before helping Darwin revise *Descent*, George had taken up questions of human evolution and inheritance himself. In August 1873, he had published in the *Contemporary Review* 'On beneficial restrictions to liberty of marriage', in which he suggested that modern scientific views of inheritance might lead to restrictions on marriage in order to discourage the spread of various mental and physical disorders (G. H. Darwin 1873b). In July 1874, an anonymous essay appeared in the *Quarterly Review*

discussing works on primitive man by John Lubbock and Edward Burnett Tylor. It included an attack on George's paper as speaking 'in an approving strain . . . of the encouragement of vice in order to check population'. The review was by St George Jackson Mivart, one of the most severe critics of the theory of natural selection, and one who had succeeded in offending the usually generous Darwin by his previous anonymous attacks ([Mivart] 1869; 1871c). In his review, Mivart criticised both son and father, dismissing Darwin's views on the development of language as 'nonsense' and as displaying 'amazing ignorance' ([Mivart] 1874b, p. 45). He also circuitously implicated Darwin in the supposed endorsement of immorality, for the link between prostitution and reduced population in various cultures had been made in *Descent of man* (*Descent* 1: 134). By interpreting George's article as a defence of such immoral practices, Mivart was indirectly accusing Darwin himself of supporting the 'hideous sexual criminality of Pagan days' ([Mivart] 1874b, p. 70).

As the authorship of the review became known within Darwin's immediate circle, a bitter dispute ensued over Mivart's misrepresentation of George's views (see Appendix V), and more generally the respectability of Darwin's evolutionary views and the ethics of scientific conduct (see Dawson 2007, pp. 77–81). Darwin first considered taking legal action over the 'scurrilous libel' on his son (letter to G. H. Darwin, [27 July 1874]). George, however, consulted with his friends in the legal profession and concluded that he could not use the libel law or even allege 'specific injury in trade or profession'. He recognised the 'skilful venom' of Mivart, and suggested that he instead should write an 'explicit denial & short account' of his essay. Mivart's attack had been published in the *Quarterly Review*, one of the most prestigious and politically Conservative journals with a long tradition of anonymous reviews. Its proprietor was none other than John Murray, Darwin's publisher. So incensed was Darwin that he thought it appropriate to apply pressure on Murray to print George's defence. After re-reading George's original article he could not see 'a shadow of foundation for the false, scurrilous accusation of [a] lying scoundrel' (letter to G. H. Darwin, 1 August [1874]). He drafted a brief statement of denial in the form of a letter to the editor, and sent it to George. Drafts went back and forth in early August, as father and son agonised over the wording of both the letter to the editor and the letter to Murray to accompany it. The depth of Darwin's feelings can be gauged by his willingness to stake his thirty-year relationship with Murray on the outcome (enclosure to letter from G. H. Darwin, 6 [August] 1874):

> I think you will see that I have no choice on this head, if you will put yourself in my position, and imagine me to be the proprietor of a review in which according to your own judgment and that of all the friends whom you had consulted, a calumnious and groundless attack on your son had appeared and no reparation was granted. In this case you would I feel sure, no longer treat me as your friend, and you would

> free yourself at the earliest possible period from all business transactions with me.

George worried that it would be 'a great annoyance to go to a new publisher' and advised that Darwin should not push Murray to the point of cutting off relations. 'I'm a grown man now', he reminded Darwin, '& shd. stand on my own footing, & if it is refused I'm really no worse off than if I had sent my letter direct to the Editor & it had been refused' (letter from G. H. Darwin, [6 or 7 August 1874]). When the letter was finally sent to Murray, Darwin referred only to their 'long & friendly intercourse' to justify his 'asking a favour'. He explained why he had written to Murray and not the editor of the *Quarterly*: 'I cannot expect fair treatment from him without your aid, after his employment of a gentleman to review my *Descent of man*, who was notoriously pledged by two previous publications to review me in a hostile spirit' (letter to John Murray, 11 August 1874). Darwin was referring to Mivart's highly critical review of *Descent* ([Mivart] 1871b), which had also been published anonymously in the *Quarterly*. This review had caused Darwin such great offence that he had broken off his correspondence with Mivart (see *Correspondence* vol. 20, letter to St G. J. Mivart, 11 January [1872]). To Darwin's relief, Murray replied immediately: 'I have lost no time in seeing the Editor upon the subject who considering the matter has no hesitation in agreeing to your request to print your Son's letter as it stands in the next number of the Review & in the same type' (letter from John Murray, 12 August 1874). George's letter appeared in the October issue together with a rejoinder from the (still anonymous) reviewer.

However, the Mivart affair was not finished. Darwin was not satisfied with the published rejoinder, which was not an apology but a defence, and which allowed Mivart to remain behind the veil of anonymity. As the two men had corresponded for years, and had even regarded each other as friends, Darwin wanted Mivart both to address the matter privately and to take public responsibility for his published views. In December, he sought advice from Huxley and Hooker, sending them a draft letter that asked Mivart directly whether he was the author of the review (see letter to J. D. Hooker, 14 December 1874). Huxley stepped in, shunning Mivart at an evening meeting and communicating the 'swell' of his indignation through William Walter Roberts, a Catholic priest and friend of Mivart's, who was attending Huxley's lectures. Father Roberts's manner left Huxley in no doubt that Mivart had written the article (enclosure to letter from J. D. Hooker, 21 December 1874). Huxley's message through Roberts brought a very apologetic response from Mivart to Huxley, his former teacher; a plethora of excuses followed Mivart's statement that the review caused him more pain and regret than anything he had written before (see Appendix V, p. 641). Darwin thanked Huxley for representing him in public but was still inclined to write to Mivart directly after he knew the full result of Hooker's and Huxley's representations (letter to T. H. Huxley, 22 December [1874]). Huxley responded in sympathy: 'If anybody tries that on with my boy Leonard the old wolf will shew all the fangs he has left

by that time, depend upon it', and added, 'the severest & most effectual punishment for this sort of moral assasination is quietly to ignore the offender & give him the cold shoulder' (letter from T. H. Huxley, 23 December 1874). He enclosed his reply to Mivart, which stated that Mivart should have written to Darwin or George offering him the 'fullest & frankest apology' and sent a retraction to the editor of the *Quarterly Review*. Huxley concluded: 'our views on those points which I hold to be the most important of all to mankind, are too hopelessly divergent to render familiar intercourse between us pleasant or adviseable'.

On Christmas Eve, Darwin wrote to Hooker that they were still in a dilemma because Mivart had admitted nothing in public and neither the apology in the private letter to Huxley nor a private apology to George would do: '& the case is in some respects worse as he now owns that for some months he has thought himself wrong, & yet on Oct 15th he published that shabby rejoinder' (letter to J. D. Hooker, 24 December [1874]). On the same day, Mivart replied to Huxley's letter in detail, concluding: 'Widely divergent as are our views as to what is most important for the welfare of Mankind, I shall never while we both live, cease to hope that that divergence may cease & even while it still exists it does not on my side in the least obstruct "familiar intercourse" or render it "unpleasant" *to me*, because it does not on my side, produce the least personal ill feeling. Of course I can only submit to your wishes in this respect but I do so with regret & with a hearty wish for many happy new years for you & yours' (see Appendix V, p. 644). In his dealings with both Huxley and Darwin, Mivart wanted a clear distinction between the realm of public debate and the realm of private relations. However, from Darwin's point of view, Mivart had violated codes of friendship and of scientific conduct by attacking Darwin's family and personalising the conflict, and by failing to address in private letters disagreements that were later made public through anonymous reviews. While staying with Hooker over Christmas, John Tyndall, professor at and superintendent of the Royal Institution of Great Britain was informed of Mivart's offence; he offered his support to Darwin, judging Mivart's act as 'the natural outflow of his character' (letter from John Tyndall, 28 December 1874). Darwin's friends were closing ranks against Mivart. Hooker even suggested having him removed as secretary of the Linnean Society (letter from J. D. Hooker, 29 December 1874). Huxley advised against this (*Correspondence* vol. 23, from J. D. Hooker, 3 January [1875]), preferring to attack Mivart in print, as in his review of Ernst Haeckel's *Anthropogenie* in the *Academy* (2 January 1875; see Appendix V, p. 644–5) . The affair rolled on into January 1875 and was never resolved to Darwin's satisfaction. Assisted in the wording by his wife, Emma, and daughter Henrietta, he finally wrote a polite, very formal letter to Mivart on 12 January 1875, refusing to hold any future communication with him. This is the last letter between them that has been found.

George moved on from the affair, and despite periodic bouts of illness affecting his digestive system and diet treatments from Darwin's own doctor, Andrew Clark, he began to make a career for himself. By the end of the year he had drafted articles on cousin marriage, the theory of exchange value, and the second elliptic

integral (G. H. Darwin 1875a, 1875b, 1875d, 1875e). Darwin's other children were also doing well. Despite ill health, his youngest son Horace began the year by taking the examination for the BA degree in the mathematical tripos at the University of Cambridge. Darwin, whose experience of mathematics while an undergraduate was far from happy, sent words of encouragement after the first tests: 'I heartily rejoice that you have stood the examination without being bad & have done pretty well' (letter to Horace Darwin, 9 January [1874]). Horace came sixth among those who achieved second-class degrees. He started a three-year apprenticeship with the engineering firm Easton and Anderson of Erith, Kent. After a month's trial Darwin wrote to the firm about Horace's illness: 'My son is most desirous to enter your works; & I am sure he will never voluntarily be idle. Under these circumstances I trust that you will be so good as not to bind him to long hours of work' (letter to Easton and Anderson, 4 May [1874]). At the end of June, Darwin's fourth son, Leonard, who had joined the Royal Engineers in 1871, went to New Zealand as photographer on an expedition to observe the transit of Venus. Darwin had taken advantage of the correspondence about phyllotaxy he had with Hubert Airy, the son of the astronomer royal, George Biddell Airy, to help Leonard gain the commission (*Correspondence* vol. 20, letter to Hubert Airy, 24 August 1872). The passage took twelve weeks aboard the immigrant ship *Merope*. Leonard joined a colourful collection of saloon passengers, and enjoyed a comfortable cabin (see letter from Leonard Darwin to Emma Darwin, [after 26 June – 28 September 1874]). However, poor weather resulted in almost total failure of observations in New Zealand (see G. B. Airy ed. 1881).

Darwin's third son Francis married Amy Ruck, the sister of a friend of Leonard Darwin's in the Royal Engineers, on 23 July 1874. The newly-weds went on honeymoon to Switzerland but that did not stop them contributing to the family enterprise by observing *Pinguicula* (butterwort) for Darwin's work on insectivorous plants. Amy drew a plant and Francis was disappointed that they seemed not to catch insects nearly so much in Switzerland (letter from Francis and Amy Darwin, 8 August [1874]). Francis had given up the idea of a medical career, and moved back to Down with Amy to become Darwin's secretary. They rented Down Lodge and Emma Darwin wrote, 'They have . . . made the rooms look very well, & the garden is certainly beyond the average in prettiness & snugness' (letter from Emma Darwin to J. B. Innes, 12 October [1874]). Less happy were the various local disputes that the Darwins had with the vicar of Down, George Sketchley Ffinden, including one over the use of the Down schoolroom as a winter reading room in 1873 (see *Correspondence* vol. 21, letter to Down School Board, [after 29 November 1873]). Emma saw a 'great blessing' in the rumour that Ffinden might be leaving to take up his dead uncle's position of vicar of Deptford (letter from Emma Darwin to J. B. Innes, 12 October [1874]), but to her disappointment it was 'all moonshine' (letter from G. H. Darwin, 18 October 1874). Darwin's much loved 'sandwalk', the gravel path on which he made several circuits a day for exercise and uninterrupted thinking, also became a source of vexation. Darwin's efforts to purchase the wooded land,

which he had been renting from John Lubbock, led to a straining of relations with his neighbour and protégé. After consultation with lawyers over a doubt that it might have been included in Lubbock's marriage settlements, the sale was agreed in April for £300 (letter from John Lubbock, 2 April 1874), a high price that aggrieved Darwin.

Darwin's garden at Down continued to be a source of inspiration. In April, he wrote a letter to *Nature*, observing that the flowers of primroses were being destroyed by birds in his garden to a larger extent than usual. He wondered whether the cause was birds feeding on the nectar, and whether the phenomenon was confined to Kent or more widespread. He appealed to correspondents in England and abroad to observe whether the primroses there suffered, and to state the result, whether negative or affirmative, adding whether primroses were abundant in each district (letter to *Nature*, 18 April [1874]). He received numerous replies from all over the country. Edward Frankland described his pet bullfinch accurately attacking the nectaries of cowslips but his canary indiscriminately eating every part of the flower. Both birds had been in captivity for years and had little experience of cowslips or primroses, and Frankland added, 'The businesslike way in which the bullfinch went to work upon the flowers convinces me that its selective skill is hereditary' (letter from Edward Frankland, 26 April 1874). Darwin replied, asking for more information: 'Good Heavens what a prodigy the brain of every creature is.— The eagerness of caged birds for green food must be a rather disturbing element. Could you get a good bunch of Primrose flowers or cowslip flowers & try once again; & observe whether your bird swallows any part of the cut-off portion, or merely presses them for, as I supposed, the nectar' (letter to Edward Frankland, 28 April [1874]). Frankland concluded that his Isle of Wight bullfinches had inherited 'a more utilitarian character than that possessed by the Kent birds' (letter from Edward Frankland, 30 April 1874). The botanist Thereza Story-Maskelyne also sent the remains of cowslip flowers that had been attacked by her canaries (letter from T. M. Story-Maskelyne, 4 May 1874). In a second letter to *Nature*, Darwin summarised the descriptions he had been sent from near Preston in Lancashire, north Hampshire, Devonshire, and Ireland. He suggested that Frankland's experiments showed that the behaviour of the bullfinch was instinctive and likened them to Douglas Spalding's observations on the instinctive actions of chickens when their eyes were uncovered, after having been blindfolded from the moment of being hatched (letter to *Nature*, 7 and 11 May [1874]; Spalding 1872a). Darwin was so impressed with Spalding's work on the instinctive capacities of young animals that he invited him to lunch at Down. He reported to his son George that Spalding was planning to experiment on the sense of direction in animals, and had been trying blindfolded children; he thought Spalding had arrived at the same results as George, although nothing is known of George's experiments (letter to G. H. Darwin, 27 May [1874]). However, the death in July of Spalding's patron, Lady Amberley, marked the end of his research programme (letter from D. A. Spalding, 21 July 1874).

By 1874, Darwin had resigned himself to the fact that he would not complete all of the more grand theoretical publications that he had once planned: 'I shall

never have strength & life to complete more of the series of books in relation to the Origin, of which I have the M.S. half completed; but I have started the subject & that must be enough for me' (letter to W. D. Fox, 11 May [1874]). Despite this, Darwin brought the same combination of careful observational practice and theoretical insight to his highly original botanical investigations of insectivorous plants. Even more than his previous research for *Orchids* and *Climbing plants*, this work drew on methods from a variety of scientific fields, especially physiology and chemistry. Taking stock of what he had achieved, he wrote to his cousin William Darwin Fox: 'I am preparing a book almost wholly on *Drosera* or the Sun-Dew, which is a wonderful plant under a physiological point of view, & I think I have made some curious discoveries. One of the chief new points is that it secretes a fluid analogous to gastric juice, for it contains a ferment, closely analogous to pepsine, with an acid, & can thus in a few hours dissolve the hardest cartilage, bone & meat &c. &c.' (letter to W. D. Fox, 11 May [1874]). His research was greatly assisted by botanists from Kew and around the country, and by London chemists and animal physiologists.

Physiological botany was only beginning to be widely pursued in Britain and Darwin's interest in digestion, sensitivity, and other 'animal'-like properties in plants led him to work with physiologists at the Brown Animal Sanatory Institution in London, who performed comparative animal experiments on the digestibility of various substances on his behalf. Thomas Lauder Brunton sent the results of his experiments on the digestion of chlorophyll with extracts from a dog's stomach (letter from T. L. Brunton, 28 February 1874), and Edward Emanuel Klein subjected the bones of the skull of a cat to digestion with artificial gastric juice for about a week (letter from E. E. Klein, 14 May 1874. John Burdon Sanderson sent the results of his experiments on a range of substances, including haemoglobin, globulin, and mucin. He also did experiments with pepsin (letter from J. S. Burdon Sanderson, 25 April 1874), and with dentine and enamel (letter from J. S. Burdon Sanderson, 19 June 1874). Darwin's work inspired Burdon Sanderson to do his own original research on insectivorous plants, and Darwin sent him his notes on *Dionaea* (Venus fly trap) to help with his lecture at the Royal Institution (letter to J. S. Burdon Sanderson, 21 March 1874). Sanderson published the results of his work on electrical phenomena associated with the contraction of *Dionaea* leaves in *Nature* (Burdon Sanderson 1874). Hooker also gratefully received a summary of Darwin's results 'higglety-pigglety' (letter to J. D. Hooker, 20 July [1874]). In 1873, Hooker had begun a series of experiments on the digestive ability of the tropical pitcher-plant, *Nepenthes*, and he was now presenting some preliminary findings in his presidential address to the department of botany and zoology at the meeting of the British Association for the Advancement of Science (J. D. Hooker 1874a). Hooker had been 'driven wild' by the address and had been 'working steadily at Nepenthes every day' and had made a good deal out. He continued, 'its apetite for cartilage is simply prodigious … Nothing can be more lovely than to draw out the cartilage attached to a thread after immersion it looks like a ball of rock crystal refracting the light most beautifully' (letter from J. D. Hooker, 17 August 1874). All summer, Hooker and Darwin traded stories about the relative digestive powers

of their experimental subjects. Darwin wrote that, compared with *Nepenthes*, 'Poor Drosera & Dionaea cut quite an insignificant figure, as a cube of cartilage of $\frac{1}{10}$ inch is almost beyond their digestive power', but he took 'rather a malicious pleasure' in Hooker's failure to get *Cephalotus* (the Albany pitcher-plant) to digest, comparing it with his own *Utricularia* (bladderwort; letter to J. D. Hooker, 20 August 1874).

Although the sundew and the Venus fly trap were the main plant groups in Darwin's study, he also sought out a variety of other insect-eating plants. The surgeon and botanist John Ralfs sent *Utricularia* from Cornwall, but Darwin was unwell when it arrived, so Francis worked on the tiny bladders under the microscope. Darwin looked forward to having his 'brain clear & hand steady' in order to work on its difficult structures (letter to John Ralfs, 13 July [1874]). The research may have been assisted by a new type of high-resolution water-immersion lens that Darwin had purchased from France on the recommendation of Hooker and physiologists at the Brown Institution (see letter to Edmund Hartnack et Cie, 1 March 1874, and *Correspondence* vol. 21, letter from Francis Darwin, [11 October 1873]). Darwin wasted several weeks in fruitless trials and observations on *Utricularia*, concluding: 'The negative work takes five times more time than the positive' (letter to J. D. Hooker, 30 August [1874]), and that, although they caught many small freshwater crustaceans, they could not digest them but fed on the decomposed remains. He wrote to the chemist Edward Frankland to find out whether at the 'close of the putrefaction of flesh, skin &c, any substance is produced before the final resolution of the matter into gasses & salts of ammonia' (letter to Edward Frankland, 31 August 1874). Lady Dorothy Nevill supplied Darwin with a specimen of *Utricularia montana* to work on. At first, Darwin mistook the empty stem tubers for bladders; when he found that the real bladders, which were very small and transparent and on the roots, captured prey, he exclaimed: 'I have hardly ever enjoyed a day more in my life than this day's work' (letter to D. F. Nevill, 18 September [1874]). Francis's new wife, Amy, drew the plant (letter to Francis Darwin, [17 September 1874]), and the German botanist Ferdinand Cohn provided observations on the structure and mechanism that Darwin agreed with (letter to F. J. Cohn, 12 October 1874). Darwin's American correspondent Mary Treat sent observations of the prey caught in the bladders and declared the hidden-fruited bladderwort (*Utricularia clandestina*) to be the most wonderful carnivorous plants that she had seen (letter from Mary Treat, 2 December 1874).

The social breadth of the network that Darwin drew on in his work on insectivorous plants was remarkable. The aristocratic horticulturist Dorothy Nevill hugely admired Darwin and was always eager to help by sending specimens from her well-stocked garden. She sought every opportunity to meet him in person and she valued the photograph he sent highly (letter from D. F. Nevill, [11 September 1874]). At the other end of the spectrum, the Dublin accounts clerk Thomas Cooke Copland sent Darwin details of an Australian variety of sundew (letter from T. C. Copland, 23 June 1874). Asa Gray publicised Darwin's work on insectivorous plants in his articles for *Nation* and *Gardeners' Chronicle* ([Gray] 1874a; [Gray] 1874b) and